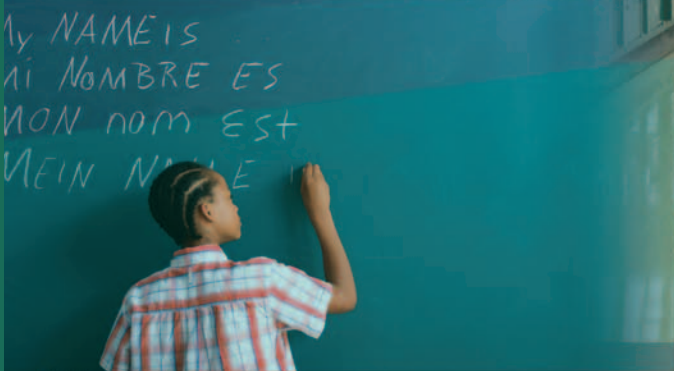


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PSYCHOLOGY *of* CLASSROOM LEARNING

An Encyclopedia



ERIC M. ANDERMAN, Editor in Chief
LYNLEY H. ANDERMAN, Co-editor

Psychology of Classroom Learning
An Encyclopedia

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Eric M. Anderman

EDITOR IN CHIEF

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Preface

NEED FOR *PSYCHOLOGY OF CLASSROOM LEARNING:* *AN ENCYCLOPEDIA (PCL)*

Children and adolescents spend much of their time in school environments. Indeed, the school social context has profound influences on children's and adolescents' psychological, academic, social, and physical development. When one considers that most students attend school for 180 days per year and spend at least six to seven hours per day at school for over a decade, the potential influence of the school environment on educational, developmental and personal outcomes becomes quite profound.

Teachers of course play an extremely important role in children's and adolescents' development. Students spend almost all of their in-school time in the presence of teachers. The daily practices that teachers use in their classrooms have important and enduring effects on students' self-perceptions, their understanding of their world, their identities, and their professional plans for the future.

In many teacher education programs, educators are required to take one course in Educational Psychology. That course typically covers theories of learning, theories of motivation, cognitive and social development, assessment, and behavior management. Consequently, a huge amount of material is covered in a brief period of time. In addition, these courses often are offered and required at the beginning stages of teacher education programs, or even prior to acceptance into a teacher education program. Thus for many teachers in training, the role of psychology in the classroom is taught early in the teacher preparation program, before students have a chance to spend time in classrooms and apply these important principles in actual schools. Oftentimes, students are taught all of the theory, but not the implications of that theory for practice.

The role of psychology in education has a long and important history. The role of psychology in education has been discussed by philosophers such as Aristotle and Plato, as well as by early psychologists such as William James, and later disciples such as B.F. Skinner. Woolfolk Hoy (2000) notes that the role of educational psychology in teacher preparation has changed during the past 100 years: in the early 1900s, the focus was on the application of laboratory-based studies of learning to classroom learning; however, in the later 1900s and more recently, focus shifted to how learning occurs in actual classrooms. In addition, whereas the early focus of educational psychology was on the characteristics of students as learners, the roles of the social context of the classroom (i.e., the teacher,

curriculum, and the setting) have become better integrated into educational psychology in recent years.

In the beginning of the 21st century, it seemed important to us to produce an encyclopedia that summarizes much of the current research on the role of psychology in classroom learning. Both policy-makers and the general public realize that the interactions that students experience in school settings have important effects on many valued outcomes. Recent publicity regarding violence in schools, pregnancies during early adolescence, achievement gaps, and advances in neuroscience has kindled a renewed interest in the role of psychology in education. Our hope is that this encyclopedia will serve as an invaluable resource to practicing teachers, teacher education students, and to parents.

SCOPE AND CONTENTS OF *PSYCHOLOGY OF CLASSROOM LEARNING: AN ENCYCLOPEDIA*

Both psychology and education are extremely broad disciplines. One of the challenges in developing the scope and content for *Psychology of Classroom Learning: An Encyclopedia* involved providing thorough coverage of the content. As we describe below, the study of psychology and classroom learning is not confined to one field. Rather, research on the role of psychology in education emanates from extremely diverse fields within the social sciences.

Psychology and Classroom Learning: Studied by Diverse Scholars from Diverse Fields. The study of psychology is often broken down into sub-domains, such as developmental psychology, counseling psychology, clinical psychology, biological psychology, personality psychology, social psychology, organizational psychology, and of course educational psychology. Although these are considered distinct domains within the field of psychology, there is much overlap among these sub-groupings of psychology. Research related to classroom learning can be found in empirical journals in all of the sub-areas of psychology. In addition to educational psychology, research focused on the role of psychology in education appears quite often in journals in the domains of developmental psychology and social psychology.

In addition, the formal study of education is an extremely broad field. Whereas the study of the role of psychology in classroom learning is most commonly encountered in departments of educational psychology, there are individual scholars who study and publish about the role of psychology across a diverse array of fields within education. Indeed, when one examines the structures of schools and colleges of education, and the journals in the field of education, it is evident that there are extremely diverse divisions within the field. For example, colleges and universities often contain departments with varied names such as Foundations of Education, Urban Education, Higher Education, Teaching and Learning, Curriculum and Instruction, Educational Policy Studies, Educational Studies, Educational Administration, Educational Leadership, Special Education, Educational Research, and Educational Evaluation.

Within each of these organizational divisions there are individuals who conduct important research on the role of psychology in classroom learning. For example, in the field of Higher Education, many individuals study college student learning in the context of universities; in the field of Educational Administration, researchers examine the psychological effects of leadership on both teachers and students; in the field of Curriculum and Instruction, scholars study the roles of psychological variables across an array of subject domains (e.g., reading, mathematics, literacy, science, foreign language education, physical education, etc.).

In addition, when one examines peer-reviewed journals in the field of education, it is apparent that research related to the role of psychology in classroom learning is found in a large variety of journals. Whereas much of the research is published in predictable outlets (e.g., the *Journal of Educational Psychology*, *Contemporary Educational Psychology*, the *British Journal of Educational Psychology*, *Educational Psychologist*, *Learning and Individual Differences*, and *Educational Psychology Review*), much of the relevant research is also found in many other journals that span a variety of disciplines. For example, there are numerous studies about psychological aspects of science education in journals such as the *Journal of*

Research in Science Teaching; there are studies examining the role of psychology in literacy in journals such as *Reading Research Quarterly*; there are numerous studies that examine psychological issues in journals published by the American Educational Research Association (e.g., *American Educational Research Journal* and *Review of Educational Research*).

In addition, the role of psychology in education also is examined by scholars from other disciplines. In order to fully appreciate the many perspectives that are used to study this phenomenon, it also is important to consider research that emanates from other fields. For example, much important research about the interactions that occur in classroom settings is conducted by anthropologists. In addition, given the constantly changing research base on neurobiology, it is important to consider studies that emanate from the field of neurology. Numerous scholars from other academic domains also study the role of psychological variables in classroom learning.

Content Covered in *Psychology of Classroom Learning: An Encyclopedia*. The content that is covered in this encyclopedia is diverse. The editorial team spent much time discussing and examining many potentially relevant topics before we arrived at the specific entries that are included in this work. We wanted to make certain that the topics covered represented both (a) trends in current empirical research, and (b) the needs of practicing educators. We realize and acknowledge that sometimes there is not direct overlap in these areas. We also realize that practicing educators often do not feel that researchers study topics that are truly relevant to the daily lives of students and teachers; therefore, we worked diligently to provide coverage of topics that are both on the cutting-edge in the research world, and practical to the lives and concerns of educators.

Although *PCL* covers a large range of topics, there are some important themes that run through the entire work. First, many entries that examine the topic of learning in school contexts have been included. Obviously the study of learning is central, given that it is part of the title of this book. Nevertheless, we have tried to cover a broad range of perspectives on academic learning. These include entries examining various theories and perspectives on learning (e.g., operant conditioning; sociocultural theory), applications of learning theory (e.g., intelligence testing; concept learning), and learning in various subject areas (e.g., learning in mathematics, science, reading, writing, and foreign languages).

Second, *PCL* includes many entries that focus on academic motivation. Many educators comment that their students are not motivated, and many students who eventually drop out of school note that the material covered in school was “boring” or not relevant to their lives. We have included entries that focus on both the characteristics of motivated (and unmotivated) students, as well as on instructional practices that can be fostered by educators to enhance student motivation. Entries focus on theoretical frameworks for the study of motivation (e.g., goal orientation theory, attribution theory), applications of motivation to aspects of the instructional context (e.g., school transitions, school climate), and instructional practices that enhance or hinder motivation (e.g., rewards, praise).

Third, the user will find entries that examine developmental issues. It is extremely important to acknowledge the roles of psychological and social development in education. In addition, we particularly believe that it is extraordinarily important for educators to understand the role of cognitive development in education. Students may be of the same chronological age, but may be at very different levels of cognitive development. The instructional practices used to address these developmental differences can have profound effects on subsequent learning and motivation. For example, some 6-year-old children may be better able to learn simple mathematical concepts than are others; some educators may start using grouping practices during the first grade to better instruct students who are at different levels of development. However, such grouping practices may yield some beneficial effects (e.g., the teachers may be able to more easily provide appropriate instruction to slower learners), and some negative effects (e.g., the placement of some children into low-ability groups may lead to stigmatization, and such children may never be able to transition into

average or high-ability groups). Thus it is extremely important for educators to have a comprehensive understanding of developmental issues. It also is important to realize that cognitive and social development do not stop at the end of childhood; rather, development continues to play an important role during the adolescent years, and even for adult learners. In *Psychology of Classroom Learning: An Encyclopedia*, we have included a broad range of entries examining developmental issues. Some of the entries examine theoretical frameworks in the study of development (e.g., information processing theories of development, Piaget's and Vygotsky's theories of development); other entries examine applications of developmental theory to instruction (e.g., development of core knowledge domains); and other entries focus on different albeit equally important areas of development (e.g., emotional development, epistemological development).

Fourth, there are many entries that focus on some of the empirical aspects of education. With the establishment of the Institute of Education Sciences in the early 21st century, well-controlled empirical experiments (i.e., clinical trials) in educational research have assumed an important role in the formation of educational policy. Although there is disagreement in the field about the importance of this recent trend, we believe that it is exceedingly important for educators and students of education to be able to critically read and understand current and forthcoming research. Therefore, we have included entries that focus on educational research methods (e.g., longitudinal research, design experiments, action research, experimental research, and quasi-experimental research).

In addition, the testing and assessment are extremely prevalent both in the United States and abroad. Tests are quite often used to determine high-stakes outcomes; indeed, many teachers' and principals' jobs are dependent on the outcomes of such assessments. Thus it is extremely important for educators to understand assessment. Therefore, we have included entries that examine important contemporary issues in the field of educational testing and assessment (e.g., reliability, item analysis, classical test theory, classroom assessment, item response theory, norm- and criterion-referenced testing, etc.).

Fifth are the entries that focus on the role of psychology in the learning of exceptional students. Children and adolescents in schools express diversity in many different ways, and it is extremely important for all educators to realize that some of their students will have unique needs. Therefore, we have included entries that examine some of the needs of exceptional learners. More specifically, we have included entries that examine specific categorizations of exceptionalities (e.g., gifted learners, bilingual learners, learning disabilities, orthopedic impairments, deafness/hard of hearing, mental retardation, autism spectrum disorders, and attention deficit hyperactivity disorder [ADHD]), as well as instructional practices that can be particularly useful with exceptional populations (e.g., goal-setting, behavioral objectives, token economies).

Sixth, *PCL* includes entries that describe instructional practices that are rooted in psychology. These various practices cut across issues of learning, motivation, development, assessment, and exceptionality. It is vital for educators to understand the theoretical rationale and development of various practices, so that they can apply and use these practices appropriately and effectively. Thus we have included entries that examine practices that focus on learning in groups (e.g., cooperative learning, reciprocal teaching), practices that involve parents (e.g., home schooling, homework, parent involvement), classroom instructional practices (e.g., gender bias in teaching, multicultural educational), and practices that involve entire schools (e.g., creation of positive school climates, promotion of feelings of school belonging, school size, etc).

Users of *PCL* will also find brief biographies of particularly noteworthy researchers. These individuals have spent their careers studying various aspects of the role of psychology in classroom learning and instruction. Many of these biographies have been written by researchers who have been acquainted with these eminent scholars either as their former students or colleagues. Biographies are included of scholars who contributed to the early development of important

theories (e.g., Lev Vygotsky, Jean Piaget, William James), scholars who have contributed to better understanding the role of psychology in effective instruction (e.g., Wilbert McKeachie, Ann Brown, Jere Brophy), and individuals who have affected research and policy at a broad level (e.g., Albert Bandura, Urie Bronfenbrenner, David Berliner, Jerome Bruner).

Finally, we also have included some of the “classics.” As in any field of study, there are certain theories and topics that have served as important bases for current research. Consequently, we have included entries that review some extremely important background topics that remain relevant in the 21st century. These include entries on topics such as behaviorism, classical conditioning, direct instruction, and parenting styles.

WHY NOW?

The timing of the release of the *Psychology of Classroom Learning* is important for several reasons. One of the main reasons that we developed this product was to provide a timely resource for teacher education students and practicing educators. The theories, research, and instructional practices that are reviewed in *PCL* provide a solid research base for examining contemporary educational problems, and potential solutions to those problems.

In the United States, we remain in the era of the *No Child Left Behind* legislation. The introduction of this legislation in the early 21st century led to many changes in educational policies and these changes, in turn, have had many implications for the relation between psychology and education. For example, the use of high-stakes assessments to determine whether or not schools are performing effectively has significant implications and ramifications. Many teachers and school administrators feel pressured to obtain high scores on these summative assessments; this has important implications for how teachers interact with students on a daily basis. If a school does not perform well on these assessments, the pressure to perform better in subsequent years may affect the types of instructional practices that teachers use in classrooms. This may impact student motivation and achievement in important ways.

Perhaps one of the most pervasive problems in education is the proliferation of the use of instructional practices that are not based in solid empirical research. As a parallel example, in the field of medicine, few patients would want their doctors to suggest the use of medical techniques that were not proven to be effective through extensive empirical research. Indeed, if you were told that you had high blood pressure, and your doctor informed you that she read an article on the internet suggesting that eating brown rice lowered blood pressure, you might be doubtful; you probably would feel more secure if the doctor learned of this new treatment via articles that were published in peer-reviewed medical journals. However, can we say that this same type of logic applies in education? Probably not; many educators try and use instructional techniques that are learned “on the fly” and which are not necessarily proven techniques. Of course we may not always want to apply the same standards that we use in the field of medicine to the field of education, but, as editors of this encyclopedia, we do strongly believe that practices should be based on empirical research.

There is evidence that educators do often adapt instructional practices that are not based on solid research. For example, many practicing educators base their instructional practices on Gardner’s theory of multiple intelligences; however, as noted by Waterhouse (2006), there is little empirical support from either educational research or from research in cognitive neuroscience to support the direct application of this theory to educational practices.

In a recent chapter, Berliner (in press) describes several examples of the mismatch between contemporary educational practices and solid research evidence. First, he notes that although there is a 25 year history of the effectiveness of a reading comprehension technique known as *reciprocal teaching* (Palincsar & Brown, 1984), the technique is still seldom used in classrooms today. Second, Berliner notes that research clearly indicates that retaining students in their current grade for an extra year does not positively affect achievement, and often is predictive of subsequent educational problems, such as eventually dropping out of school. Nevertheless, Berliner describes recent national legislation that

advocates against promotion of students who are failing into the next grade level; this legislation runs counter to research indicating that promoting students to the next grade, and providing them with appropriate educational support, would lead to better outcomes. Finally, Berliner reviews the extensive body of research on homework. Much of this research indicates that having students complete nightly homework has little positive effect on academic achievement for elementary school aged children; when homework is given, only small amounts are recommended for elementary school youth (e.g., Cooper, 2003). Nevertheless, the assignment of homework to young children remains prevalent.

Another currently relevant example involves the promotion of students' self-esteem. The self-esteem movement is very popular in American schools. Many schools offer self-esteem classes, and many teachers spend time on self-esteem programs. In addition, expensive curricula often are sold with the implicit guarantee that these curricula will raise children's and adolescents' self-esteem. Indeed, there is a pervasive belief among educators that self-esteem is related to positive social and educational outcomes, and that by increasing students' self-esteem, we may be able to both improve academic achievement and foster the avoidance of engagement in risky behaviors. Nevertheless, empirical research on self-esteem for the most part completely fails to support these contentions (e.g., Baumeister, Campbell, Krueger, & Vohs, 2003; Coley & Chase-Landsdale, 1998; Wylie, 1979). In fact, some research indicates that many criminals (e.g., murderers, rapists, etc.) have quite high self-esteem (Baumeister, Smart, & Bodeon, 1996). However, despite the compelling research, self-esteem continues to be an important entity in American education.

If These Practices are Not Based in Research, Why do They Remain So Popular in the Field of Education? One of the main reasons for the publication of *PCL* is to help both teacher educators and practicing teachers to be able to identify effective educational practices that are based on solid empirical research. All of the entries in this encyclopedia are written by scholars with expertise in each area and extensive lists of additional references are provided for further reading on each topic. We truly hope that some of the misconceptions about educational practices and some of the misuse of instructional practices that are currently prevalent will be altered with the publication of this encyclopedia.

Why do so many instructional practices that are not rooted in research remain popular in classrooms? There are several explanations for this. First, education is a field filled with traditions. Most practicing teachers remember how they were taught, and it is often difficult to break with well-learned habits. Thus, a teacher who was taught multiplication during his or her own childhood via rote memorization techniques may use the same practices 20 years later, simply out of force of habit. In addition, although a teacher who is new to the profession may have learned new research-based techniques in college or graduate school, it often is difficult for new teachers to introduce novel practices into a school environment that has operated in a particular way for many years (i.e., "we don't do it that way at this school").

Second, as noted by Berliner (in press), teaching is a highly private endeavor; what goes on in classrooms is seldom observed by outsiders. Therefore, it often may be difficult to communicate new, research-based instructional techniques to practicing educators. In addition, there often is little accountability for the use of new research-based techniques in education. Whereas a teacher may learn a new technique such as reciprocal teaching during a professional development seminar or in a graduate education course, there are few systems in place to verify that the teacher is using the technique during instruction. In addition, if the teacher is using the technique at all, consultations with experts to provide ongoing support in the use of the new technique are seldom provided.

Waterhouse (2006) uses the theory of multiple intelligences, the "Mozart" effect, and the theory of emotional intelligence as three examples of recent educational theories that have had strong effects on educational policy and practice, despite the fact that little sound empirical research supports these theories. Waterhouse suggests that these and other ideas

remain popular and continue to influence policy and practice because they are appealing to teachers (i.e., they provide teachers with a sense of control over student learning), they provide quick fixes for enduring problems (i.e., they can help all students become better learners), and they provide simplified explanations for complex cognitive processes. In addition, the publication of materials and curricula on these topics is prevalent, and educational marketplaces are filled with materials that make extraordinary promises with little basis in well-conducted research. An examination of the reference list in many of these materials clearly proves this point—seldom are such materials referenced with extensive lists of peer-reviewed empirical studies that support the suggested practices.

PARAMETERS OF *PSYCHOLOGY OF CLASSROOM LEARNING: AN ENCYCLOPEDIA*

The relation of psychology to education is highly complex. Thus we acknowledged from the outset that we would be unable to include an exhaustive review of all of the relevant topics. As indicated above, we have tried to provide coverage of the important themes that are relevant in the field, and we also have tried to include entries that are related to current practical issues. Nevertheless, there are certainly limitations regarding coverage in the book.

First, the entries are focused on fairly recent research. Whereas there is a long history of the role of psychology in classroom learning, for the most part, we have included entries that examine research that has been conducted during the past 20 years. As mentioned earlier, there are some exceptions, including biographies of notable scholars and reviews of some of the classic theories and programs of research in the field. However, the majority of the entries focus on current research, as opposed to earlier research that was more focused on laboratory studies and decontextualized views of learning (see Woolfolk Hoy, 2000, for a review).

Second, the entries in *PCL* for the most part emanate from a western perspective on the role of psychology in education. We acknowledge that learning is deeply rooted in cultural beliefs and practices, and that many of the theoretical perspectives that are described in this encyclopedia may not seem directly relevant to educators in other parts of the world. Nevertheless, we truly hope that the vast array of entries in this encyclopedia can serve as important resources to teachers across a variety of cultures.

AUDIENCE AND ORGANIZATION

Psychology of Classroom Learning: An Encyclopedia is intended to serve a diverse audience. First and foremost, we have developed *PCL* to serve as a resource for teacher education students and for practicing teachers. There are over 300 topics covered in this encyclopedia, and we believe that there are entries that can be beneficial to educators at all grade levels, from preschool through postsecondary education. Issues of learning, motivation, development, and assessment are not unique to any one particular setting or age group; therefore, we believe that these entries will provide useful information for educators at all levels.

Second, we believe that *PCL* can serve as an excellent resource for graduate students in the fields of education and psychology. The research base for each entry is quite current and the bibliographies are extensive. This encyclopedia will be an excellent resource for graduate students who are preparing masters theses and doctoral dissertations in education.

Third, we also believe that *PCL* will be useful for parents. Parents need to be advocates for their children in schools. If a parent feels that a child or adolescent is not being served well by a particular school or teacher, then the parent who comes into the school with a reliable source of knowledge can more effectively argue for changes in policies and practices that will positively affect his or her children's learning. The entries in this encyclopedia have been written so that individuals without a strong background in psychology or education can understand the main points discussed in each entry.

The encyclopedia is organized alphabetically. As noted earlier, major themes such as learning, motivation, and assessment are evident in the book. Nevertheless, we organized the entire volume alphabetically so that both general readers and experts can easily locate

information on topics using commonly used names for each entry. Each entry has been peer-reviewed for accuracy of content and contains an extensive bibliography of both print and electronic sources for further research.

PCL includes convenient cross-referencing of two types: “See” and “See Also” references. “See” references fall within the body of the work and refer the reader to articles discussing that topic. For example, if one wanted to find information about childhood and looked under “Childhood,” there would not be an article, but rather the instruction to “SEE *Early Childhood Development*.” “See Also” cross-references fall at the end of articles and direct the reader to one or more other articles that may shed more light on the topic. At the conclusion of the article on Aptitude Testing, for example, you will find “SEE ALSO *Accountability; High Stakes Testing; Intelligence: An Overview*.” At the end of Volume 2, there is an extensive Index to terms and concept in the articles.

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Psychology of Classroom Learning: An Encyclopedia would not have been possible without the contributions of many important individuals. First, we would like to acknowledge Miranda Ferrara at Macmillan Reference USA, our extraordinary product manager and task-master. Miranda managed the flow of manuscripts, invited all of the authors to contribute, and sent out those friendly “reminders” for late manuscripts. She monitored the review and revision process for over a year. Above all, she kept us organized, on task, and happy throughout this process.

We also want to acknowledge our extraordinary team of Associate Editors. We came up with three first-choices and we were delighted when all three said yes. Tamera Murdock of the University of Missouri Kansas City handled many of the entries dealing with motivation and development; Lee Swanson, of the University of California Riverside, reviewed the entries examining exceptional learners and cognition; and Clark Chinn worked with authors who wrote about issues related to learning and instructional practices. Given that there are over 300 entries in the encyclopedia, there was inevitably much overlap in the entries handled by each associate editor. All three were models of professionalism, and each brought his or her extraordinary expertise to the project. The comments that the associate editors provided to the contributors was always relevant, effective, and concise. In addition, the patience of each of the associate editors with the editors and the contributors was always and continues to be appreciated.

In addition, we are extremely grateful to the many scholars who contributed to this encyclopedia. When we look at the list of contributors, we are truly amazed at the extraordinary caliber of the contributors. We can truly state that the contributors to *PCL* represent a list of the most eminent scholars in the world on these topics. We are truly indebted to each author for contributing his or her knowledge, wisdom, and expertise to this volume.

Finally, we also must acknowledge our two children, Jacob and Sarah. They continue to remind us daily why we do the work that we do. The research that is presented in this encyclopedia can improve education for the next generation of learners. If the information contained in these entries helps even one teacher to improve the learning of one student, then the time will have been more than well spent.

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List of Articles

Authors are listed alphabetically under article title, not necessarily by lead author.

A

ABILITY GROUPING
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The following classification of articles arranged thematically gives an overview of the variety of articles and the breadth of subjects treated in Psychology of Classroom Learning: An Encyclopedia. Along with the index and the alphabetical arrangement of PCL, this thematic outline should aid in the location of topics. It is our hope that it will do more, that it will direct the user to articles that may not have been the object of a search, and that it will facilitate the kind of browsing that invites the reader to discover new articles and new topics, related, perhaps tangentially, to those originally sought.

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2. BIOGRAPHY

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6. GROUPING

Ability Grouping
 Class Size
 Collaborative Learning
 Communities of Learners
 Discussion Methods
 Gifted Education
 Individualized Education Program (IEP)
 Learning Disabilities
 Learning in Informal Settings
 Mental Retardation

Reciprocal Teaching
 Social Comparisons
 Social Skills
 Special Education
 Speech and Language Impairments
 Tutoring

7. INSTRUCTION

Ability Grouping
 Academic Press
 Anchored Instruction
 Applied Behavior Analysis
 Authentic Tasks
 Behavioral Objectives
 Berliner, David Charles
 Bilingual Education
 Bloom's Taxonomy
 Bransford, John D.
 Cheating
 Classroom Assessment
 Classroom Environment
 Cognitive Apprenticeship
 Cognitive Load Theory
 Cognitive Strategies
 Collaborative Learning
 Communication with Parents to Enhance Learning
 Communication with Students to Enhance Learning
 Competition
 Concept Maps
 Constructivism: Case Based Learning
 Constructivism: Discovery Learning
 Constructivism: Inquiry Based Learning
 Constructivism: Overview
 Constructivism: Problem Based Learning
 Constructivism: Project Based Learning
 Criterion Referenced Tests
 Cultural Bias in Teaching
 Culturally Relevant Pedagogy
 Direct Instruction
 Discussion Methods
 Feedback in Learning
 Gage, Nathaniel Lees
 Gagné, Robert Mills
 Gender Bias in Teaching
 Gifted Education
 Goal Setting
 Guided Participation
 Home Schooling
 Homework
 Individualized Education Program (IEP)
 Intelligence: An Overview
 Learning and Teaching Foreign Languages
 Learning and Teaching Mathematics
 Learning and Teaching Reading

- Learning and Teaching Science
 Learning and Teaching Writing
 Learning in Informal Settings
 Learning Styles
 Mastery Learning
 McKeachie, Wilbert J(ames)
 Moral Education
 Multicultural Education
 Multiple Intelligences
 Peer Tutoring
 Praise
 Problem Solving
 Providing Explanations
 Questioning
 Reciprocal Teaching
 Rewards
 Scaffolding
 Service Learning
 Situated Cognition
 Sternberg, Robert J(effrey)
 Strategies Instruction
 Teacher Beliefs
 Teacher Efficacy
 Teacher Expectations
 Test Taking Skills
 Time On Task
 Transfer
 Tutoring
- 8. INTELLIGENCE**
- Emotional Intelligence
 Gardner, Howard
 Intelligence Testing
 Intelligence: An Overview
 Multiple Intelligences
 Spearman, Charles Edward
 Stanford Binet Intelligence Scales
 Sternberg, Robert J(effrey)
 Theories of Intelligence
 Thorndike, E(dward) L(ee)
 Triarchic Theory of Intelligence
 Weschler Intelligence Test
- 9. LEARNING**
- Achievement Motivation
 Alexander, Patricia A.
 Analogy
 Anchored Instruction
 Anderson, John Robert
 Applied Behavior Analysis
 Attention Deficit Hyperactivity Disorder (ADHD)
 Authentic Tasks
 Bandura, Albert
 Behaviorism
 Berliner, David Charles
 Bloom's Taxonomy
 Brain and Learning
 Bransford, John D.
 Brown, Ann Leslie
 Bruner, Jerome S(eymour)
- Calfee, Robert C.
 Class Size
 Classical Conditioning
 Cognitive Apprenticeship
 Cognitive Load Theory
 Cognitive Strategies
 Communities of Learners
 Concept Development
 Concept Learning
 Concept Maps
 Conceptual Change
 Connectionism
 Constructivism: Case Based Learning
 Constructivism: Discovery Learning
 Constructivism: Inquiry Based Learning
 Constructivism: Overview
 Constructivism: Problem Based Learning
 Constructivism: Project Based Learning
 Creativity
 Critical Thinking
 Cultural Deficit Model
 Culturally Relevant Pedagogy
 Decision Making
 Development of Core Knowledge Domains
 Direct Instruction
 Distributed Cognition
 Dual Coding Theory
 Emotional Intelligence
 Epistemological Beliefs
 Ethnic Identity and Academic Achievement
 Expertise
 Feedback in Learning
 Gagné, Robert Mills
 Goal Setting
 Individualized Education Program (IEP)
 Information Processing Theory
 Intelligence: An Overview
 Knowledge
 Knowledge Representation
 Lave, Jean
 Learned Helplessness
 Learning and Teaching Foreign Languages
 Learning and Teaching Mathematics
 Learning and Teaching Reading
 Learning and Teaching Science
 Learning and Teaching Writing
 Learning Disabilities
 Learning in Informal Settings
 Learning Styles
 Mastery Learning
 Memory
 Metacognition
 Modeling
 Multicultural Education
 Multiple Intelligences
- Operant Conditioning
 Opportunity/Achievement Gap
 Parent Involvement
 Parenting Styles
 Peer Tutoring
 Pintrich, Paul Robert
 Possible Selves Theory
 Problem Solving
 Reasoning
 Reinforcement
 Relevance of Self Evaluations to Classroom Learning
 Rewards
 Rogoff, Barbara
 Scaffolding
 School Transitions: Elementary School
 School Transitions: High School
 School Transitions: Middle School
 School Transitions: Overview
 Self Efficacy Theory
 Self Esteem
 Self Explanation
 Self Handicapping
 Self Regulated Learning
 Sensation Seeking
 Shared Cognition
 Simon, Herbert (Alexander)
 Situated Cognition
 Skinner, B(urrhus) F(rederic)
 Social Cognitive Theory
 Social Comparisons
 Sociocultural Theories of Motivation
 Sociocultural Theory
 Strategies Instruction
 Theories of Intelligence
 Theories of Learning
 Theory of Mind
 Thorndike, E(dward) L(ee)
 Transfer
 Volition
 Vygotsky, Lev Semenovich
- 10. LITERACY**
- Anderson, Richard C(hase)
 Argumentation
 Calfee, Robert C.
 Learning and Teaching Foreign Languages
 Learning and Teaching Reading
 Learning and Teaching Writing
 Pressley, G. Michael
 Reciprocal Teaching
 Second Language Acquisition
- 11. MANAGEMENT**
- Aggression
 Attention Deficit Hyperactivity Disorder (ADHD)
 Bullies and Victims

Classroom Management: Assertive Discipline
 Classroom Management: Overview
 Classroom Management: Punishment
 Classroom Management: Rules and Procedures
 Classroom Management: Token Economies
 Classroom Management: Withitness
 Communication with Parents to Enhance Learning
 Communication with Students to Enhance Learning
 Conflict Resolution
 Dropping Out of School
 Emotional/Behavioral Disorders
 Peer Relationships: Peer Pressure
 Prosocial Behavior
 Social Skills
 Time On Task

12. METHODOLOGY

Action Research
 Correlational Research
 Cross Sectional Research Designs
 Design Experiment
 Experimental Research
 Expert Novice Studies
 Item Analysis
 Item Response Theory
 Longitudinal Research
 Meta Analysis
 Microgenetic Research
 Normal Distribution
 Qualitative Research
 Quasiexperimental Research
 Reliability
 Research Methods: An Overview
 Single Case Designs
 Sociometric Assessment

13. MOTIVATION

Academic Press
 Achievement Motivation
 Anxiety
 Attribution Theory
 Attributional Retraining
 Authentic Tasks
 Autonomy Support
 Bandura, Albert
 Beliefs about Learning
 Brophy, Jere E(dward)
 Caring Teachers
 Cheating
 Classroom Environment
 Communication with Students to Enhance Learning
 Competition
 Dweck, Carol S(usana)
 Eccles, Jacquelynne S.
 Evaluation (Test) Anxiety

Expectancy Value Motivational Theory
 Flow Theory
 Goal Orientation Theory
 Goal Setting
 Graham, Sandra (Haley)
 Help Seeking
 Home School Dissonance
 Identification with Academics
 Interest
 Intrinsic and Extrinsic Motivation
 Learned Helplessness
 Maehr, Martin L.
 Mastery Learning
 Midgley, Carol
 Peer Relationships: Peer Pressure
 Pintrich, Paul Robert
 Possible Selves Theory
 Praise
 Reinforcement
 Relevance of Self Evaluations to Classroom Learning
 Rewards
 School Belonging
 Self Determination Theory of Motivation
 Self Efficacy Theory
 Self Esteem
 Self Handicapping
 Self Regulated Learning
 Social Cognitive Theory
 Social Comparisons
 Social Goals
 Sociocultural Theories of Motivation
 Sociocultural Theory
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 Teacher Expectations
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 Vygotsky, Lev Semenovich
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14. PHILOSOPHY

Dewey, John
 Epistemological Beliefs
 Epistemological Development
 James, William
 Moral Education
 Simon, Herbert (Alexander)
 Theories (as a form of knowledge)

15. POLICY

Accountability
 Berliner, David Charles
 Class Size
 Comprehensive School Reform for High Poverty Schools
 High Stakes Testing
 Home Schooling
 Homework
 School Transitions: Elementary School

School Transitions: High School
 School Transitions: Middle School
 School Transitions: Overview
 Service Learning
 Special Education
 Standards for Educational and Psychological Testing

16. PSYCHOLOGICAL CHARACTERISTICS

Anxiety
 Beliefs about Learning
 Expertise
 Gender Identity
 Identification with Academics
 Impression Management
 Impulsive Decision Making
 Interest
 Possible Selves Theory
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 Stereotype Threat
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17. SOCIAL CONTEXT

Bronfenbrenner, Urie
 Caring Teachers
 Classroom Environment
 Communication with Parents to Enhance Learning
 Communication with Students to Enhance Learning
 Communities of Learners
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 Conflict Resolution
 Dropping Out of School
 Ethnic Identity and Academic Achievement
 Home Schooling
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 School Climate
 School Transitions: Elementary School
 School Transitions: High School
 School Transitions: Middle School
 School Transitions: Overview
 Socioeconomic Status
 Vygotsky, Lev Semenovich

18. STRATEGIES

Analogy
 Argumentation

Attributional Retraining
Autonomy Support
Brown, Ann Leslie
Cognitive Strategies
Critical Thinking
Decision Making

Help Seeking
Impression Management
Memory
Problem Solving
Reasoning
Reciprocal Teaching

Scaffolding
Self Explanation
Self Handicapping
Self Regulated Learning
Strategies Instruction
Strategy Development

A

ABILITY GROUPING

Ability grouping is the practice of making student groupings based on ability and achievement in an attempt to provide instruction specifically relevant to each group's needs. Ability groups can differ in size and duration depending on the educational goals the groups are intended to meet. Groups can range from the small groups created for reading instruction in diverse elementary school classrooms to high school tracking methods that create just three broad ability groups within an entire high school population. Although ability grouping has become a standard educational practice in many schools, it continues to inspire heated debate and extensive research.

WITHIN CLASS GROUPING

Within-class grouping is the practice of dividing a class of students with diverse abilities into groups based on ability and achievement level. This is commonly accomplished by assigning every member of the class to a particular group that they will be taught with during instruction in a particular subject. In some cases ability grouping is also accomplished by removing a few students from the class for the purpose of specialized instruction and allowing the rest of the class to be instructed together. This is sometimes done to provide specific instruction to a few students who are seen as very high achieving, and sometimes to provide more individualized assistance to students who are seen to be achieving significantly below their peers.

At the elementary school level, within-class grouping is a fairly established practice. A 2006 study by Chor-

zempa and Graham found that 63% of primary grade teachers surveyed reported using ability groupings in reading instruction. In addition to reading instruction, mathematics instruction is also commonly taught in ability groups at the elementary school level. Ability grouping is less commonly used for other subjects such as science, social studies, and art.

Classrooms that practice within-class ability grouping for reading typically divide the children in the class into two or three reading groups. These groups are often assigned names, colors, or animals to differentiate them and to provide each group with a group identity. The way in which children are assigned to groups varies depending on the teacher making the assignments and any school or district-wide policies that provide grouping guidance. In many cases a variety of guidelines are in place with the classroom teachers having final authority for grouping decisions. Teachers may use testing, past performance, individualized evaluation of skills, or other factors to determine which reading group a child should be placed in. In most cases a combination of testing and observational methods may be used.

Ability-grouped reading instruction allows teachers to provide instruction that is attuned to the level of competency of the children in the group. For example, the lowest level reading group may benefit from extra work on sounding out words and using context clues to decipher meanings, whereas the most advanced group may be ready to tackle more complex sentences and concepts. Ability grouping also allows the teacher to focus on using instructional methods that are successful with different levels of learners. A lower-achieving reading group may benefit significantly from repetition, flash

Ability Grouping

cards, and drills to help the students achieve basic mastery of recognizing phonemes. Repetition and drills may, however, frustrate a higher-achieving group of learners who are already able to read short sentences. Discussions of plot and character may motivate and engage the higher-level group, while it may frustrate another group of learners.

Ability groupings in math follow generally the same structure and purpose as ability groupings in reading. Because so many mathematical concepts build directly on previously learned material, it can be a frustrating and nonproductive experience for children who have not yet mastered one area to be rushed on to the next concept. Ability grouping in math allows children who have demonstrated mastery of a subject to move on, while allowing those who need more help or repetition the opportunity to achieve an understanding of the subject at their own pace.

Ability grouping in elementary education has many proponents who point to its success in providing more student-specific instruction in areas in which many students struggle. Opponents of ability grouping, while acknowledging that it does provide some small advantages over traditional whole-classroom education, argue that its potentially negative effects on students far outweigh any benefits derived from the student-specific curriculum.

Many of the arguments against ability grouping cite concern for the psychological and social well being of the children involved, especially children placed in the lower-achieving ability groups. Children become aware of differentiating characteristics very early on, and the emphasis placed on reading and math achievement by having some reading and math groups clearly labeled as the “slower” groups, while others are labeled as the “gifted” or “accelerated” groups, is not lost on children. This can lead to children being more aware of how other students perceive their achievement. One study found that students who were tracked in math had increased ego orientation, which led to students labeled high achieving being less willing to seek help, while not increasing the willingness of low achievers to seek help (Butler, 2008). Although teachers and other adults may try to treat all of the ability groups with equal respect, children show a very keen knowledge of their placement and the placement of others. This can lead to children placed in lower-ability groups to feel unsure of their educational potential, losing self-esteem, and developing low self-expectation.

It is not only the learners themselves that are affected by the assignment of children to ability-specific groups. Parents, and even teachers, have often demonstrated expectations of students that are ability-group specific. There is significant concern that low expectations can have negative results on academic achievement. Many educators and parents have also expressed concern about

designating children as remedial or advanced students at such an early age, fearing that such designations may continue with the children throughout their educational experience. Although many teachers and schools attempt to allow students to switch easily between ability groups if their achievement warrants it, such easy switching can be very difficult to implement. Additionally, if the lower-reading group spends a significant amount of time working on concepts the other groups have already mastered, it may be prohibitively difficult for a child to catch up without additional intervention.

Teaching time may also be negatively impacted by ability grouping. If teachers are focusing all their attention on the specific needs of one group of learners, the other learners will not be benefiting from the guided instruction of the teacher. This can often result in students participating in a large number of desk activities. Many classrooms utilize teacher aides, computer activities, learning groups, or even adult volunteers to help provide structured learning for students not currently engaged with the teacher. This however, may lead to a decreased quality of instruction during this time, and a loss of instruction time overall.

Although within-class grouping is an accepted practice in many elementary schools, it is not very common at the high school level. High schools rarely rely on students remaining in a single class throughout the day, with ability groups being formed for a few specific subjects. Instead, high schools are much more likely to rely on between-class grouping to provide ability-specific instruction.

BETWEEN CLASS GROUPING

Between-class grouping is the system in which students are separated into different classes based on ability levels. It can also refer to the system in which students are placed into broad groups that all have the same classes, although not necessarily in a single classroom. This is often referred to as *tracking*. Tracking was once primarily used to refer to systems in which students destined for a specific educational outcome were grouped together and given classes specific to the perceived abilities of that group. In this way, many schools came to have a vocational track, a college prep track, and many other tracks. Over time the term *tracked* has come to refer generally to any system in which students are placed into groupings based on ability.

Forming whole classes of students based on ability is much more common in high school and junior high school than in elementary school. It has become the standard for many high schools, which often have Advanced Placement classes, college prep classes, remedial classes, and others designed to provide groups of students with instruction specific to their needs.

Between-class ability grouping was once more common, and more rigid, than it generally is in high schools in the early 21st century. In American high schools before the 1850s students were generally promoted each year based on ability and comprehension of the relevant material rather than age. In this way each grade of students was more a collection of individuals who had achieved a mastery of common material than it was a group of same-aged individuals. Although, strictly speaking, this was not between-class grouping it paved the way for between-class grouping. After the 1850s, age became a more relevant factor in promotion and determination of which grade a student was placed in. In the early 1900s, when more and more students stayed in school through high school, various educational tracks with specific emphases were proposed and adopted. Although many supporters of tracked education in its early days had noble ideals, tracking often served as a tool of discrimination against children who were economically disadvantaged or members of minority groups. Such children were often put into tracks in which vocational training was the main purpose, shutting them off from the opportunity for a more academically based education.

Although the specific emphasis of education changed over the years, many high schools still practiced a variety of tracking programs into the 1960s. Although many of these later programs were theoretically aimed at helping certain groups of students make progress by teaching to their specific needs, such as gifted students, remedial students, or students who needed English as a second language instruction, they still served to funnel students onto paths from which it was frequently very hard to deviate.

In the 1970s and 1980s a broad movement began against the use of tracking as a method for helping students achieve their educational goals. A number of studies and reports came out showing some of the dangers of rigid tracking systems and highlighting the children who were ill served by such systems. Many schools moved away from specifically tracked systems, eliminating the idea of labeling children as they entered the school.

Most high schools in the United States retain at least some form of between-class grouping for some or all classes. Schools with low levels of poverty, high numbers of students, racial diversity, and diverse student achievement levels are more likely to practice ability grouping (VanderHart, 2006). Math classes are especially likely to be grouped by ability. Classes are often designated as honors classes, and students of high achievement are grouped together to receive instruction that takes advantage of their strengths. These classes therefore cover more complex topics and include more in-depth discussions. Although some or all classes in a high school may be grouped, students themselves often do not receive special

designations. In this way students who excel at English may be in the honors English class, while also being in a remedial math class because that is a subject in which they experience difficulties. In this way students can receive instruction tailored to their ability in each subject and avoid many of the pitfalls of a whole-child designation.

Proponents of the between-classes grouping system cite its ability to provide targeted instruction. They also frequently suggest that lower-achieving students can ask questions in class without the risk of embarrassment in front of their higher-achieving peers. Higher achievers can benefit from more in-depth instruction that can focus on larger concepts and broader issues, whereas lower achievers can benefit from more extensive coverage of the core topics.

Although many people, especially parents, tend to be in favor of high schools structured along between-class grouping lines, many individuals believe that it can do significant harm, especially to the students placed into the lower-achieving classes. Several prominent groups, including the American Civil Liberties Union, the National Governors Association, the National Education Association, and the College Board, have all voiced their opposition to ability grouping. Many of the arguments against between-class ability grouping are similar to those against within-class ability grouping. Students who are grouped into one of the lower-achieving groups are at risk for lowered self-esteem and lowered self-expectations. They are also at risk for parents and teachers having low expectations of them, a circumstance which studies have shown can often be a self-fulfilling prophecy (Benner, 2007).

Another common concern with between-class ability grouping is that the lower-achieving groups may receive a lower quality of education overall than their higher-achieving peers. Lower-achieving classes tend to spend more classroom time on discipline than higher-achieving classes, with proportionately less time spent on subject matter instruction. Teachers of lower ability group classes are frequently found to be less qualified and less experienced than their peers who provide instruction to the highest achieving groups. This may be for a number of reasons, including the fact that teaching lower-achieving groups may be seen as less desirable, so such positions are assigned to less experienced educators. Additionally, teaching higher-level classes such as Calculus or Advanced Placement English often requires additional training or certification, resulting in teachers who have been more extensively trained.

Although thousands of studies have been conducted on ability grouping since the 1950s, the results are far from clear. Studies are often contradictory, and although one benefit may be shown repeatedly it still leaves room for spirited debate about whether the benefits are outweighed

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by possible side effects, and whose interests should take precedence in an educational setting that needs to serve everyone.

SEE ALSO *Bilingual Education; Gender Bias in Teaching; Special Education.*

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Helen Davidson

ABUSE AND NEGLECT

Although teachers' essential concern is with children's success in the school environment, it is clear that individual performance levels are affected by a host of factors outside of the classroom. Just as the home and neighborhood environments of children can enrich their school experiences, negative environments can have a detrimental impact on both students' academic performance and their classroom behavior. One of the most potentially damaging of these environmental factors is child maltreatment.

THE SCOPE OF CHILD ABUSE AND NEGLECT

Definitions of child maltreatment vary across states and jurisdictions, as well as across research studies. However, according to the 2003 Keeping Children and Families Safe Act, federal law defines child abuse and neglect as follows:

Any recent act or failure to act on the part of a parent or caretaker which results in death, serious physical or emotional harm, sexual abuse, or exploitation; or

An act or failure to act which presents an imminent risk of serious harm.

While child maltreatment may take many forms (e.g., sibling abuse, medical neglect, educational neglect), it is typically categorized into four domains: physical abuse, sexual abuse, psychological or emotional abuse, and neglect.

According to a compilation of reports from child protective services agencies across the United States, during the federal fiscal year 2005, approximately 3.3 million reports of suspected maltreatment, involving 6 million children, were received (U.S. Department of Health & Human Services, 2007). Of the 62.1% of reported cases screened for investigation, 28.5% included at least one child who was determined to be a victim of maltreatment. Overall, an estimated 899,000 children were substantiated as victims of abuse and/or neglect. In comparison, a 2005 national survey of children and caregivers reported that 14% of children were victims of child maltreatment (Finkelhor, Ormrod, Turner, & Hamby, 2005). Consistent with federal reports, the vast majority of children were identified as victims of neglect (60%), followed by physical abuse (18%), sexual abuse (10%), and emotional abuse (10%); although not reflected in this classification system, many children are victims of multiple forms of maltreatment (e.g., Sedlack & Broadhurst, 1996). Notably, more than half of children substantiated as victims of maltreatment by child protective service agencies were over the age of 7, that is, school-aged.

THE EFFECTS OF CHILD MALTREATMENT ON SCHOOL PERFORMANCE

Experiencing abuse and/or neglect may impact children's school performance in multiple ways, including lower grades, increased absences, increased disciplinary problems, and higher rates of school dropout (Putnam, 2006; Hurt, Malmud, Brodsky, & Giannetta, 2001). According to the National Clinical Evaluation Study, over 50% of abused children experienced some type of difficulty in school, including poor attendance and disciplinary problems; approximately 30% had some type of cognitive or language impairment; more than 22% showed evidence of a learning disorder; and approximately 25% required some type of special education services (Caldwell, 1992). At the extreme end of the continuum, severe physical injury and head trauma in particular may produce organic conditions that negatively impact learning,

Signs of child maltreatment for educators**Physical abuse:**

Unexplained bruises, cuts, welts, bite marks, burns, or fractures
 An explanation from the child that is inconsistent with the nature of the injury
 A child's reporting an injury inflicted by his or her caretaker
 A child's appearing extremely fearful or startling easily

Sexual abuse:

An abrupt change in behavior
 Seductive behavior with other children and/or adults
 Extreme behavior in regard to touching (e.g., inappropriate sexual touching, reluctance to be touched by an adult)
 Age-inappropriate knowledge of sex
 Consistent appearance of isolation, depression, or anger
 Child complaints of itching, bleeding, or bruising in the genital area

SOURCE: Lowenthal, 1996

Emotional abuse:

Impaired sense of self-worth
 Failure to thrive
 Intense fear, anger, and/or depression
 Delayed physical, emotional, or intellectual development
 Extreme behaviors (e.g., extreme compliance, passivity, or aggression)

Neglect:

Lack of supervision
 Unaddressed medical problems
 Evidence of caretaker drug or alcohol abuse
 Inappropriate dress or hygiene
 Hunger or fatigue

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

motivation, and school performance. In addition, neurodevelopment can be impaired either by a lack of sensory experience (e.g., neglect) or through abnormally active neurons caused by traumatic experiences (e.g., abuse) (Lowenthal, 1999). In fact, there are data to suggest that maltreatment can lower children's IQs (Putnam, 2006). However, negative outcomes are not limited to the most extreme cases of child maltreatment.

In the past 10 to 15 years, improved methodologies (e.g., representative samples, increased sample size, use of adequate comparison groups, examinations of children's school performance longitudinally) have led to a growing consensus that maltreatment is significantly associated with deficits in school performance. Utilizing a community sample of 420 maltreated children in grades kindergarten through 12, matched with 420 nonmaltreated controls (on gender, school, grade level, residential neighborhood, and, when possible, classroom), Eckenrode, Laird, and Doris (1993) found that maltreated children performed at significantly lower levels on standardized tests and school grades. More specifically, among students in grades 2 through 8, maltreated children scored significantly below the comparison group in both reading and math. These negative effects exceeded those associated with living in poverty (i.e., having received public assistance). Further analysis revealed an interaction between maltreatment and grade level; reading deficiencies were more pronounced among maltreated children in the lower grades. Results also demonstrated that maltreated children were more likely to repeat a grade and had significantly more discipline referrals and suspensions than comparison students. However, there were few differences between groups of older students (grades 9 through 12) in grades and grade repetition, suggesting

that there may be a selective process of dropping out of school among maltreated children.

Leiter and Johnsen (1994) identified school outcomes in three domains: cognitive learning, participation, and integration (i.e., socialization). Comparing these outcomes between a sample of maltreated children drawn from the North Carolina Central Registry of Child Abuse and Neglect and a general school sample, the researchers found that abused children performed significantly worse on all school measures, including grades, standardized test scores, grade retention, and absences. Moreover, the dropout rate for abused children was more than three times higher than that of their nonabused counterparts. These deficits appeared to exceed those of children suffering other forms of social disadvantage.

In a comparison of abused, neglected, and nonmaltreated children's school performance, socioemotional development, and adaptive behavior, Wodarski, Kurtz, Gaudin, and Howing (1990) found that, controlling for socioeconomic status (SES), both abused and neglected children scored lower on a composite index of overall school performance. In regard to behavior, teachers rated both abused and neglected children more negatively on the Child Behavior Checklist Teacher form. Overall, children who had experienced physical abuse were viewed as more problematic in school, "displaying academic deficits, problem behaviors, lowered self-esteem, delinquency, and elevated feeling of aggression, and pervasive adjustment difficulties in a variety of contexts" (p. 510). On a more hopeful note, older children in both maltreatment groups demonstrated areas of strength in adaptive behaviors.

DIFFERENT IMPACTS OF VARIOUS MALTREATMENT TYPES

As data have accumulated to evidence the detrimental effects of maltreatment on school performance, researchers have begun to explore the differential impact of specific types of maltreatment, as well as the processes through which maltreatment influences academic achievement (Leiter, 2007). For example, in their 1993 study, Eckenrode and colleagues found that for both grades and test scores, children who had experienced neglect, either alone or in combination with abuse, performed most poorly, while children who had experienced physical abuse had the most discipline problems. In a secondary analysis of the Eckenrode et al. (1993) data, Kendall-Tackett and Eckenrode (1996) examined the developmental course of children who had experienced neglect alone or in combination with other abuse. When effects for gender and SES were controlled, results showed that neglected children performed more poorly than their peers, with a marked drop during the transition from elementary to junior high school. Neglect alone had a negative impact on grades and number of suspensions regardless of whether it occurred alone or in combination with physical or sexual abuse. However, the combination of abuse and neglect had a particularly strong negative effect on number of disciplinary referrals and grade repetitions. In contrast to the growing body of evidence that particularly severe deficits may follow from neglect, the results of studies investigating the impact of sexual abuse on academic development have been mixed (Trickett & McBride-Chang, 1995).

Child maltreatment may further impair children's school performance when combined with other challenges. For example, Kerr, Black, and Krishnakumar (2000) found that children with both failure-to-thrive and maltreatment demonstrated more behavior problems and worse cognitive performance and school functioning than did those with only one of these risk factors. Because of its association with poor school performance, poverty has been a subject of particular interest to researchers examining the academic effects of child maltreatment. Using the Hahnemann Elementary School Behavior Rating Scale, Reyome (1994) compared teachers' ratings of achievement-related classroom behaviors for (1) a group of sexually abused or neglected children in grades K to 6, (2) nonmaltreated children receiving public assistance, and (3) nonmaltreated lower middle class children. For 13 of the 14 factors measured, there was a statistically significant difference between the three groups. Compared to nonmaltreated lower middle class children, the abused or neglected students exhibited fewer classroom behaviors positively associated with academic achievement (for example, originality, classroom involvement) and more classroom behaviors negatively associated with

academic achievement (e.g., disruptive social involvement). However, when compared to students from similarly disadvantaged socioeconomic backgrounds, the maltreated students showed few differences in negative classroom behaviors (with the exception of withdrawn behavior). Maltreated children were nonetheless less original, independent, and involved in classroom work than were the comparison children.

In an effort to develop better responses to maltreated children in the schools, researchers have sought to elucidate the processes through which abuse and neglect affect academic performance. Some of the first longitudinal studies of the development of maltreated children, which focused on infants and preschool children, indicated that at these early ages, children display more insecure attachments; lower intelligence scores; impaired cognitive development, including language; lower levels of effectance motivation; more negative and less positive affect; and fewer prosocial behaviors, along with more aggressive and noncompliant behavior. As noted by Eckenrode et al. (1993), taken together, these findings suggest "a continuity of disadvantage for maltreated children with regard to the negotiation of age-appropriate developmental tasks" (p. 59).

Subsequent studies suggest that this pattern of compounding deficits continues through the school years. For example, Rowe and Eckenrode (1999) demonstrated that there was a time element associated with risk; abused children were at substantially higher risk of repeating kindergarten and first grade than were their nonabused counterparts. This differential was not detected in grades 2 through 6, suggesting that academic difficulties appear early in a child's school career. Such early academic difficulties have been associated with increased risk of school drop out.

Leiter (2007) examined the temporal pattern of declines in school performance, exploring the trajectory of school performance after an initial report of maltreatment. An analysis of data from a large urban school district and state child protective service records for 715 children demonstrated that for study outcomes, absenteeism, and grades, adverse influences accumulated with time; however, the rate at which these adverse influences accumulated was more rapid for older maltreated children. Maltreatment beginning early in a child's life impacted absenteeism more negatively than did maltreatment with a later onset. The negative impact of maltreatment on attendance was almost immediate and exceeded the impact on grades, especially immediately after an initial report. The negative effects on grades appeared over longer periods of time. In addition, maltreatment heightened the negative impact of aging on school performance. Letier noted that as children age, school grades may decline for reasons unassociated with learning ability (e.g., higher standard imposed by high

school teachers); however, increased absenteeism may, in fact, reflect an increased level of disengagement from school that proves equally detrimental to academic achievement. Intervention by child protective services did evidence some ability to offset the impact of maltreatment more for grade point average (e.g., school performance) than for absenteeism (e.g., school participation).

In one study designed to explore the motivational patterns of maltreated children, younger (6- and 7-year-old) children tended to present themselves in a positive manner that was inconsistent with their descriptions by teachers and nonabused peers (Barnett, Vondra, & Shonk, 1996). Although their perceptions of peer acceptance dropped, older (8- to 11-year-old) maltreated children, like their younger counterparts, held views of their competence and acceptance that were inconsistent with those of their teachers. While there were few differences in regard to scholastic functioning and motivational orientations, existing differences did favor nonmaltreated children. Abused children tended to score lower on verbal intelligence and higher for special education status than did their nonabused peers. As noted by the researchers, these findings suggest that negative views about oneself may actually predict working harder and engaging more with schoolwork among maltreated children, a pattern of motivational orientation that is virtually the opposite of the pattern observed among nonabused children.

SUGGESTIONS FOR EDUCATORS

As of 2007, there are laws in all 50 states that require reporting of suspected cases of child maltreatment. While these laws vary in the scope of professionals and other adults included as mandatory reporters, teachers and other school personnel are clearly bound by these requirements; in fact, teachers may be personally liable for reporting abuse (Lowenthal, 1996). Although data suggest that teachers are generally reluctant to report (Tite, 1993), in order to satisfy their legal obligations, educators should make a report of any suspected abuse or neglect within 24 hours and place a detailed record of the observed indicators of abuse in the student's file.

Summarizing previous work, Lowenthal (1996) identified the potential signs of child maltreatment for educators. The specific indicators for physical abuse, sexual abuse, emotional abuse, and neglect are listed in Table 1.

Although frequently concerned that they have received limited to no training on how to identify child abuse, teachers do appear to have accurate perceptions of the effects of maltreatment on classroom behavior, indicating that they should have confidence in their ability to serve effectively as reporters (Yanowitz, Monte, & Tribble, 2003).

Ultimately, the decision of whether maltreatment is substantiated lies with children's protective services;

however, teachers can employ various strategies to assist possible victims, including adopting an accepting, caring attitude; honoring confidentiality in the case of disclosure (excluding the legal duty to report); being sensitive to students' cues; developing active listening skills; setting reasonable goals to enhance students' confidence and success; establishing a structured classroom environment; engaging the student in class activities; emphasizing the student's strengths and abilities; and working with other professionals to identify and to implement appropriate interventions (Lowenthal, 1996).

SEE ALSO *At-risk Students; Emotional Development.*

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Sharon G. Portwood

ACADEMIC PRESS

Educational demands are sometimes characterized as academic press. With increased calls for teachers to make classrooms demanding, researchers and practitioners need clarification on how academic press is defined and measured and how press relates to educationally relevant outcomes.

ACADEMIC PRESS DEFINED

Human behavior has been conceptualized in terms of both personal needs and environmental press. Henry A. Murray labeled demands from the environment that prompt behavior as *press* and urged psychologists to develop models of behavior that include both personal needs and demands from the environment. Such a press can be characterized from an individual's perception of demand or from an objective view of environmental demands. Moreover, press does not operate independent of its context but acts within a "patterned meaningful whole" (Murray, 1938, p. 40) in the total environment. An academic press, therefore, describes the pattern of demands for engagement with academic work placed on a learner within the classroom and school environment.

TYPES OF PRESS

Three broad categories of academic press emerge from the research literature: press for completion, for performance, and for understanding.

Press for completion. The demand to achieve a list of objectives or meet academic standards within a set period of time can be called a press for completion or coverage of material and is often independent of the quality of the work being completed. This press has been described as the number of students who complete certain courses or grade levels, such as the percentage of students completing high school or taking algebra in the eighth grade, and number of semesters of a particular subject area completed. Press for completion in classrooms is reflected in an emphasis on completing a curriculum and assignments, on the number of hours of homework, or on doing work exactly as students are directed rather than having them think about the task at hand.

Press for performance. A press for performance emphasizes a demand for a level of achievement such as a specific passing grade or test scores or scoring better in comparison to others. Academic press may be thought of as "the degree of normative emphasis placed on academic excellence by members of the organization" (Shouse, 1996, p. 175). Such a press may encompass a variety of school policies meant to improve the "academic climate" or emphasis on academic success, such as the degree to which a school honors student achievement, whether competition for grades is encouraged, and the use of *absolute achievement* grading practices.

Press for understanding. Finally, academic press can be thought of as a press for understanding or the degree to which students are required to engage in higher-order thinking skills, such as linking understanding to previous knowledge, checking answers against what they already know, and demonstrating conceptual understanding. Press for understanding has been described by instructional practices, such as attention on the main point, checking for understanding, asking high level questions, demanding justification or clarification, encouraging connection making, and sustaining an expectation for explanation.

LEVEL OF PRESS

The environmental level at which press operates adds another dimension to understanding academic press.

School Level. In an attempt to create better schools and improve student achievement, several studies have examined the influence of academic press at the school level as

it contributes to school climate. Schools that implement certain policies to emphasize academic excellence are considered to have a stronger climate of academic press than those that implemented fewer of the policies.

Classroom Level. Academic press may have greater impact on student outcomes in the immediate environment of the classroom rather than at the more distant school level. Studies of classroom academic press often emphasize instructional practices. Press for understanding is typically demonstrated by teachers pressing students to explain, justify, and relate ideas as opposed to relying on students' perceptions of the school as affecting what they might do in the classroom.

COMMON WAYS TO MEASURE ACADEMIC PRESS

Early research on press differentiated forms of press. The lack as of 2008 of conceptual consistency regarding types and levels of academic press has led to the development of several divergent measures. One approach has been to form a comprehensive index that includes several types of press; however, this approach does not provide an understanding of the relative importance of different forms of press or their relation to outcomes. Academic press has also been measured by the presence or absence of school policies such as ability grouping, incrementally based grading, remediation, promotion based on mastery, or discipline codes. Student self-report measures are also a common way to measure perceptions of academic press. These measures report student perceptions formed over an extended period of time and are closely linked to reported educational beliefs and behaviors. One advantage of this method is that aggregate perceptions of all students in the class can provide a classroom measure of academic press. Observation measures of academic press have focuses on instructional practices and teacher-student discourse. This approach to measurement, which provides rich classroom description of related classroom features, however, may introduce observer bias and contradicts the assertion that perceptions of press are most closely linked to an individual's behavior.

EDUCATIONAL OUTCOMES ASSOCIATED WITH PRESS

Most descriptions of academic press start with the premise that the teacher is central in creating classroom demands. As Meece (1991) states, "We assumed that teachers who frequently probed students' levels of understanding and asked for explanations, rather than simply affirming or negating answers, create a 'press' for mastery in their classroom" (p. 271). However classroom character is not determined by one factor, such as the teacher, but is related to a constellation of characteristics. The

learner experiences many elements of the classroom that can serve as agents of academic press, such as the teacher, the task, and peers; similarly, the learner may experience external sources such as parents.

Outcomes. Academic press has been related to short-term achievement outcomes such as grades even for low achieving students when accompanied by increased effort. Press also may moderate the relationship between other aspects of the environment, such as social support, and learning. Moreover, academic press works in combination with instructional pacing, support, and scaffolding to support learning. Academic press also has been associated positively with self-efficacy, self-regulation, and school belongingness and negatively with avoiding help-seeking and bullying.

Group Differences. Variation in student experience of press may be a result of different treatment or different perceptions. Press has been found to have different effects on different groups such as diminishing the avoidance of help-seeking in girls in math classrooms or enhancing academic interest in African-American middle school students. Even in the same classrooms lower achieving students have reported experiencing lower press than high achieving students. Gender, race, and prior achievement may play a key role in the how press operates in classrooms.

Academic press has been used to describe the emphasis, value, and opportunity for learning presented by the environment. However, the theoretical conception and empirical measurement of academic press varies in educational research by type of press, source of press, and reported outcomes. Research on the processes by which press serves to enhance learning or achievement and how it interacts with other features of the learning environment would enhance understanding of this factor in education.

SEE ALSO *Achievement Motivation*.

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Michael Middleton

ACCOUNTABILITY

Accountability permeates education in the United States. It focuses on both the processes and products of education. Responsibility is assigned to individuals or groups, including educational leaders, administrators, teachers, other school staff, and students themselves. Measures are used to determine whether the process or products meet the desired goals, and criteria are set for whether the targets are met. The consequences attached to the accountability systems may be simply labels assigned to the individual or group to which responsibility has been assigned, or they can involve withdrawal of funding or removal of the individual or group from continuing in the same role.

DEFINITION

Accountability is the assignment of responsibility for conducting activities in a certain way or producing specific results. A primary motivation for increased accountability is to improve the system or aspects of it. To have a workable accountability system, there must be a desired goal (e.g., compliance with legal requirements, improved performance), ways to measure progress toward the goal (e.g., indicators of meeting legal requirements; indicators of performance), criteria for determining when the measures show that the goal has or has not been met, and consequences for meeting or not meeting the goal. Each of these aspects of an accountability system can vary in a number of ways.

EDUCATIONAL ACCOUNTABILITY

Educational accountability targets either the processes or results of education. A desired goal is identified (e.g., compliance with the legal mandates of providing special education, highly qualified teachers, improved student performance), and measures are identified for determining whether the goal is met (e.g., a checklist of indicators that the legal mandates have been met, a target of 90% correct for teachers taking a test of current knowledge and skills, a target of 60% of students performing at grade level by the end of each school year). Criteria for determining whether the goal has been met can involve specific determinations of ways that the goal may and may not be met (e.g., deciding how many indicators in the checklist must be marked to be considered meeting the legal mandates, determining the specific content that

does or does not count for specific types of teachers, determining how to calculate the percentage of students performing at a proficient level, and how to define grade-level performance).

Accountability occurs in many ways in educational systems. One type of educational accountability system is that in which the school is held responsible for the performance of its students. Another type of educational accountability is a system in which teachers or administrators are individually held responsible for the performance of their students. Accountability systems in which schools or individual school personnel are held responsible for aspects of the educational process are most often used as ways to adjust the processes of education. Whether the school or individual teachers or administrators are held responsible, the educational accountability approach is termed *system accountability*.

Educational accountability may also hold individuals responsible for their own performance. For example, students may be held responsible for their performance in school (such as through promotion tests or graduation exams). Teachers may be held responsible for their performance on content and pedagogy through entry examinations or periodic tests of knowledge and skills.

System Accountability. Educational accountability in which the system is held responsible for the results of its students gained popularity in the early 1990s. Although some school districts and some states had their own accountability systems, the first use of this type of accountability across the United States was the 1994 reauthorization of the Elementary and Secondary Education Act (ESEA) known as Improving America's Schools. Accountability consequences were increased significantly in the 2001 reauthorization of Elementary and Secondary Education Act known as the No Child Left Behind Act (NCLB). NCLB required that schools, local education agencies, and states be held accountable for the performance of all students in the public education system.

The accountability system focused on school responsibility for student achievement, as in No Child Left Behind, demonstrates the components of educational accountability systems. The desired goal is improved student achievement. It is measured in terms of increases in the reading and math performance of groups of students. Measurement occurs through the administration of state assessments of reading and mathematics (such as compliance with legal requirements, improved performance), and ways to measure progress toward the goal (such as indicators of meeting legal requirements; indicators of performance). The criteria for determining when the measures show that the goal has or has not been met are defined in terms of benchmarks toward an ultimate target for performance,

with specific rules for how the performance is aggregated and counted. The consequences for not meeting the goal include requiring schools that do not meet benchmarks to offer students the opportunity to attend a school that did meet benchmarks, requiring schools that did not meet benchmarks to provide additional educational services to students, and eventually closing schools that do not meet benchmarks for a certain number of years in a row.

Accountability for the process of education is a common form of educational accountability. Schools are required to meet accreditation criteria. Special education programs must demonstrate that they have provided services and maintained Individualized Education Programs (IEPs) in a manner consistent with the law. The desired goal of educational accountability focused on process is to improve the process that is targeted. Special education IEPs are an example of a process targeted for accountability. Meeting the process requirements means demonstrating compliance with a number of requirements in the law and in regulations for IEPs. Measurement occurs through the completion of a checklist, for example, that identifies the requirements (such as providing notice within a certain period of time, having specific signatures on the IEP document, and so on). The criteria for determining when the measures show that the goal has or has not been met are defined in terms of numbers of elements that must be checked. The consequences for not meeting the goal generally include a letter identifying the problems in the process. In some cases, repeated failure to meet the criteria results in penalties, such as reduction of funding, to the educational system.

Individual Accountability. Student accountability implemented via promotion or exit exams is a common type of individual accountability in schools. Students are required to pass a test to demonstrate that they are ready to move either from one grade to the next (promotion) or leave the educational system with a credential certifying successful completion (exit). The tests that are administered to students generally cover those topics that the school system or its public have deemed important for individual students to demonstrate at a certain point in time. The criteria for determining when the measures show that the goal has been met (for instance, that the student is ready to move from one grade to the next) are defined in terms of passing scores on the test. In some cases alternative criteria are available to certain students who either are not able to pass the tests or who need to demonstrate that they have met criteria through other means.

Individual accountability for the adults in the education system include such variations as teachers being held responsible for passing tests to obtain or keep jobs, or principals and educators receiving salary bonuses on the basis of student achievement. This type of accountability

includes the same components as other educational accountability systems, with goals, measures, and other criteria for determining when the goal has been met, and rewards and sanctions for meeting or not meeting the criteria.

ACCOUNTABILITY MEASURES

The most common forms of educational accountability use measures such as checklists of the process or assessments of student performance. The content of measures of educational accountability for process typically focus on resources (such as number of teachers or teacher-student ratio) or elements of a process (such as the elements of an Individualized Education Program). The content of measures of student performance focus on various student outcomes (such as what students should know and do at various grade levels, or percentage of students graduating with a standard diploma). States have defined content standards that identify what students at various grade levels should know and be able to do. Reading/English language arts and mathematics are common content areas in which standards have been set and assessments developed to measure student performance.

The measures of student achievement are nearly always large-scale assessments. These assessments are data collection instruments that usually have multiple-choice items in which students select from a list of answer choices, and also may have extended response items in which students write a response to a question. To lessen the unintended exclusion of some students from the accountability system because of their inability to be assessed on typical large-scale assessments, the assessments are designed to be widely inclusive of students of all characteristics. When the regular large-scale assessment cannot include all students, even with accommodations provided for students with disabilities and English language learners, alternative forms of measurement usually are provided (such as requiring students to demonstrate that they have the required knowledge and skills). Results of the large-scale assessments and alternatives, if available, are aggregated (added together) to produce a school score.

COMPARISON OF ACCOUNTABILITY APPROACHES

School accountability systems based on student performance provide explicit scores for schools and also attach labels that determine rewards and sanctions. The way in which the accountability systems incorporate student performance to obtain a score may vary from one place to another. Approaches to school accountability may be either cross-sectional, which are based on groups of students who may not be the same students from one year to the next, or longitudinal, which are based on individual students who

are tracked across time. Specific models of accountability within these approaches include four models: status, status change, cohort gain, and individual gain score.

The *status model* is a cross-sectional approach that uses an average score to determine a school's level of performance. This model has also been called a school-mean performance approach because it adds together students' performance scores and then determines the average to represent school performance. Status models of accountability rely on student performance scores in a single year. Schools are rated and consequences assigned based on the single year scores. In some cases, additional information such as absenteeism rate or graduation rate may be added to student performance to determine an average school score. The major drawback of this approach is that it does not recognize many of the factors that might have a significant impact on performance, such as differences in student body composition and instructional or programming factors, and does not allow for error in the measurement of performance. Measurement error is greater when the group of interest is smaller, thus complicating inferences from adding together information from small groups to reach conclusions about school performance.

A *status change model* is similar to the status model, but adds the dimension of time. It is sometimes called an improvement model. Average student performance, or a combination of student performance and absenteeism, for example, is examined over time. Typically school scores are compared year to year to see whether there are improvements in the performance of the school. For example, the percentage of students scoring proficient and above is compared from one year to the next. The major drawback of the status change model is that it is cross-sectional with different students included in the school averages from year to year, meaning that the performance of students who may be different on a variety of factors is compared. As mobility rates increase, as in the United States in the early 21st century, so do the drawbacks of the status change model. Another drawback of the status change approaches that focus on the percentage of students reaching a certain performance level is that the model does not recognize movement of students within levels, such as a student who moves from the bottom scores in a level of performance to high scores in that level, or across lower levels, such as a student who moves from the bottom level to the next higher level but is still below the targeted performance level for counting.

Another accountability model is known as the *cohort gain model*. This model uses a longitudinal approach to focus on changes in performance of individual groups of students over time. For example, those students in grade 7 in one year are compared to the performance of those students in grade 6 the previous year, with the assumption

that the students in grade 6 moved to grade 7 and therefore the large majority of students are included in the comparison. The U.S. Department of Education has required each state to use this accountability model to receive NCLB Title I funds. To the extent that the assumption of minimal mobility of students from one grade to the next is upheld, the model has the advantage of not comparing different groups of students. To the extent that the assumption of a stable student population is not upheld, the model has some of the drawbacks of the cross-sectional models of accountability.

The *individual gain score model* of accountability is a longitudinal approach that focuses on the changes in performance of individual students over time. Growth models designed to evaluate the extent to which there has been growth in the achievement of individual students and value-added statistical models that factor in teacher or school variables and define growth expectations are versions of the individual gain score model. The advantage of the individual gain score approach is that comparisons evaluate changes for exactly the same group of students, thereby eliminating any error that is introduced due to the changing students in the groups over time. A disadvantage of this approach is that it only includes those students who have data at every point in time being compared. It is often the case that a number of students are left out, and this number increases with greater student mobility or with more years in the comparisons.

In practice, the accountability models can be altered in a number of ways, and the status and longitudinal approaches can be combined. Under NCLB, numerous adjustments have been made to accountability models to meet the needs and characteristics of individual states. Some researchers have argued that regardless of the approach, the results should not be interpreted as identifying the causes of good or poor performance, or a source for explaining why one school is better than another, but rather as a source of descriptive information that requires further investigation.

SEE ALSO *High Stakes Testing; Standardized Testing.*

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Martha L. Thurlow

ACHIEVEMENT GAP

SEE *Opportunity/Achievement Gap.*

ACHIEVEMENT MOTIVATION

A quick survey of scientific literature and popular language would reveal that, while the word "motivation" has many meanings, fundamentally they refer to processes that impel an organism to act. Indeed, "motivation" comes from the Latin verb *movere*, which means "to move." Hence, motivation refers to the processes that lead to the instigation, continuation, intensity, and quality of behavior. Accordingly, the term "*achievement motivation*" denotes processes leading to behavior that aims to achieve a certain criterion or standard. The criterion can be any goal or objective, formal or informal, set by an individual or by others, in any professional or leisure domain (e.g., school, sports, work, music, gardening, even social relationships and moral conduct), which provides a guide for evaluating success and failure.

Because achievement of standards is a fundamental human endeavor, achievement motivation has been an important domain in psychological inquiry. During the century that has passed since psychology became a scientific discipline in the late 1800s, numerous theories have

been developed to explain the processes underlying achievement-oriented behavior. To a large degree, these various theories reflect the scientific zeitgeist of the time of their development, as well as the ideological beliefs of the researchers who developed them.

EARLY MOTIVATION THEORIES

Early twentieth-century theories of motivation were strongly influenced by the general scientific developments of the late 19th century—especially Darwin's theory of evolution in biology and Helmholtz's law of the conservation of energy in physics. These scientific ideas led to the conception of living organisms as types of machines, with motivation as the energy that fuels the machine (Weiner, 1990). The organism was thought to strive toward homeostasis, or an optimal state of no motion. Motivation for action was thought to derive from a deprivation that created a disruption to, or disequilibrium of, this homeostatic state. For example, deprivation of nourishment leads to motivation to seek food, and deprivation of interesting surroundings leads to motivation to seek stimulation. In these theories, the main explanatory concept—or motivational mechanism—was termed "Drive," and it was thought to represent responses to such physiological deficits that aimed to restore homeostasis to the organism.

"Instincts," "Needs," and other related motivational concepts of the early twentieth century were similar in their emphasis on the general organismic and "energetic" character of behavior. Motivational theories of the period explained how the energy provided by the drive, instinct, or need combined with the organism's skill in a certain behavior (i.e., how much practice it had) and the relative value of the behavior's reward (e.g., going for a tasty rather than a bland food) to elicit and guide action (see, for example, Hull, 1952). Theorists of the time were faced with formidable challenges as they attempted to decide how many drives, instincts, and needs existed, how to measure them, and which were primary or secondary (for example, Murrey, 1938). As motivational systems were thought to operate according to similar principles in all organisms, much of the research during this era was conducted with animals. It was much easier to create deprivation and test instigation of behaviors aiming at different rewards among animals than among people: e.g., among rats in a maze.

It was ideological beliefs as much as empirical investigations and clinical understandings that led to developments in motivational theories during the first half of the 20th century. For example, the fundamental belief that scientific psychology should focus on observable behavior and avoid any reference to "mentalism" was the impetus for B. F. Skinner's (1938) version of behaviorism, which focused exclusively on observable reinforcements and

punishments for explaining the likelihood of behavior. Another important ideological perspective—"Humanism"—led Abraham Maslow (1955) to distinguish the human motivation system from that of animals, and to arrange human needs according to a hierarchy in which general physiological needs were at the bottom and the unique human self-actualizing needs were at the top. And it was as much an ideological battle as a scientific one that framed the fierce debate about the role of cognition in motivation. "Drive" theorists, led by Hull (1952), held fast to the automatic machine metaphor, whereas the "Cognitivists," led by Tolman (1932), argued that cognitive processes, such as *expectations* for a reward, must be included to explain variation in motivation.

THEORIES OF THE MID 1900S

The Hull-Tolman debate was decidedly won by the proponents of cognition and led to the inclusion of cognitive processes, such as expectancies for success and perceptions of its value, alongside drives and needs in the major theories of achievement motivation of the middle of the 20th century. Arguably, the most notable among these theories was that of David McClelland, John Atkinson, and their colleagues (McClelland, Atkinson, Clark & Lowell, 1953). For these researchers, achievement motivation was based in a personality characteristic that manifested as a dispositional need to improve and perform well according to a certain standard of excellence. This achievement motive, which the researchers labeled *n Achievement*, or *nAch*, was believed to form during the first years of life through parents' child-rearing practices: primarily, how early parents expected and rewarded—either tangibly or affectively with warmth and affection—independence in their children. McClelland and his colleagues hypothesized that these early experiences led to the propensity to experience a strong emotional arousal when cues in the environment were interpreted as an opportunity to achieve. Individuals were thought to differ from each other in the strength of this arousal and in the breadth of cues that elicited it.

As need for achievement was thought to be based in affective associations established in the first years of life, McClelland, Atkinson, and their colleagues believed that people were not conscious of this characteristic of their personality. Therefore, these researchers considered it inappropriate to assess people's need for achievement by asking them directly to talk about their motivation. Instead, they chose to assess this need indirectly through a projective instrument called the Thematic Apperception Test (TAT) that purportedly elicits unconscious processes. In this instrument, people are asked to write a story describing the thoughts, emotions and behaviors of a person in an ambiguous picture or drawing (for

example, a child sitting in front of a violin). The stories are then coded for achievement-related content including indicators of competition, accomplishments, and commitment to achieve. This technique, labeled the Picture Story Exercise (PSE), was used in numerous studies that tested the relations of *nAch* with various indicators of performance. The PSE was also used to investigate the way different environmental cues (e.g., success and failure feedback) were related to elicitation of the achievement need, and to investigate differences in level of *nAch* among people from different social groups (e.g., McClelland, 1961). This latter work was rather controversial due to its stereotype-promoting implication that people from certain groups were inherently low in need for achievement. About a decade later, Maehr (1974) challenged this deterministic implication by highlighting the role of contexts and situations over that of personality in motivation and achievement.

It was not long before research, observations, and earlier notions of human motivation suggested that *nAch* was not the only achievement motive. Analyses of the PSE indicated that while some people had ample positive imagery related to achievement (and were identified as high on *nAch*) and others had very little (and were identified as low on *nAch*), many people actually had strong *negative* imagery associated with achievement. Researchers realized that a more complete description of the achievement motive would require supplementing the positive affective arousal triggered by the potential for achievement, or *Hope of Success* (HS), with the negative affective arousal triggered by the potential for failure, labeled *Fear of Failure* (FF). Similar to HS, FF was believed to be shaped during the early years of life through child-rearing practices that included punishment—again, either tangible or affective, such as love withdrawal for failing to meet parents' expectations. Thus, in addition to outcomes associated with high HS, research during the middle of the 20th century paid much attention to the processes and outcomes associated with FF and its related construct of "Anxiety about Failure." These two motives later came to represent an important distinction in the achievement motivation literature between *approach* and *avoidance* motivations (Elliot & Covington, 2001).

Much of the research during the 1950s and 1960s in the need for achievement framework relied on the PSE. However, while the PSE proved to be a successful measure of *nAch*, it had critics who questioned its reliability and validity. These criticisms led researchers to construct alternative measures to assess achievement needs: summated scales. This method involves giving a questionnaire to participants and asking them to rate their agreement with a number of statements describing characteristics or emotional reactions that define *nAch* and FF (e.g., "I will not be satisfied until I am best in my field of

work," Jackson, 1984). The ratings on the different items are then summed to provide a score indicative of the person's level of achievement motivation.

The construction of these easily used scales increased the number of studies relating self-reported *nAch* and FF to a wide range of outcomes. However, unlike the PSE, summated scales ask people directly about their motivation. Interestingly, research found that responses on the scales do not correlate with scores of *nAch* derived from the PSE. Moreover, scores from these two types of measures seem to be associated with different outcomes. Years later, these findings led McClelland and his colleagues (McClelland, Koestner & Weinberger, 1989) to argue that the two measures tap into two different motivational systems. They argued that the PSE indeed assesses *nAch*, which is the unconscious, or "implicit," emotional arousal that is experienced in response to achievement cues. In contrast, the scales assess conscious cognitive perceptions and evaluations, which are self-attributed, or "explicit." These explicit motives were thought to be influenced by social norms and expectations and were closer in meaning and psychological function to the other cognitive concepts that became dominant in motivational theories during the second half of the 20th century: expectancies for success, perceived value, perceptions of control, and goals.

COGNITIVE PROCESSES IN MOTIVATION

In its theoretical formulation, Atkinson's (1957) and McClelland's (1985) theory of achievement motivation combined *nAch* with cognitive expectations of success and with the value of such success to a person. In fact, this theory was often referred to as the Expectancy-Value model of achievement motivation. The inclusion of cognitive processes as central concepts in the explanation of human behavior indicated a shift in the metaphor that guided motivation theory: from that of a machine to that of a rational decision-maker (Weiner, 1991). Atkinson held, for example, that people would rationally construct the value of success to be higher on difficult than on easy tasks. Similarly, he expected people to have lower expectancies for success on difficult than on easy tasks. Atkinson contended that these two perceptions interacted to result in a person's behavioral tendency to engage in a task, which was highest at moderate levels of task difficulty, and zero at both very low and very high levels. However, in Atkinson's theory, this relationship was still thought to be affected by people's unconscious need for achievement, and to be strong only for individuals with high need for achievement. For individuals with low need for achievement, the behavioral tendency to engage was expected to be low regardless of task difficulty.

The cognitive processes of expectancies for success and perceived value continued to be important motivational concepts throughout the second half of the 20th century and the beginning of the 21st century. Indeed, the “cognitive revolution” in psychology in the middle of the 20th century, combined with criticisms of the *nAch* perspective, resulted both in increased attention to cognitive processes in motivation and in waning interest in the concepts of the past. Rather than striving toward homeostasis, humans were now considered to be continuously active, and motivation was thought of as the process underlying the behavioral choices that they made. But it was also becoming clear that people were not rational decision-makers (Weiner, 1991). People constructed different meanings for the same task that guided their perceptions, expectations, and valuing. These meanings were considered to be as much a result of social interactions as of personal dispositions. Thus, the focus during the last three decades of the 20th century was on people’s subjective experiences of success and failure (created in the laboratory or in natural social settings such as schools), the attributions they made to these events, their evaluations of their competence, their expectations of success or failure in the future, and the goals they adopted for engagement.

MOTIVATION THEORY AT THE LATE TWENTIETH CENTURY

Unlike the grand theories of the early decades of the 20th century, no single theory dominated the field of achievement motivation in its late decades. Instead, several theoretical frameworks developed side by side, employing various social-cognitive concepts and mechanisms. These different frameworks highlighted processes as applied to different units of analysis (e.g., the academic task at hand, the subject matter, academic learning, achievement generally, life goals); they emphasized the role of the individual, the environment, or their interaction; and they focused on somewhat different indicators of motivation (e.g., choice, persistence, quality of engagement, affective experience). Arguably, the dominant concepts of the last decades of the 20th century could be said to be *Self* and *Goals*. Self processes, including perceived competence, sense of control, and sense of autonomy, as well as the values and goals that defined the criteria of success and failure, appeared in one form or another in almost all the theoretical frameworks. These cognitive structures, which emphasize the agentic nature of behavior, seem to characterize the zeitgeist of motivational theorizing of this period. Along with the reliance on cognitive processes, the most common method of assessing motivational processes within these frameworks is summated scales, although other methods including interviews, observations, and experiments are employed as well.

Today, in the first decade of the 21st century, one can identify several directions in motivational theorizing.

The cognitive concepts of *Self* and *Goals* continue to play a prominent role. However, current theorizing places greater weight on the social-cultural foundation of these cognitive processes (Volet & Järvelä, 2001). Thus, the importance of culture, the social context, and social relations and interactions to achievement motivation is receiving more and more attention. Another apparent trend is the integration of earlier motivational concepts, primarily achievement needs, with the later cognitive processes (Elliot & Thrash, 2001; for an integration of cognitive processes with humanistic needs see Deci & Ryan, 2000). Conceiving of implicit and explicit motives as complementary systems, and identifying corresponding neurological systems in the brain, is likely to instigate further research and theoretical developments (Schultheiss & Brunstein, 2005). Finally, emotional processes, which were rather neglected during the heavy emphasis on cognitive concepts, are receiving recognition as important energizing concepts in their own right, and research on the emotional nature of achievement motivation is beginning to bear interesting fruit (Linnenbrink, 2006).

FACILITATING ACHIEVEMENT MOTIVATION IN SCHOOL

In conclusion, motivational theories reflect the zeitgeist as well as the ideology of their authors. Different theories represent different metaphors of human action, emphasize different underlying processes, and focus on different outcomes. When attempting to understand student motivation, for example, educators and researchers should be critical consumers and consider the fit of a theory with their own values and needs. Such consideration should include the methods for assessing motivation, as these methods are inextricably embedded in theoretical assumptions. Finally, theoretical assumptions are tied with implications for motivational interventions. Motivational theories that emphasize stable personality characteristics are, by nature, more pessimistic with regard to interventions (although see McClelland, 1965, 1978). Arguably, educators might find most useful those theoretical perspectives that emphasize the role of the social environment in students’ motivation. Among these, it seems, there is relative agreement: quality achievement motivation among all students is facilitated by caring and safe environments that promote meaningful relationships between and among adults and children, in which the emphasis is on personal development and collaboration rather than on competition and social comparison, in which students are encouraged to pursue their interests and to learn from mistakes, and in which feedback is geared towards learning and not merely evaluation (Pintrich & Schunk, 2002).

SEE ALSO *Attribution Theory; Expectancy Value Motivational Theory; Goal Orientation Theory; Self-Efficacy Theory.*

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Avi Kaplan

ACTION RESEARCH

Action researchers develop actionable knowledge. They do not merely study problems from a distance. Participants become empowered and aligned around the truths created/discovered in the action research so that desirable change results.

WHERE TRUTH MEETS POWER

The work of action researchers challenges much received wisdom in both academia and among social change and development practitioners, not least because it is a practice of participation, engaging those who might otherwise be subjects of research or recipients of interventions as inquiring co-researchers. Action researchers do not start from a desire of changing others out there, although their work may eventually have that result, rather it starts from an orientation of change with others. Action research is therefore not a methodology but an orientation to inquiry that comprises a great variety of practices.

In the often-cited definition given by Peter Reason and Hilary Bradbury in their *Handbook of Action Research* (2001, 2006, 2008), action research is described as

“a participatory process concerned with developing practical knowing in the pursuit of worthwhile human purposes . . . It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people.”

OVERVIEW OF STEPS AND PROCEDURES

Common among the varieties of action research is a holistic approach that integrates reflection and action. Thinking together in dialogue is especially valued because innovation and coordinated action is thereby generated. A review of a large variety of action research projects over the years shows that action research has the following characteristics:

- grounded in real life experience,
- developed in partnership,
- addresses significant needs,
- develops new ways of seeing/interpreting the world (i.e., theory),
- works with (rather than simply studying) people,
- uses methods that are appropriate to the audience and participants at hand,
- develops needed structures to allow for follow up or institutionalization of new practices so that the work may have a lasting, positive impact.

While there are many ways of doing action research, the following steps suggest how a generic action research project evolves over time:

- Co-scoping the work in an insider/outsider team (e.g., scholar/practitioner),
- Mapping the entire system in which the need for change is perceived,
- Identifying key stakeholders and possible leverage for desired change,
- Collecting targeted data, often including interviews and focus groups,
- Meeting with stakeholder on preliminary findings and design of participatory implementation,
- Ensuring infrastructure that will sustain the work,
- Presenting findings for wider audiences with use of metrics to support the effort.

ASSESSING VARIETIES OF ACTION RESEARCH

The best way of understanding action research is to be immersed in a project. Perhaps second best is to read rich descriptions. The following constructs, selected from *The Handbook of Action Research* and the Sage journal *Action Research*, offer a way of appreciating what can otherwise seem like a bewildering array of projects.

The construct of context refers to the manifold types of places and organizations in which action research takes place. Action research happens in private spaces; in urban communities; in business, healthcare, and development contexts; and in the ministerial offices of nation states.

The term *leadership* refers to the core group of movers in the action research projects. In most cases the movers design a project that envelops larger numbers of people at different levels of engagement over time from supporters to active co-researchers. However, sometimes those who generate the original design for the action research also experience it, as for example with collaborative inquiry aimed at professional improvement for all participants.

First-, second-, and third-person modes of inquiry often coexist in one project. But for the sake of overview it is helpful to differentiate which predominates as the cause of a project's impact. First-person mode refers to the work that each individual does with regard to cultivating an orientation of learning. Second-person mode refers to the work of group learning that usually underpins the participative approach in action research projects, within which people engage with one another. Third-person mode refers to efforts to involve or share information with those not originally involved in the

work, which typically happens through publication or invitation for others to join an on-going effort.

The level of impact refers to the place in a system where impact is felt, for example, at the level of the individual; the small group organization or unit of community; or at the level of the whole society.

Finally, people who study action research ought to look at the order of change. First order change or single loop change refers to the degree to which concrete results are experienced by project participants. Second order or double loop change refers to the change occurring at the level of operating theories and values.

METHODOLOGICAL STRENGTHS AND WEAKNESSES

Action research typically involves two sets of actors whose roles may blur. One set is directly responsible for effecting change in a system while the other helps frame and theorize the work. Strengths and weaknesses are therefore viewed through different lenses—the need to act and the need to understand.

For practitioners it is often that a good balance between first and second order outcomes (immediate results and value added learning) helps to better commend the action research approach as it allows for momentum to build around small wins.

For those situated in a scholarly context, methodology must include the question of how to relate to conventional social science and especially how to work with the issue of partial objectivity. In the West, most action researchers have been brought up in a broadly Cartesian worldview, which channels their thinking in significant ways. It views the world as made of separate things. These objects of nature are composed of inert matter, operating according to causal laws. They have no subjectivity or intelligence, no intrinsic purpose or meaning. The philosophy of Descartes states that mind and physical reality are separate. Humans alone have the capacity for rational thought and action and for understanding and giving meaning to the world. This split between humanity and nature, and the abrogation of all mind to humans, is what Max Weber meant by the disenchantment of the world. Participation therefore becomes an epistemological principle with methodological implications. An attitude of inquiry includes developing an understanding that people are embodied beings that are part of a social and ecological order, that they are radically interconnected with all other beings, not bounded individuals experiencing the world in isolation. This all leads to individual researchers suggesting that there can never be one right way of doing action research.

In addressing the important question of how one knows if action research can be deemed good (Bradbury & Reason, 2003; Bradbury, 2007), Bradbury and Reason

argue that a key dimension of quality is for action researchers to be aware of their choices for quality and to make those choices clear, transparent, articulate, to themselves, to their inquiry partners, and, when they start writing and presenting, to the wider world. This is akin to the crafting of research that Kvale (1995) advocates, or following Lather (2001), away from validity as policing toward incitement to dialogue. The degree of actionability in the work of Bradbury and Reason is a function of how rigorously they can address issues of quality in their knowledge generation efforts.

Generally then Bradbury and Reason suggest that action researchers keep an eye on a handful of issues and address them early and often in the life of a project. Those are considerations of quality with regard to the following:

1. Quality of partnership,
2. Quality of practical outcome,
3. Quality of methodological and theoretical rigor (being careful to include the multiple ways of knowing best suited to participants),
4. Quality of infrastructure.

ACTION RESEARCH, INSTRUCTION, AND EDUCATION

Action research can be undertaken by people in all walks of life as they study and attempt to change their world. It does not have to be part of a formal academic project. It can be facilitated by scholars and those in graduate training at universities, by those in think tanks and nongovernmental organizations around the world. Scholarly action researchers are called upon to unify oppositional approaches that include the integration of theory and practice, action and reflection, empirical analysis and normative vision, critique and appreciation, explanation and action, vision and current reality. In academic cultures that more readily replace *and* with *or*, this will always be a challenge. Thankfully this challenge also offers opportunity for experiencing that the action research approach makes a positive difference, especially as researchers contribute to a more sustainable world.

SEE ALSO *Research Methods: An Overview*.

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Hilary Bradbury
Peter Reason

ADHD

SEE *Attention Deficit Hyperactivity Disorder (ADHD)*.

ADOLESCENCE

Research on adolescence is over 100 years old and can be characterized by two main trends (Lerner & Steinberg, 2004). In the first 70 years or so, research was mainly confined to separate disciplines. Biologists described physical development and the changes that accompany puberty; psychologists studied cognitive development; sociologists examined how various social arenas influenced adolescents; and educational psychologists studied how adolescents' motivation differed across school and classroom settings. This research produced a detailed account of how adolescents develop. More recently, however, researchers have generated more complex understandings of youth. Instead of, for example, studying biological or social development separately, researchers are increasingly examining how different areas of life interact and affect one another.

Another trend consists of changing assumptions about adolescence. Throughout the first 70 years of research, there was a common assumption that adolescence was a time of "storm and stress" (Hall, 1904). Indeed, many believed that puberty brought an inevitable upheaval that led to antisocial attitudes and recklessness. However, since that time, these generalized assumptions have been challenged. Data suggest that for most, the transition from childhood to adulthood is relatively smooth (Arnett, 1999).

The long history of research into adolescent development has resulted in a wealth of practical implications for educators who work with adolescents and strive to provide proactive, healthy opportunities that will facilitate youth's optimal development.

DEFINITIONS OF ADOLESCENCE

Notions of adolescence are defined by biology and culture and are best understood in a social-historical context. The most longstanding definition of the onset of adolescence links it to puberty, when hormone activity produces the development of secondary sex characteristics (pubic hair and voice change in males; breast development and menarche in females). However, while these biological changes are evidence of the transition from childhood to adolescence, the transition out of adolescence is less well defined. The adage that "adolescence begins in biology and ends in culture" reflects the variable understanding of when adolescence ends. However, theories and models have emerged to explain the transition out of adolescence into early adulthood (Arnett, 2000).

Culturally, definitions of the timing and meaning of adolescence have changed over the years as expectations of youth shifted. A hundred years ago, notions of adolescence were scarcely understood, since teens did not attend high school and most assumed adult roles of providing for their family and getting married at average ages of 14 and 15. Expectations that teens assume adult roles at young ages precipitated the transition into adulthood at much earlier ages than is the case in the 21st century.

However, during the twentieth century expectations of youth began to shift in response to the demands of a changing economy. The need for a better-educated workforce, along with the child welfare movement, propelled youth out of the workforce and into high schools, thus delaying their entry into adult roles. This trend has continued into the present. Now, young people are expected to stay in school much longer, which means they spend more time with same-age peers and enter adulthood later than ever before. These shifts have influenced views of what it means to be an adolescent (e.g., Nichols & Good, 2004).

As a result of these economic and cultural shifts, the time period of adolescence has been extended to include the ages of 10 through the mid twenties, with most researchers dividing the age span into early (10-13), middle (14-17) and late (18-mid twenties) adolescent (Smetana, Campione-Barr, & Metzger, 2006). This division corresponds to American school structures, allowing analyses of development and context according to middle school, high school, and college.

ADOLESCENT DEVELOPMENT

Adolescence represents a period of significant growth. Individually, adolescents experience rapid physical growth and changes, accompanied by shifts in cognitive and emotional capacities. At the same time, the development from childhood into young adulthood brings new cultural and societal opportunities and expectations. At no other time in life do so many shifts in development and social contexts occur simultaneously.

Physical Growth and Change. Most physical growth occurs during the early and middle phases, with the onset of puberty the most characteristic feature of adolescence. The biological changes of adolescence include hormonal changes leading to growth of secondary sex characteristics, growth in height and weight, and changes in body composition (changes in bone, muscle, and fat). The onset of puberty, as marked by hormone changes, starts as early as age 8 in girls and age 9 in boys, with the development of external characteristics typically appearing a few years later. Over time, females are maturing and developing at younger and younger ages, although this is not the case for males.

Puberty-related changes in the body at earlier ages have implications for how youth cope with these changes especially for girls. Researchers have investigated how biological and social factors affect one another by looking at puberty status, which refers to the degree of physical maturation (hormone changes, breast development, voice change), and puberty timing, which refers to puberty status relative to same-age peers (Susman & Rogol, 2004). One theory that has been advanced to explain the effects of puberty timing is referred to as the Maturational Deviance Hypothesis. It suggests that adolescents who are "off time (earlier or later) in their pubertal development experience more stress than do on-time adolescents" (Susman & Rogol, 2004, p. 30). Studies reveal that youth who mature earlier or later than their same-age peers are vulnerable to at-risk outcomes such as problems with coping, antisocial behavior, and emotional distress (Brooks-Gunn, Peterson & Eichorn, 1985). Early-developing girls are especially at risk for poor body image, higher levels of depression, and substance abuse. By contrast, late-developing boys seem to be at greater risk for depressed mood, lower self-esteem or confidence, and lower achievement.

While late-maturing boys may be vulnerable to some negative outcomes, this finding is not consistent across studies. By contrast, the finding that early development is disadvantageous for girls is more consistent. Often referred to as the early-maturational or early-timing hypothesis, research studies more or less consistently show how early maturation among girls is associated with negative

outcomes. There is also data to suggest that boys too may be disadvantaged if they mature before their peers. In general, research seems to suggest that for both boys and girls, off-timing puberty may have negative effects.

Cognitive Growth and Change. Jean Piaget's theories have provided a starting point in the study of the changing nature of cognitive processing in the development from childhood to adolescence. Piaget described how adolescence brings forth the capacity to think logically and abstractly (Piaget, 1955). Since Piaget's time, researchers have sought to understand more complex questions of how processes such as memory, reasoning or problem-solving skills, and expert knowledge develop through adolescence. In short, these interrelated processes seem to develop together, which means researchers cannot determine their individual developmental paths. Instead, a review of literature on cognitive processing as a whole suggests that adolescence brings the "attainment of a more fully conscious, self-directed, and self-regulating mind" (Keating, 2004, p. 48). Thus, in contrast to children, adolescents become more aware of their surroundings and able to direct their own thinking, learning, and problem solving.

Two areas of cognitive development have received much attention: moral reasoning and changes in interpersonal perspective taking. Lawrence Kohlberg (1984) has significantly contributed to understanding of how adolescents reason in their moral decision-making. Drawing from Piaget's work, Kohlberg theorizes that the capacity to morally reason grows more complex and differentiated over time. Kohlberg argues that in general, data suggest that early adolescents typically reason according to his stage two—individualism, instrumental purpose, and exchange, but by about age 13, reasoning progresses to include mutual understandings. Thus, for a 12-year-old, being "good" is about following the rules for one's own good, whereas in stage three, the capacity to understand another person's experiences broadens notions of morality to include a concern for others and the nature of varying circumstances. In short, one's frame of reference moves from childhood moral reasoning that is based on personal perspectives or "what is right is what is good for me" to adolescent moral reasoning that is based in greater appreciation for others' perspectives and experiences or "what is right is for one may not be right for another."

Robert Selman's 2003 work on the development of perspective-taking has built on the work of Kohlberg and others to shape understanding of adolescent social and moral cognition. Selman studied the progression of perspective-taking skills, referred to as interpersonal understanding, throughout development to understand how cognitive changes in the capacity to understand someone else's perspective influences relationships. At the earlier stages in childhood, perspectives are limited to a single

view of the world with very little back and forth understanding. By level two (around early adolescence), adolescents are better able to understand that people have different perspectives. This stage is marked by reciprocity, in which what they give to others is linked to expectations of what they will receive in return. Level three is also marked by mutual understanding that is characterized by genuine giving and caring for another person without expectation for a return. Early adolescents operate consistently at level two, but as they grow older, they operate more frequently at level three.

Selman's work, along with that of Kohlberg and others (e.g., Gilligan, 1982) suggests that adolescents are cognitively different from their childhood counterparts in that adolescents have the capacity to see and understand the world as others see it. Morally and cognitively, this means that adolescents (both early and middle) are more generally prosocial in thought and action than their childhood counterparts (Eisenberg & Morris, 2004). Further, it suggests that for adolescents, fostering and maintaining relationships become more complex as the ability to imagine multiple roles for themselves and multiple perspectives of others deepens.

Social and Emotional Changes. Erik Erikson's 1950 theory of identity development has had a significant impact on the understanding of adolescent social and emotional development. According to Erikson, people's sense of who they are unfolds throughout their lives and is driven by the struggle between their "internally defined selves and those selves that are defined, confirmed, or denied by others" (Nakkula & Toshalis, 2006, p. 19). The constant negotiation between these two selves shapes who a person is and who he or she will become. There are eight stages in life during which certain struggles are primary. During adolescence, the primary struggle is over the central question of "Who am I?" Adolescents yearn to be themselves both in relation and reaction to others, and they need relationships in which experiments with identity will be embraced. The struggle to find a balance between individuation and connection drives identity experimentation and the fleeting passions that often accompany it (Nakkula & Toshalis, 2006, p. 22).

Theory on identity development was advanced by James Marcia, who proposed four identity states: foreclosure, moratorium, diffusion, and identity achieved. Each state is characterized by varying levels of exploration and commitments (Marcia, 1966). In Marcia's concept of identity achieved, a person has undergone explorations of possible selves and come to some level of commitment as a result of those explorations. Identity diffusion is the opposite. It applies to someone who has made no commitments and has not gone through any period of exploration. Identity moratorium applies to someone who is actively

experimenting or exploring but who has not yet made any commitments, whereas in foreclosure, a person has made commitments without having explored possible options.

The value of these identity status constructs is that they provide a theoretically based framework for understanding the path to healthy identity formation. At the core of these theories is the implication that struggle, experimentation, or exploration is fundamental to the acquisition of healthy identity. Further, these theories imply that the path to an achieved identity involves negotiation between the inner self and social, cultural definitions of the self. Research suggests that identity exploration is often triggered by cognitive and social shifts in which emerging understandings of how others see the world challenge previous definitions. These challenges often unfold in complex social contexts such as schools, peer groups, media environment, and families. In general, at some point, adolescents' views of who they are meet competing definitions that raise the possibility that their own beliefs may be wrong. The resulting challenges often propel teens into exploration, including the taking of risks and pushing of boundaries, in order to better understand their own and others' views of themselves.

Identity struggles emerge because of competing expectations from peers and cultural institutions of which youth are a part. This is true for a wide range of identity constructs, including gender, ethnicity, race, class, and sexual orientation. For example, researchers have long sought to understand the achievement gap between privileged, White cultures and disadvantaged, largely minority cultures. Theorists argue that the achievement gap in the United States is partly explained by a minority culture's distrust of an educational system that is largely based on European values that are perceived as perpetuating segregation and discrimination (Ladson-Billings, 1995). For teens trying to discover their true academic, ethnic, and gendered identity commitments and values, competing expectations cause a dilemma. For minority teens, school may be valued at home, but among peers, doing well in school may be viewed as "acting White" or as abiding by the rules established by another culture. The implicit accusation, that a person has "abandoned" his or her own culture in favor of someone else's, forces minority youth to examine the meaning of school and culture in their lives.

SOCIAL CONTEXTS OF DEVELOPMENT

Adolescent physical, cognitive, and emotional development occurs within social institutions, including families, friends, and schools. Therefore, understanding the nature of development necessitates understanding the social contexts in which it occurs. For adolescents, families, peers,

and schools constitute the most important cultural contexts in which development unfolds.

Parents and Families. Notions of adolescence as a time of "storm and stress" suggest that this time period will be marked by rebellion, antisocial attitudes, and conflict with parents. However, research suggests that this is the exception rather than the norm. Data reveal that between 5% and 15% of teens are antisocial and excessively rebellious of adult authority (e.g., Collins & Laursen, 2004). Therefore, in family interactions, a majority of youths proceed through adolescence in a relatively stable, healthy, prosocial fashion.

Still, parent-adolescent relationships change in certain ways during the transition from childhood to adulthood. For example, disagreements grow in number and severity throughout adolescence as teens seek out autonomy and independence from parental rules. Thus, conflicts, when they do arise, are typically about rule negotiation, with teens seeking more independence and parents struggling to know when and how to accommodate them. One meta-analysis of studies examining longitudinal patterns in parent-child conflict suggests that frequency of conflicts grows from early to mid adolescence and then tapers off in later adolescence, whereas the intensity of conflicts grows through mid adolescence and stays about the same through later adolescence (Laursen, Coy, & Collins, 1998). Data suggest that this pattern holds relatively the same for parent-child relationships in different cultures.

Peers. Research suggests that adolescent peer groups are dynamic systems that grow bigger and more important with the transition from elementary through middle and high school. Although it has been known since 1900 that a teen's peer group is important, recent research has provided a more complex picture of the role and influence of such groups. Brown (2004) comments on a few basic themes uncovered by this rich literature, pointing out that teen friendships are relatively unstable over time. It has been suggested that fewer than half of "reciprocated" best friends last more than one full year, and between one third and one half of peer groups dissolve with time (Brown, 2004). One way of studying this is through nomination procedures in which teens identify popular and well-liked kids and those who are not. These status ascriptions are relatively stable in the short term, but they often vary over the long term. Peer groups are therefore fluid systems that change over time.

Another research topic has been how adolescents manage their friendships. As a way of understanding peer-peer relationships, researchers have studied how adolescents manage conflict. In one set of studies, it was found that youth vary with respect to how they respond to aggressive acts. For example, prosocial youth are less

likely to attribute aggression to intentional hostility and are more likely to seek out reconciliation than youth who are characterized as withdrawn or rejected.

Bullying has also received increased attention over the years in the wake of incidents such as the shootings at Columbine High School, Colorado, in 1999. A national survey of youth in grades 6–10 reveals that approximately 29% of students report being involved in bullying (as the bully, victim, or both), and that 13% report engaging in moderate or frequent bullying of others (Nansel et al., 2001). Further, bullying more often occurs in grades 6 through 8, with males as the bully and/or victim more often than females. Males are typically more involved in physical bullying whereas females are often more involved in indirect, relational bullying, such as gossip, rumors, and exclusion. The consequences of bullying can be significant because victims often are lonely, depressed, and have low self-esteem. By contrast, students who are infrequently bullied tend to be more strongly bonded to the school and invested in prosocial behaviors and beliefs (Cunningham, 2007).

SCHOOL CONTEXTS: IMPLICATIONS FOR TEACHERS

One consistent theme throughout the literature on adolescence is the notion of “struggle” or “exploration.” The concomitant emergence of cognitive changes, identity conflicts, and changing role expectations as adolescents progress through school requires that they have open, safe places in which to test, explore, and discover for themselves their identities. For cognitive development, this requires having opportunities to form understandings about right and wrong. For emotional development, it means having safe environments for testing identities in multiple contexts (e.g., in peer groups, through school-based and after-school activities). For social development, it means exploring role definitions through interactions with friends, peer groups, and adult role models and mentors. Teachers can help youth manage these learning experiences through active listening, authoritative management styles, and by helping youth feel like they belong and have safe places in which to explore. This is especially important for middle school contexts in which young adolescents are especially vulnerable to disengagement from school (Eccles, 2004).

The Search Institute has summarized developmental assets for positive youth development that offer ideas for helping youth achieve their potential. These include four external and four internal assets. External assets include (a) having supportive, positive fulfilling relationships with members of one’s communities (schools, families, friends); (b) empowerment (being perceived positively by members of the community); (c) knowing clearly what

family and school expects, (d) a community that provides a safe place with rich opportunities for exploration. Internal assets include (a) being committed to learning, (b) positive values for making good choices, (c) social competencies to engage in familiar and new situations, and (d) positive self concept (Scales & Leffert, 2004). Using these developmental assets as a guide, teachers can assist youth by arranging environments that foster external assets and engaging in relationships that facilitate internal assets.

Teachers play a significant role in the lives of adolescents, and knowledge of adolescence equips them to be sensitive to the diversity in youth’s experiences and the competing forces in their lives. Armed with this knowledge, teachers can offer safe spaces for youth to explore and test their emerging ideas of who they are and who they want to become.

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Sharon L. Nichols

AGGRESSION

The psychological literature generally concurs that human aggression is any behavior intended to harm another living being who is motivated to avoid such behavior. Aggressive behavior can be physical, verbal, or relational; implies action or the threat of action; and can be characterized as either direct or indirect. Physical and verbal aggression, as their names suggest, describe physical harm or insults or threat of such actions. Relational aggression, by contrast, refers to behaviors that cause emotional harm by manipulating or damaging a victim's relationships with his or her peers or by injuring one's feelings of group acceptance (Dodge, Coie, & Lynam, 2006). Both physical and verbal aggression can be direct (e.g., a physical assault or a derogatory remark) or indirect (e.g., destroying another's prized possession or insulting a victim behind his or her

back). Some, but not all research (see Bushman & Anderson, 2004) further distinguishes two types of aggression by the motives underlying the behavior. Proactive or instrumental aggression is a means to another end; the harm is directed toward attaining objects, privileges, or similar self-serving ends. Reactive, retaliatory, or hostile aggression is behavior motivated to harm another that is displayed in anger as a response to a perceived threat or provocation (Dodge, Coie, & Lynam, 2006).

THEORIES OF AGGRESSION

Aggression in childhood and adolescence has typically been framed in one of a few prominent theories. Social learning theory (Bandura, 1973) is one of the earliest and most enduring theories of aggression that influenced thinking on children's aggressive behavior. Bandura theorized that children learned aggression by observing the behavior and the consequences of that behavior for others, a proposition made famous through the various "Bobo" studies that demonstrated the power of both live and filmed models to influence children to enthusiastically hit a Bobo doll. Closely related to modeling, this theory asserts that children who are positively reinforced or who observe others being positively reinforced for aggression are much more likely to persist in this behavior. Models provided through the mass media extend the power of observational learning far beyond the child's immediate environment. Importantly, media models are typically reinforced for aggression (Wilson et al., 2002), making them extremely powerful according to social learning theory.

Other recent theories have implicated family process in the development of aggression in childhood. Chief among them is coercion theory (Patterson, 2002), which postulates that the development of aggression is largely explained by coercive family processes in which parents and children mutually train one another's behavior. Children aggress, parents demand compliance, children escalate their aversive behavior, and parents escalate their demands but ultimately yield to the child's behavior, tacitly reinforcing children's aggressive behavior and perhaps modeling aggression in the process.

Social information processing theory (Dodge, Coie, & Lynam, 2006) has been another generative model for the study of childhood aggression. Dodge (1986) originally developed a model of information processing that identified a hostile attributional bias as a foundation for the display of children's angry or reactive aggression in social situations. His five-step model posited that children first encode and then interpret cues; highly aggressive youth may presume hostility from peers and selectively attend to cues that support that hostile attributional bias. The next steps include access or construction of a

response, selecting a response, and enacting that response; for aggressive children with a hostile attributional bias, that response is most often aggressive. A further elaboration included an additional intermediate step of selecting a goal or preferred outcome of a response. As well, reciprocal effects between the child and the child's social environment (e.g., peer influences and reactions) and existing cognitive structures (e.g., memory stores, social schemas) that the child brings to the situation, were incorporated into the model.

The addition of constructs from social psychology (e.g., schemas) foregrounded linkages between this and another social information processing model of childhood aggression (Huesmann, 1988) that has influenced the study of media effects and aggression. Huesmann and colleagues argued that a child acquires aggressive scripts through observational learning (in both the proximal environment and the media) and perceived reinforcement of aggressive behavior. The accumulation and subsequent networking of multiple aggressive scripts into cognitive schemas results in social behavior that emphasizes aggression. Normative beliefs, or cognitions about what is right for the self, are also key cognitive structures in the Huesmann model. Aggressive children are presumed to have a greater store of aggressive scripts as well as normative beliefs that condone more aggression.

These information processing theories have been blended into a unified model (Huesmann, 1988) that highlights four decision points. A youth first perceives danger from the environment and next searches for and retrieves scripts from memory that are relevant to the situation. The youth then evaluates scripts stored in memory to decide what actions are acceptable, what actions lead to the most desired goal, and which actions are actually feasible. Finally, the youth evaluates the expected responses to any action. An aggressive child will selectively perceive cues and inappropriately attribute hostility when none exists. That child will also have a larger store of aggressive scripts from which to select and a greater propensity to positively evaluate aggressive scripts. This combination typically leads to a display of aggression.

The most comprehensive of the developmental theories of aggression, the biopsychosocial model (Dodge, Coie, & Lynam, 2006) is a transactional developmental model that incorporates biological dispositions; sociocultural contexts; and experiences with parents, peers, and social institutions. This model proposes that genetic bases and prenatal insults; life experiences that involve harsh treatment, rejection, and failure; family experiences that include poverty, neighborhood and family instability, harsh discipline, and limited parental education; and excessive early exposure to media violence all unfold in a transactional relationship during the child's develop-

ment. Many of these factors also represent negative social experiences that can lead to dysfunctional patterns of social information processing, and these information processing patterns link the broad life experiences to the individual display of aggression. This comprehensive model most effectively demonstrates the multiple points of convergence (e.g., observational learning, social information processing, reinforcement) in all of the major theories of aggression in childhood and adolescence.

MEASURES OF AGGRESSION

One common measurement strategy is checklists or rating scales that are completed by any combination of teachers, parents, and the child. A typical instrument widely used in research, schools, and clinical practice is the Achenbach Child Behavior Checklist, a scale with separate forms for parents (CBCL), teachers (TRF), and students (YSR). Scores on the multiple forms can be compiled to examine distinct problem areas across informants, including aggression and delinquent behavior. Other multiple informant rating scales for aggression in childhood and adolescence include the Social Skills Rating System, the Eyberg Child Behavior Inventory and Sutter-Eyberg Student Behavior Inventory, and the Behavioral Assessment Scale for Children (Buros Institute, 2007).

Direct behavioral observation, often described as naturalistic observation, is considered by some (Hudley, 2006) to be the most effective strategy for assessing aggression in childhood and adolescence. Behavior does not occur in a vacuum, and direct observations are able to capture the interactive environment in which the behavior exists, including the antecedent conditions and the consequences that elicit and maintain aggressive behavior. Naturalistic observations include recording behaviors in their natural setting and a descriptive coding system that requires a minimum of inference from observers and coders. Observational codes can measure behavior in several ways. Event recording simply tallies the frequency of a given behavior during the observation period. Interval recording similarly captures frequency, but divides the observation period into segments and counts the number of segments in which the target behavior is displayed, either throughout the interval or at a particular time point in the interval. Duration recording measures the length time a behavior lasts. Functional behavior assessment, an observational strategy, assesses antecedents, frequency, duration, and consequences of the aggressive behavior for the target child and others in the environment to determine the functions that the aggressive behavior serves for the child. In spite of obvious benefits of direct observation, the strategy can be limited by several problems (Hudley, 2006). Behaviors must be clearly defined, and observers must be trained to fully

understand the exact behaviors that are to be captured. Observer bias or the tendency to see what one expects to see is especially troublesome in direct observation of aggression. In addition, particularly with adolescents, participant reactivity to the presence of observers can change or eliminate the exact behaviors that are the target of the observation. Finally, in school settings direct observations can be labor intensive and exceed the resources that are available on site.

Sociometric assessments continue to be used widely in research on childhood aggression, although their use in educational and clinical practice has declined dramatically (Hutton, Dubes, & Muir, 1992). The most common sociometric strategies involve children providing assessments of peers in school. These strategies have demonstrated substantial predictive validity for future negative outcomes. Peer nomination assessments typically ask students to nominate classmates or students in their grade who fit certain characteristics (e.g., starts fights), students they prefer (like most), or reject (like least) (see Hudley & Graham, 1993). The Class Play (Masten, Morrison, & Pelligrini, 1985), a variant of peer nomination techniques, directs children to cast their classmates in a variety of roles, either positive or negative, in a hypothetical play that the class will perform. In contrast, peer-rating procedures allow each child to rate every other student in the class on specified characteristics, preferences, or rejection. For young children, responses can be recorded with a series of faces rather than a numerical rating scale. Ethical concerns surrounding children expressing negative opinions about their peers have been raised, but no harmful reactions from participation in sociometric procedures have been documented (Iverson & Iverson, 1996).

DEVELOPMENTAL CHANGE IN AGGRESSION ACROSS CHILDHOOD AND ADOLESCENCE

Physical aggression in childhood is a relatively stable phenomenon. Highly aggressive boys and girls in middle childhood often continue to be aggressive in adolescence and adulthood, although the links between early and later behavior may not be as strong for girls as they are for boys (Dodge, Coie, & Lynam, 2006). Certainly not all highly aggressive children are aggressive and violent as they grow older, but such children are overrepresented in the population of aggressive and violent adolescents and adults. For example, longitudinal research has found that children at age 8 who were rated by their peers as highly aggressive self-reported high rates of aggression at age 18 and physical aggression toward spouses and children at age 30. Most troubling, those who were parents by age 30 reported high aggression for their children (Huesmann, Eron, Lefkowitz, & Walder, 1984).

From early infancy to the early school years, children's aggression is typically expressed through temper tantrums and direct physical means (hitting, pulling, pushing, etc.). In the general population, simple displays of direct aggression peak between 2 and 3 years of age and then decline, largely due to children's developing social and cognitive abilities. However, some children remain aggressive through adolescence and beyond, and the form of their aggressive behavior changes across development. These children may show any combination of increasingly dysfunctional social cognitions, increasing aggression in interpersonal situations, and steady declines in prosocial behavior (Dodge, Coie, & Lynam, 2006). As well, children shift the site of their behaviors from early childhood through adolescence, as increasing age allows them to spend more time in the community and less time under direct adult supervision. As the setting for behavior changes, new forms of behavior may emerge; the 8 year old who fights at school may engage in physical mugging at 17. Finally, the intensity or force of aggression also changes over time for some aggressive children, in a trajectory that moves from simple hitting and pushing in early childhood to physical assaults with deadly objects in late adolescence and early adulthood.

OUTCOMES FOR HIGHLY PHYSICALLY AGGRESSIVE CHILDREN

Childhood aggression carries a host of negative developmental consequences that persist and accumulate over time, including delinquency and criminality, peer rejection, poor school adjustment, and mental health concerns. Although highly, overtly aggressive elementary age children are often rejected by their peers, not all aggressive children are rejected; those most likely to be rejected are socially incompetent and retaliate aggressively at times when peers find the behavior unwarranted and in violation of peer norms. Children and adolescents who are both rejected and aggressive in elementary school experience significantly higher rates of self reported depression and lower rates of peer rated friendship than their average peers. Aggressive children therefore may find themselves part of a deviant peer group composed of other, similar children who reinforce aggression, delinquency, and other behaviors (Dodge, Coie, & Lynam, 2006).

Another robust consequence of early aggressive behavior is adolescent delinquency and adult criminality, particularly among men. Longitudinal data find that men convicted of a violent crime by age 30 were more than three times as likely to have been rated by teachers and parents as highly aggressive in childhood or early adolescence than a comparison group of men who were not convicted of such crimes (Loeber et al., 2005). Highly aggressive students are also perceived as generally less

academically successful, more behaviorally disruptive, and less motivated in class (e.g., off task, not doing homework) in comparison to their nonaggressive peers (Cairns, Cairns, & Neckerman, 1989). Finally, high levels of aggression have been cited as among the primary reasons that children and adolescents are referred to mental health services (Dodge, Coie, & Lynam, 2006).

SCHOOL AND FAMILY BASED INTERVENTION

Because cognitive mediators have been firmly linked to children's aggressive behavior, school based programs have often focused on cognitive-behavioral interventions. Cognitive-behavioral strategies address specific cognitive distortions that cause the display of aggression. One such program, the BrainPower Program (Hudley, 2003; Hudley et al., 1998), modifies attributional bias that supports childhood aggression, as described earlier. This program teaches aggressive children to recognize that negative social outcomes with peers may sometimes be caused by accidental rather than intentionally hostile causes. Students are taught to effectively search for social cues, initially attribute ambiguous negative outcomes to accidental causes, and develop less verbally and physically aggressive behavioral responses.

However, given the overwhelming evidence that multiple interpersonal processes regulate childhood aggression (Dodge, Coie, & Lynam, 2006), aggression reduction programs are most effective as one part of a comprehensive intervention to support the healthy development of children, families, and communities. One example of many such programs, Families and Schools Together (FAST) (McDonald & Sayger, 1998), incorporates the full range of relationships and settings impacted by youths' antisocial behavior. FAST builds, sustains, and enhances relationships between youth and their families, peers, teachers, and other community members. FAST brings a group of families from the same community together for weekly activities and two years of monthly school-community meetings to facilitate the development of mutual support networks in the community and the school.

Classrooms with lax and inconsistent discipline and schools that do not address problems of aggression and bullying see more physical aggression among students (Osher et al., 2004). Witnessing aggression (e.g., fighting, bullying, weapons) in school increases physically aggressive behavior, more so for girls than for boys (O'Keefe, 1997). However, zero tolerance discipline policies for physically aggressive behavior reduce attendance, motivation, and engagement in school among those students who do not run afoul of the policy. These negative policies typically do not reduce physical fighting in schools and actually promote aggression and youth violence in the community by

expelling children who need the structure and education provided by school. The overall goal for schools must be the two-sided process of reducing aggressive behavior and promoting a peaceful, positive climate, and that responsibility can be shared by students and adults alike. School groups organized specifically to promote non-violence often benefit from improved school climate and reduced levels of aggressive, antisocial behavior, including bullying, fighting, and teasing (Office of Elementary and Secondary Education, 2002).

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Cynthia Hudley

ALEXANDER, PATRICIA A.
1947-

Patricia A. Alexander was born in Washington, DC, on October 28, 1947, to a first-generation Italian immigrant mother and a father who came to the city from the Virginia Mountains as a result of the World War II draft. Alexander's life is one of classic blue-collar America. She attended a Catholic primary school where she struggled in basic subjects like reading and writing. Upon occasion Alexander has recounted a story of the day that she realized that all of her second-grade peers could read words that she had no idea how to understand. That day she decided that learning to read and write was going to require a great deal of hard work. Despite these early struggles, Alexander went on to graduate from Hammond High School, Alexandria, Virginia, in 1966, and was the first member of her family to attend college.

In 1970, she graduated from Bethel College, McKenzie, Tennessee, with a degree in elementary education. Following her degree, Alexander worked for nine years as a middle school language arts and science teacher primarily in rural Virginia in the Shenandoah County Public Schools (SCPS). In her final three years with the SCPS,

she was given the opportunity to teach students with exceptionalities reading and mathematics in a laboratory setting. This experience was fundamental in Alexander's career as it turned her attention to the issue of individual differences in children and ways that educators could foster positive academic growth for all learners. Following this experience, she enrolled in James Madison University, Harrisonburg, Virginia, where in 1979 she obtained a Masters of Education degree in reading/elementary and early childhood education. In 1981 she received her Doctorate in Philosophy in reading from the University of Maryland, College Park, Maryland. Alexander accepted her first faculty position as an assistant professor of educational curriculum and instruction at Texas A&M University in 1981. Less than a decade later she was a full professor with a joint appointment in educational psychology and educational curriculum and instruction at Texas A&M University, and in 1995 she returned to the University of Maryland at College Park as professor of human development and convener of the educational psychology specialization. In 2000 she was named Distinguished Scholar-Teacher in Human Development at the University of Maryland in recognition of her outstanding research and teaching.

MAJOR CONTRIBUTIONS TO EDUCATIONAL PSYCHOLOGY

Alexander has made seminal contributions to many areas of learning and instruction. Among her notable contributions are her research on the role of strategic processing and analogical reasoning in reading comprehension and problem solving (e.g., Alexander, Willson, White, & Fuqua, 1987), explorations on interest in student learning (e.g., Alexander, Kulikowich, & Schulze, 1994), and investigations regarding the powerful influence of knowledge and beliefs in the acquisition of domain-specific expertise (e.g., Alexander, Murphy, & Kulikowich, 1998; Alexander, Schallert, & Hare, 1991; Garner & Alexander, 1994). Perhaps her most noteworthy contribution, however, is the *model of domain learning* (MDL) (Alexander, 1997). The MDL depicts the journey toward expertise in a domain in terms of select cognitive and affective components (i.e., subject-matter knowledge, learner interest, and general strategic processing) in a way that was groundbreaking in the field of educational psychology.

These components are positioned within a framework that addresses both stages (i.e., long-term characterizations) and phases (i.e., recurrent, iterative aspects) of domain learning. The stages predicted in the MDL are essentially non-regressive and non-recursive and aligned with the experiences, schooling, and work that tend to be age-associated. While the stages are meant to depict step-like changes in domain learning trajectories, the phases are intended to capture the fluidity within the learning process. It is the recurring patterns emerging from the phases that give rise to the profiles indicative of a particular stage of domain learning. The MDL entails three stages: *acclimation*, *competence*, and *proficiency/expertise*. Woven through these three stages are the critical forces of subject-matter knowledge, interest, and strategic processing that serve as catalysts for structuring and restructuring within and across each stage. Thus, it is the configuration of these components that bridges the stages and gives them identifiable characteristics.

Acclimation, the initial stage of development toward expertise, represents that point when individuals are confronted with a domain for which they possess little relevant knowledge, interest, or strategies. Overall, individuals in the acclimation stage demonstrate limited and fragmented knowledge of the subject, rely heavily on surface-level strategies, and report relatively higher levels of situational interest than individual interest.

A number of changes take place during the phases of acclimation on the road to competence. Specifically, the indicators of competence within a domain include a distinct increase in the breadth and depth of subject-matter knowledge, a deeper personal investment in the domain combined with decreased reliance on situationally interest-

ing conditions, and finally a willingness to exert the effort necessary to employ deep-level processing strategies.

The change from competence to proficiency requires a synergy among subject-matter knowledge, interest, and strategic processing. Those individuals fortunate enough to achieve proficiency in a domain are distinguishable from competent learners in several ways. First, the subject-matter knowledge of an expert becomes increasingly dense and cohesive, and proficient learners actually generate knowledge. In addition, individual interest and knowledge combine as a unified force. Finally, they may experience a slight rise in deeper strategic processing due to the knowledge generation and solving of novel domain problems, and a concomitant decrease in surface-level strategies.

Through her pioneering work, Alexander has given researchers and educators new ways to envision individual differences in student learning within a domain. Essentially, the MDL lays out a developmental trajectory of expertise; that is, a road map to proficiency. In addition, the domain-specific nature of the model lends versatility to its application in diverse settings such as those commonly found in schools and the workplace. This is so much the case that the MDL has become foundational in programs designed to train the teacher leaders of tomorrow such as the KEYS initiative (Hawley & Rollie, 2002). In the end, Alexander's MDL exemplifies the 1930 admonition of John Dewey (1859-1952) "No act can be understood apart from the series to which it belongs" (p. 412). The MDL calls on researchers and educators alike to think more deeply about learning and individual differences in developmental and multidimensional ways.

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P. Karen Murphy

ANALOGY

Analogical thinking lies at the core of human cognition and is a key component for a multitude of functions such as problem solving, reasoning, and discovery and learning. It has been argued that the very act of forming an analogy requires a kind of “mental leap,” inasmuch as it necessitates seeing one thing as if it were another (Holyoak & Thagard, 1995). Many scientific discoveries frequently rely on these mental leaps, and analogy forms the basis for our everyday problem solving, from the simplest instance to the most sophisticated reasoning strategy. Analogical reasoning has been classified into two common types: classic analogy and analogical problem solving. Both types of analogical reasoning involve analogical mapping, a central process of discovering which elements in the target correspond to specific elements in the source and aligning them together.

CLASSIC ANALOGY AND ANALOGICAL PROBLEM SOLVING

Classic analogy usually applies knowledge from a set of familiar elements (the relation of A to B) to relations about yet unknown elements (the relation of C to D) (Sternberg, 1977). Classic analogical problems are states $A:B::C:?$ For example, *dog* is to *puppy* as *cat* is to ? The answer is *kitten*. By knowing the relation between the first two elements (a *puppy* is a baby *dog*), one can use that knowledge to complete the analogy for a new item (*cat*). Because analogies are based on similarities, one must understand the relational similarity between dogs and cats and puppies and kittens in order to solve the analogical problem above.

Analogical problem solving, the second type of analogical reasoning, consists of a source case (which is generally already understood to some extent) and a target case (about which new knowledge is desired), and a relation that maps these elements from one case to the other. The analogical problem is considered solved when individuals can successfully transfer their knowledge from the source set and apply it correctly to the target set. A classic study by Gick and Holyoak had the participants attempting to solve the “tumor” problem. They were presented with a situation in which a doctor was trying to save his patient’s life by eradicating a stomach tumor. The participants needed to advise the doctor on the kind of ray that at sufficiently high intensity can destroy the tumor but not harm the surrounding healthy tissue. The solution was to

aim multiple low-intensity rays at the tumor from many angles; the rays would “meet” at the site of the tumor and their “sum” would equal the full strength of the ray. Gick and Holyoak found that the problem was quite difficult to solve. To determine whether participants could transfer a solution from an analogous problem to the tumor problem, they had participants first read an analogous story about the “general and a fortress” in which the general had to divide his troops into many small groups and attack the fortress from different directions. Having an analogous story in structure (source set) prior to reading the target problem allowed the participants to transfer their previous knowledge and correctly solve the analogy. However, most participants required a hint before they noticed that the solution “general and a fortress” problem could be applied to the “tumor” problem.

The analogy helps learners make connections between the pre-existing source knowledge and the new target. It has also been suggested that analogies facilitate abstraction from individual cases to general schemata (Gick & Holyoak, 1983) or help the learner generate new inferences about the target. Studies have shown that analogies can support productive conceptual change when neither the target nor the source are well understood; knowledge of each can be enriched through a process of “bootstrapping” (Kurtz, Miao, & Gentner, 2001). Investigations have demonstrated how analogies are used in non-experimental settings such as political debates (Blanchette & Dunbar, 2001), as well as in more naturalistic settings, such as scientific laboratory meetings. Although analogical transfer is an important component in human thinking and reasoning, lab studies do not always demonstrate effective use of analogies in solving problems. Some studies indicate that in lab scenarios in which participants typically use source information to solve problems superficially similar to the source, scientists often use structural features and higher-order relations in making the analogy during the discovery process.

COMPONENTS AND PROCESSES INVOLVED IN ANALOGICAL REASONING

Analogical problem solving can be functionally divided into multiple processes. The first component involves representing the source information. Studies have demonstrated that individuals’ ways of encoding source analogues and the characteristics and quality of the representations influence subsequent transfer. For example, children who formed a goal structure of a source problem (e.g., goal of the main character; obstacle; and action to overcome obstacle and achieve goal) transferred more readily than those who encoded only specific details (e.g., Brown, 1989). Differences in breadth of learning are related to differences in the depth of initial learning, and this more

“robust learning” partially explains the better retention and wider generalization evident in subsequent transfer.

The second component is perceiving the analogical relationship, and a major obstacle to transfer is the failure to access spontaneously a source analogue. Informing problem solvers about the potential usefulness of source analogues, increasing the superficial similarities between tasks, and encouraging solvers to extract a more abstract principle from the source analogues have proved useful in improving the accessing process (Gentner & Rattermann, 1991).

Once a source analogue has been retrieved, the correspondences between the problems’ key elements need to be mapped. The mapping process is guided by the common relational structures between analogous tasks, and perceiving these underlying structures presents a great challenge to successful transfer, often not only for young children but also for some adults. It is important to note that the difficulty in analogical transfer is not simply a developmental problem, but in various contexts may pose difficulty for all learners. Accessing an analogue and mapping relations do not ensure successful implementation of a solution. The last component involves executing an acquired strategy or principle. When the source and target problems share only a solution principle but differ in specific procedures, children might experience an obstacle in executing a source solution, despite the availability of the strategy (e.g., Ross, 1989). Experiencing diverse procedures illustrating a solution principle facilitates the extraction of a strategy, which is not embedded in a specific procedure, and its flexible and effective generalization to relevant problems.

The conceptual model concerning transfer processes and the age differences associated with each component addresses the observation that children in particular often experience difficulty with analogical transfer. This model also addresses questions of why some analogues are more difficult to use in problem solving than others and helps pinpoint how people at different age levels differ in solving analogous tasks, and how various factors influence transfer performance.

THEORIES OF ANALOGICAL REASONING

While it is well documented that analogical reasoning is a sophisticated conceptual process that is central to everyday thinking and learning, many underlying mechanisms that support the development of analogical reasoning are not yet well understood. Previously established theoretical accounts of analogy have two important processes: *relational processes*, which establish correspondences based on similar relations among the objects in the two problems, and *object-matching processes*, which create correspondences based on the similarity of an object in the

target problem to one in the source problem. However, research has shown existing evidence of consistent developmental differences in drawing analogies, and efficiency in analogical problem solving has been offered as a sensitive index of age-related differences. Younger children are more prejudiced by surface features than by structural or deeper causal properties and they are more dependent on hints pointing to the relations between problems. With age and experience, an expanding knowledge base, and increasing mental resources, children become more effective in perceiving deep relations or causal structures. Theorists have put forth three major hypotheses to account for age-related differences in analogical reasoning.

The first hypothesis is *increased domain knowledge*. In the late 1970s Piagetian studies suggested that young children are unable to reason analogically prior to achieving formal operations at approximately 13 or 14 years of age. Goswami and Brown have greatly disagreed with that claim and proposed in their 1989 study a “relational primacy hypothesis,” arguing that analogical reasoning is fundamentally available as a capacity from early infancy but that children’s analogical performance increases with age due to the accumulation of knowledge about relevant relations. While Piaget’s tasks frequently involved uncommon tasks (e.g., a “steering mechanism”) which were likely unfamiliar to youngsters, Goswami presented analogical reasoning tasks that were more relevant to children as young as 3 years old, who in turn, demonstrated knowledge about those relations. That said, having knowledge about relevant relations still cannot fully account for age-related effects in young children’s performance on analogical reasoning tasks since children still seem to fail on analogies in systematic ways even when they possess relational knowledge relevant to the task.

The second hypothesis, an alternative explanation of young children’s observed age-related increase in analogical reasoning performance, is *relational shift*. In a 1991 study, Gentner and Rattermann suggested that children primarily begin to attend to feature similarity between objects and will reason on the basis of perceptual features rather than on the basis of relational similarity. Following a relational shift, or a fundamental maturational change in their thinking, children can and will reason on the basis of relational features. Developmental literature has shown support for this hypothesis, demonstrating the interrelations between young children’s processing of object similarity and their processing of relational similarity.

A third explanation for developmental changes in analogical reasoning shows the limits on children’s working memory capacity that affect their ability to process multiple relations simultaneously. In a 2002 study Andrews and Halford defined *relational complexity* in terms of the number of sources of variation that are

related and must be processed in parallel. In a binary relation in which “a dog chases a cat,” the chase itself is a single relation, while the interaction between the dog and the cat become the arguments or the second relation. A child would need to hold both arguments, dog and cat, as well as the relevant relation in mind to reason on the basis of this relation. Andrews and Halford argued that for a developmental continuum in children’s working memory capacity, children can process binary relations (a relation between two objects) after 2 years of age and can go on to process ternary relations (a relation between three objects) after 5 years of age. Age deepens children’s development of executive functions, particularly the ability to reflect on the relation between two rules. Cognitive maturation also allows children to efficiently solve analogical problems with higher levels of complexity once they have an increased control over their thoughts and actions.

THE ROLE OF ANALOGY IN COMPREHENSION, TRANSFER, AND DEVELOPMENT

Whether and how children retrieve relevant information and use examples acquired in the past to solve analogous problems is a fundamental issue in the study of cognitive development. Experimental investigations of analogical transfer can be traced back to the beginning of the 20th century (e.g., Thorndike & Woodworth, 1901); however, the centrality of transfer to children’s thinking and learning still remains a rather peripheral aspect in developmental psychology.

In broad terms, analogical thinking involves metaphor comprehension (e.g., Gentner & Markman, 1997), similarity and relational mapping (Markman & Gentner, 2002), classical analogy (Goswami & Brown, 1989), and problem solving by analogy (Brown, 1989). The transfer of strategies from familiar situations to novel problems reflects how deeply children acquire strategies, how broadly they generalize them to different situations, and how flexibly they think and reason. Strategy generalization is one of five critical dimensions of strategic change in children’s thinking (Siegler, 2000) and is an ultimate measure of children’s learning.

While traditional Piagetian accounts of analogical reasoning suggested that it is an ability that develops later in life, early competencies in solving analogical problems were demonstrated with infants as young as 10 to 12 months. The infants first observed their parent solving a problem and then were able to transfer the strategy themselves to a new problem, which shared the same underlying structure but differed in superficial features.

Substantial evidence further demonstrates that preschool children who observed an experimenter demonstrating with an appropriate tool (a rake that was both

long enough to reach the toy and had a functional head with which to pull the toy closer) transferred more effectively than did those who received only a hint about using the tool. Specifically, these children were increasingly likely to choose a tool that was similar in causal function to the source tool (e.g., a long cane) instead of tools sharing only perceptual similarities (e.g., a rake head without a handle or a handle without an effective head). Receiving a hint still proved somewhat helpful; children offered a hint outperformed those who received neither demonstration nor hint. These findings reveal that from a very early age children not only have a rudimentary ability to analogize in problem solving but that help provided by the adult allows the children to move beyond simply understanding analogies based on perceptual similarity and conceptualize them based on their causal function.

With the emergence of evidence that outlines the consistent developmental differences, it is well known that younger children are more prejudiced by surface features than by structural or deeper causal properties, and they are more dependent on hints pointing to the relations between problems. By providing direct instruction in the original learning situation teachers facilitate an effective way of subsequent transfer of strategies. Children’s strategy transfer also benefits from specific probing questions that encourage self-explanations that give the children the opportunity to explain both the reasoning behind their strategy choices as well as the conclusions they drew from their design (Siegler, 2000). Children’s superior performance in learning and transferring in such a probe condition suggests that direct instruction and asking children to generate self-explanations enhances learning and transfer.

INSTRUCTIONAL USES OF ANALOGIES

There are numerous research findings in support of analogy-enhanced teaching and learning. The widespread use of analogies as explanatory tools in introducing new concepts occurs across various disciplines in middle schools, high schools, and colleges. This has proved a reliable method of teaching in many countries worldwide.

Analogies, models, and modelling have been recognized as key tools for scientists, science teachers, and science learners. The familiar situation base or source analogue provides a kind of model for making inferences about the unfamiliar situation or the target analogue. By finding a structural alignment between a novel situation and the familiar situation learners are able to bring new ideas or concepts closer to their understanding and achieve eventual mastery.

Classroom-based research demonstrates that the use of models and analogies within the pedagogy of science education may provide an effective understanding of the

nature of science. Studies show that in order successfully to develop conceptual understanding in science, learners need to be able to reflect on and discuss their understanding of scientific concepts as they are developing them. Furthermore, it has been found that pedagogies that involve various types of modelling are most effective when students are able to construct and critique their own and scientists' models. Research also suggests that group work and peer discussion are important ways of enhancing students' cognitive and metacognitive thinking skills. Lastly, understanding of science models, analogies, and the modelling process enables students to develop an awareness of scientific knowledge, as well as providing the tools to reflect on their own scientific understanding.

A vast body of research shows the importance of analogy use in math learning. Novice learners have great difficulty spontaneously noticing the similarity between two problems or instances that embody the same principle but have a different form (e.g., Gick & Holyoak, 1983). For example, a novice learner who correctly solves one math problem will have difficulty noticing that a second problem has the same conceptual structure if its form is changed into a word problem, if it is written in an alternate way, or if semantic cues in the problem invoke different background knowledge. Since analogical reasoning follows a series of specific steps that can lead to deep processing of novel information, yielding the capacity to learn and transfer knowledge to unfamiliar targets, the application to learning mathematics is especially relevant.

Mathematics is characterized by abstract structure in which underlying relationships remain the same but the object slots can be filled in various ways. Noticing higher-order similarity relationships between such instances of structural similarity is at the core of complex mathematical thinking. For instance, students may not at first notice the similarity between addition of numbers and addition of variables because variables are different at the surface level. However, with assistance or an increase of expertise, they could generate an analogy between these objects and use what they know about addition of numbers to inform their reasoning about addition involving variables. This simple case illustrates the power of analogy in enabling reasoners to apply information from one mathematical topic to other topics that are structurally similar.

In a 2004 study conducted in eighth-grade mathematics classrooms, Richland, Holyoak, and Stigler discovered that teachers used verbal analogies on a regular basis. When explaining a problem, non-math sources were used almost exclusively when instructors were developing analogies to teach mathematical concepts and when using analogies for socialization purposes. Conversely, when explaining mathematical procedures, teachers were most likely to use non-contextualized math

problems. These findings suggest that teachers were explicitly or implicitly tailoring their analogy production to the cognitive needs of students. When students were showing difficulty, teachers generated sources and targets with higher surface similarity, thus making analogy more transparent for learners.

In summary, the use of analogies for instruction, whether initiated by text, by the teacher, or by the students themselves, has been shown to improve conceptual learning. Studies show that analogies presented to students in a school setting, usually via instructional materials or teachers' spontaneous use, promote flexible conceptual learning and problem solving. Analogy allows students to use commonalities of one subject to help understand novel problems or concepts either within a single domain (e.g., physics concept of water pressure confined to a tower) or apply it to a vastly different area of knowledge across domains (e.g. using the water-tower analogy for understanding the cardiovascular system), thereby contributing to integral components of overall cognitive proficiency. Scientific research has increasingly placed analogical reasoning in the foreground, giving further support to notion that reasoning by analogy may indeed be the main engine of inventive thinking.

SEE ALSO *Providing Explanations.*

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ANCHORED INSTRUCTION

Anchored instruction is a teaching approach that situates, or anchors, problems in authentic-like contexts that people can explore to find plausible solutions. Anchored instruction in education is closely related to problem-based and case-based learning in other fields (e.g., business, medicine), but it differs somewhat because all the information for solving anchored problems is available whereas it may not be in actual problem solving situations. Anchors are typically shown in a short video (8-to-12 minutes), which students search to find information they need for solving the embedded problems. In a typical classroom using anchored instruction, students work together to formulate strategies for solving the subproblems embedded in the anchor. The problems are of high interest, and most students work for several days to help the main characters in the video solve the problems.

Presenting anchored problems in video format has several advantages. One important quality of an anchored problem is its ability to directly immerse students in a rich array of problem contexts, which helps to eliminate the barriers many students with low achievement in both math and reading confront when attempting typical text-based problems. Second, the dynamic nature of video enables students to notice subtleties in the mix of auditory and visual cues, which are missing in text-based problems. Finally, multimedia scaffolds enable students to access help stations as they work on generating solutions they think are plausible.

Theoretical underpinnings of anchored instruction are derived from well-known theorists such as John

Dewey (1933) who stressed the importance of viewing knowledge as tools. When people (students) acquire new knowledge that they understand can help them solve problems in particular contexts, they view knowledge more as a tool than as disconnected facts and procedures. The role that context plays in helping students recognize how and when to use these tools (i.e., transfer) is one of the key components of anchored instruction. The importance of context on cognition has been termed "situated cognition" (e.g., Brown, Collins, & Duguid, 1989) and "cognitive apprenticeship" (e.g., Collins, Brown, & Newman, 1989). Contextual factors in everyday problem solving have been shown to affect learning situation-specific practices and their transfer among people across cultures (e.g., Lave, Smith, & Butler, 1988).

A primary goal of anchored instruction is to engage students in problem-solving activities that can help reduce the "inert knowledge" problem that Alfred North Whitehead (1929) identified decades ago. Knowledge presented as isolated disconnected facts remains inert and thus fails to transfer. In contrast, when knowledge and skills are contextualized as they are in anchored instruction, students are more apt to recognize when to appropriately apply them and use their prior knowledge to solve similar problems they encounter in the future. Research in educational settings suggests expertise is developed through problem-solving activities that involve active construction of knowledge results (Bransford, Brown, & Cocking, 2000). Thus, anchored learning environments are generative because they motivate students to actively search for relevant information, use the information to plan strategies for solving the problem, and test their solutions.

ANCHORED INSTRUCTION IN MATHEMATICS

A well-known series of anchors for improving students' problem-solving skills in mathematics is called *The Adventures of Jasper Woodbury* (CTGV, 1997). The entire set of Jasper Adventures consists of twelve episodes, each one including a video-based problem and related extension problems. Three episodes were developed for each of four mathematical areas of study: Distance/Rate/Time, Statistics, Geometry, and Algebra. The early versions of Jasper were presented on random access videodisc technology, which enabled students to keep track of the frame numbers and to access information almost instantly with the videodisc controller or barcode reader. This feature was far superior to access methods in linear-based videotape and VCR technology.

Kim's Komet is one of the Jasper Adventures that helps students develop their informal understanding of pre-algebraic concepts, such as variable, linear function, rate of change (slope), line of best fit, and reliability and

measurement error. The video-based anchor involves two girls who compete in a car competition called the Grand Pentathlon in which competitors have to predict where on a ramp they should release their cars to navigate five tricks attached to the end of ramp straightaway. *Kim's Comet* first helps show students how to calculate speeds when times and distances are known. They do this watching the time trials in the video held the day before the Grand Pentathlon. The challenge is to identify the three fastest qualifiers in three regional races, where times and distances are known but the distances vary. For example, students explain whether a car that travels 15 feet in 0.9 seconds is faster or slower than a car that travels 20 feet in 1.3 seconds.

The next challenge is more difficult: It asks students to use their own stopwatches to time Kim's car in time trials prior to the Grand Pentathlon. The software allows students to pick various release points (i.e., heights) on the ramp so they can compute the speeds of Kim's car along the length of straightaway. Eventually the students realize that they should time Kim's car from the beginning to the end of the straightaway, where the car's speed is relatively constant, rather than on the ramp, where the car is accelerating. After computing these speeds, students plot on their graph the speed of Kim's car for each of the release points and then draw a line of best fit. Students use this line to predict speeds for all possible release points.

On the day of the Grand Pentathlon, the teachers reveal to students the critical speed range of Kim's car for each of five tricks, which are attached to the end of the straightaway. Students earn points for helping Kim successfully accomplishing each trick. The software enables students to enter the height of the release point for each event and to watch Kim as she releases her car from that height. If students provide Kim with the correct release point, they can watch as Kim's car successfully navigates the trick. However, when speeds and release points have been incorrectly computed, they watch as Kim's flies off the trick and crashes. Foundation skills needed to solve this problem include computation with whole numbers and decimals.

ENHANCED ANCHORED INSTRUCTION

An instructional method based on the concept of anchored instruction is called Enhanced Anchored Instruction (EAI; Bottge, 2001). EAI has two main components. Like the Jasper series, problems are presented in video format that students navigate to find solutions to an overarching problem. Multimedia-based learning opportunities built into newer technology enable students to access technology-mediated scaffolds, which are of particular benefit to many low-achieving students. In addition, EAI extends AI by affording students additional

opportunities to practice their skills as they solve new but analogous problems in applied, motivating, and challenging hands-on contexts.

One example of EAI is a multimedia-based problem called *Fraction of the Cost* and its hands-on related problem called the *Hovercraft Challenge*. *Fraction of the Cost* stars three middle school students who wonder if they can afford materials to build a skateboard ramp. The main instructional purpose of the problem is to help students improve their math skills in the areas of rational numbers and measurement. After students solve the problems posed in *Fraction of the Cost*, they work on solving a related problem, the *Hovercraft Challenge*, in which students have to plan and construct a rollover cage for a hovercraft out of PVC pipe. The teacher divides the class into groups of three students, and each group plans how they can make the cage in the most economical way. When students have constructed their cages, they lift them onto a 4-by-4-foot plywood platform (i.e., hovercraft). A leaf blower inserted into a hole in the plywood powers the hovercraft, which inflates the plastic attached to its underside and elevates it slightly above the floor. The last day of the project students ride on their hovercrafts in relay races up and down the halls of the school.

RESEARCH FINDINGS OF AI AND EAI

Results of formative evaluations with Jasper materials were reported in CTGV (1997). In these studies, teachers were provided extensive training on the content and use of the anchored materials. Findings suggested students in the anchored instruction groups developed more sophisticated math skills and positive attitudes compared to students in comparison groups. In a later study conducted in fifth grade classrooms (Hickey, Moore, & Pellegrino, 2001), two pairs of closely matched schools were randomly assigned to assess the effects of several Jasper series adventures on students' math achievement and motivational responses. Results showed that the anchored instruction materials had positive effects on math achievement and motivation of students in both high-SES and low-SES schools. This latter finding was especially important because it suggests that low-achieving students can profit from complex problem-solving activities without negative or motivational consequences if they are designed appropriately.

A series of quasi-experimental studies comparing EAI to traditional modes of instruction with students at several achievement levels (i.e., low, average, high) have confirmed and expanded the earlier findings with AI. These studies have yielded medium-to-large effect sizes (η^2) on curriculum-aligned problem solving tests (.31 to .79) and transfer tasks among students without disabilities (.14 to .38) (e.g., Bottge, 1999; Bottge, Heinrichs, Mehta, & Hung, 2002).

Similar results have been found in studies involving students with learning disabilities (Bottge et al., 2007) and emotional/behavioral disabilities (Bottge et al., 2006). An important finding generated from these studies suggests that teachers need substantial amounts of training to teach EAI effectively. This training should include both pedagogical methods for teaching EAI and deep understanding of the math principles embedded in the EAI problems.

Although studies suggest that AI and EAI can have positive effects on students' problem-solving skills, they have also identified some points for consideration. First, teachers need considerable training in methods and math content to teach with anchored instruction. Second, low-achieving students require explicit just-in-time instruction to help them perform difficult mathematics computation procedures (e.g., adding fractions) and understand mathematical concepts (e.g., variables). Third, EAI uses instructional technology (i.e., computer and hands-on applications), which some schools may not have or cannot afford to buy. Finally, anchored instruction may not fit neatly within traditional curricula.

Anchored instruction has the potential for helping students across a range of abilities improve their problem-solving skills. Results of several studies suggest that the contextualized nature of the anchors interest students and engage them for extended periods in problem solving activities. With low-achieving students, the related hands-on problems and learning scaffolds are especially important for solidifying the concepts embedded in the video-based anchors. One of the most important implications of these findings is that success or failure on academic tasks should not be predicted on students' prior achievement but rather on the design quality of the instructional material.

SEE ALSO *Constructivism*.

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Brian A. Bottge

ANDERSON, JOHN ROBERT 1947-

John Robert Anderson was born August 27, 1947, in Vancouver, British Columbia. He obtained his undergraduate training in psychology at University British Columbia, and he completed his PhD at Stanford University working with Gordon Bower. After a brief faculty appointment at Yale, he moved to Carnegie Mellon University in 1978 and has remained there into the early 2000s, with faculty appointments in psychology and computer science. He is married to cognitive psychologist Lynne Reder and has collaborated with her on a number of projects throughout his career. He has received a number of important recognitions of his excellence in basic psychological and cognitive science research: the American Psychological Association's Early Career Award

in 1978; APA's Distinguished Scientific Contribution Award in 1994; election to the National Academy of Sciences and the American Academy of Arts and Science in 1999; the David Rumelhart Prize for Contributions to the Formal Analysis of Human Cognition in 2004; and the Dr. A. H. Heineken Prize for Cognitive Science in 2006. He has also served as president of the Cognitive Science Society.

John Anderson's most famous contribution is the ACT theory in its various incarnations: ACT, ACT*, and ACT-R (as of 2007 on version 6.0). Interestingly, the ACT acronym matches the titles of some of Anderson's highly influential books such as *Atomic Components of Thought*, but in fact, the acronym does not stand for anything in particular. The ACT theories formally describe cognition in computational terms (i.e., with great depth), but in a way that unifies a broad range of cognitive activities (i.e., with great breadth). The framework is unifying in that it carefully describes many components of cognition (e.g., perception, categorization, memory, analogy, decision making, and problem solving) and has been used to understand many behaviors (e.g., a vast array of memory experiments, language learning, mathematical problem solving, scientific reasoning, and car driving, to name just a few examples). The theoretical framework has also been unifying in that it shows how cognition can have symbolic elements (i.e., knowledge and skills with complex, hierarchical structure) and subsymbolic elements (i.e., knowledge and skills acquired and applied gradually), an issue that has been somewhat divisive among other computational theories of cognition. Finally, the theoretical framework is unifying in that as of 2007 over 100 researchers worldwide directly use, build upon, and adapt the ACT-R theory in their own research.

To educational psychology, the ACT theories provide a theoretical framework for dividing any complex task into core elements whose acquisition can be carefully tracked and predicted. In all the ACT theories, there is a large division between procedural knowledge (knowing how) and declarative knowledge (knowing that), with different learning mechanisms for each. Performance in any task requires a combination of both kinds of knowledge (e.g., even a simple memory task requires knowing the rules of the memory task). The ACT theories describe how individual procedural and declarative knowledge elements are acquired through practice and gradually lost with time and how performance at any point in time can be precisely predicted through careful analysis of the learning history.

The ACT* theory formed the basis of a series of intelligent tutoring systems called Cognitive Tutors, the most influential of which is a high school Algebra tutor widely deployed in many high schools throughout the

United States. The core insight behind the Cognitive Tutors is that feedback and practice can be optimized on a per student basis if student progress on individual knowledge elements is tracked. Experimental evaluations on the Cognitive Tutors have regularly found a one standard deviation improvement in student learning over traditional classroom learning. The Cognitive Tutors have also served as an important validation of the ACT approach because the highly irregular learning and performance curves associated with students learning a complex task become smooth learning curves when analyzed according to ACT predictions. These Cognitive Tutors have also provided a powerful research tool for testing various theoretical questions about learning with strong experimental precision but doing so in real classroom settings.

The move from ACT* to ACT-R reflected Anderson's highly influential rational analysis of cognitive behavior. Prior to this rational analysis, cognition was widely thought of as basically defective, and the job of psychology was to document those defects. Anderson's rational analysis showed how the general structure of the human cognitive architecture was essentially a highly rational system that tries to optimize problem-solving performance with limited resources in a complex but somewhat regular environment. For example, he showed how memory-forgetting functions closely approximated the way the world gradually changes with time and context. To educational psychology, this work shows how important it is to attend not only to the general presence or absence of information in the learner's environment, but also how critical the statistical regularities of that input (e.g., when tests are given) are to shaping student learning.

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Christian D. Schunn

ANDERSON, RICHARD C(HASE)

1934–

Richard Chase Anderson is an American educational psychologist and reading educator. He has strongly influenced educational theory and practice through his own research as well as through a teaching career in which he has mentored many leading researchers in educational psychology and reading education. To date, he has written two books, edited or co-edited another six books, and written about 200 articles and book chapters.

Born in 1934, Anderson grew up in River Falls, Wisconsin. He received a bachelor's degree, cum laude, in American history in 1956 and a master's degree in social science education in 1957 from Harvard University. He earned a doctorate of education at Harvard University in 1960, working with John Carroll, a pioneer in psycholinguistics. He worked as an assistant superintendent in East Brunswick, New Jersey, for three years, and then accepted a faculty position at the University of Illinois at Urbana-Champaign, where he has remained throughout his career.

Anderson has received numerous awards, including several of the most prestigious awards in education. In 1997 Anderson won the American Psychological Association Edward Thorndike Award for distinguished career-long contributions to the psychological study of education. In 2006 he was honored by the American Educational Research Association with the Sylvia Scriber Award for his research on learning and instruction.

Anderson was at various times director or co-director of one of the most prolific and influential research centers in U.S. educational history, the Center for the Study of Reading at the University of Illinois at Urbana-Champaign. Many eminent researchers participated in the work of the Center during its 15 years of federal funding. These included senior scientists as well as visiting scholars and graduate students who trained at the center before moving on to positions of scholarship and leadership throughout the world.

Anderson's research has encompassed many topics of great relevance to educators. Among these are schema theory, vocabulary development, learning to read, cross-cultural analyses of learning to read, and collaborative reasoning. Several of his key contributions are summarized below.

Anderson was among the leaders in developing schema theory and applying it to reading education. According to schema theory, when readers read texts, they use their prior knowledge to help them make sense of these texts. Hence, reading comprehension is facilitated when readers have relevant organized knowledge

packets, called *schemas*, that they can use to interpret the information. When reading a narrative of a wedding, for example, readers apply their schema of typical wedding events (prior knowledge of the processional, the vows, the reception, and so on) and fill the slots in the schema with the details of the particular wedding described in the narrative (e.g., the details of this particular processional, vow, reception, and so on). When readers lack relevant schemas, or when they fail to activate their schemas, they understand and recall less of the new material. Schema theory can help teachers understand some of the difficulties that students have while reading, and it suggests that building relevant schemas and activating them can enhance reading comprehension.

Anderson and his colleagues also conducted a variety of studies of vocabulary acquisition. One finding emphasized that most words are learned not from explicit study but by incidental learning of word meanings from reading texts. An instructional implication of this finding is that encouraging students to read widely is important in vocabulary development.

Another line of Anderson's work focused on processes of learning to read in elementary school. A particularly important achievement was the 1985 book *Becoming a Nation of Readers*. Anderson was the lead author of this book, which arose from the work of the Commission on Reading, sponsored by the National Academy of Education. The book synthesized a broad array of research on learning to read. The authors presented this research in a way that was at once a scholarly review of the literature and a report that was highly accessible to teachers.

Anderson's later work had two tracks. In one track, he teamed with Chinese scholars to investigate learning to read Chinese. The research not only laid the foundation for building the essential literacy skills of Chinese children but also impacted the way Chinese children learn to read with an emphasis on reading more and reading for pleasure.

In the other track, beginning in the early 1990s, he and his research team developed an approach to classroom discussions called *Collaborative Reasoning*. In Collaborative Reasoning, students engage in constructive argumentation in which they give reasons and evidence for positions they take. The argumentation centers around a central question relating to material students have read. For example, after reading material relating to wolves and wolf re-introduction and management policies, students discuss whether a town should be allowed to hire professional hunters to kill the wolves that wander near the town. Anderson and his collaborators found that Collaborative Reasoning has very positive effects on classroom discourse and also improves students' reasoning and argumentation.

In his career, Anderson forged new ways of thinking about reading, learning, and classroom discussions. He conducted rigorous studies in both the laboratory and in the complexities of the classroom, and he trained new generations of educational researchers, to whom he was a great mentor and friend.

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ANXIETY

Anxiety is an important subject in educational psychology because it is known to interfere with children's ability to learn, the level of their classroom performance, and

their relationships with classmates. Anxiety can be understood as a multisystem response to an object or event that arouses apprehension. It involves biochemical and neuromuscular changes in the body, memories of past events (including personal history), anticipation of future outcomes, and appraisal of the present situation. While animals clearly experience fear, as far as is known only humans experience anxiety. Children who feel anxious in school interpret some aspect of the classroom situation through the lens of their past experiences and anticipate negative outcomes. According to Lagattuta, children begin to worry about the future because of a negative past event at some point between the ages of three and five. The specific trigger of classroom anxiety is commonly a test or task of some kind, but it may also be a feature of the social environment, such as a recent move to a new school, general feelings of isolation or rejection, verbal criticism from the teacher, or bullying by schoolmates. In general, schoolchildren are most likely to experience anxiety when they are worried about something bad happening in the future but feel powerless to avoid it, prevent it, or otherwise influence the outcome.

DEFINITIONS

In 1972 Spielberger introduced the distinction between state and trait anxiety that is commonly used by school psychologists in the early 21st century. State anxiety refers to the unpleasant sensation of fear experienced in the face of a threat, whether physical or psychological. State anxiety presupposes a cognitive perception or appraisal of a threat; that is, individuals must know or believe on some level that a specific situation is in fact dangerous or threatening. Test anxiety is a commonly encountered form of state anxiety, as is anxiety related to a public athletic competition or musical performance. Typically, children or adolescents feel less anxious after the stressful event is over. Trait anxiety, by contrast, is an aspect of personality—namely, a tendency to experience state anxiety when confronted with a threat that remains stable in a specific individual over time but varies from one individual to another. High levels of trait anxiety are closely linked to neuroticism as defined by Eysenck and Eysenck (1991).

In 1980 Spielberger distinguished between two features of both state and trait anxiety, namely worry and emotionality. Worry is related to the cognitive dimension of anxiety; that is, how individuals assess the danger and their competence or incompetence for handling it. Emotionality refers to the feelings and physical sensations associated with anxiety, such as sweating, breathing heavily, feeling nauseated, or having a dry mouth. Worry and emotionality are usually present at the same time; however, they are not necessarily closely related to each other.

Thus it is possible for children to be intensely worried but to experience only a moderate level of physical arousal or vice versa.

The physical symptoms that children may experience when they are feeling anxious are related to the so-called fight-or-flight reaction to stress. Some essential body functions, such as breathing, heart rate, and sweating, speed up or intensify, while other functions such as digestion, secretion of saliva, and blood flow within the skin slow down. Children may experience a wide range of bodily sensations, including dry mouth, nausea, vomiting, diarrhea, or abdominal cramps; dizziness, choking sensations, or shortness of breath; rapid pulse or heartbeat, irregular heart rhythms, headache, or heavy sweating; muscle tension or cramps, chest pain, shakiness and impaired physical coordination, general fatigue, or stiff or sore joints. Parents or teachers may notice other signs such as insomnia, general restlessness, or pacing the floor.

Behavioral changes associated with anxiety in children include general irritability and moodiness; regression to earlier stages of development, often around eating habits or toilet training issues; crying, angry outbursts, or temper tantrums; clinging to parents or caregivers; or avoidance behaviors, which may include school refusal, avoidance of after-school activities, or selective mutism (being unable to speak during anxious periods but able to do so normally at other times).

EVALUATION AND ASSESSMENT

Evaluation and assessment of school-related anxiety in children is a difficult and complex process. First, anxiety is a universal human experience that most children are able to manage. According to Huberty (2004), most schoolchildren cope satisfactorily with anxiety or can be taught to cope more effectively without the need for formal therapy. Between 15 and 20 percent of children in the United States, however, may eventually require treatment for a childhood anxiety disorder.

Second, some childhood fears are age-related; for example, separation anxiety is normal in children between the ages of 18 months and 3 years but usually resolves by the time the child is 4 years or older. At some point around age 8, children's anxieties become less specific; they are replaced by more abstract worries. In other words, children worry less about a mean dog next door or a monster under the bed and more about fitting in with new classmates or making friends at school. Older children and adolescents commonly experience anxiety related to schoolwork, social popularity, and other areas of competition, as they become aware that academic and social competencies are important for success in the workplace as well as in marriage and in procreation. But because children vary in their developmental timetables, it can be difficult

to assess whether an anxious child is simply going through a phase or requires closer evaluation.

Third, recent changes in a child's life, such as geographical relocation, starting a new grade, changes in the family structure (such as divorce, death, or remarriage), chronic illness, or parental job loss can affect the child's normal reactions to tests and other anxiety-provoking experiences in school. It may take time to discern whether the child is adjusting to a new situation or whether the child needs additional help. Huberty recommends looking at the child's daily functioning to determine whether professional help is needed. If children are having difficulty with everyday classroom activities, then the anxiety must be addressed regardless of its cause. Evaluating the degree to which the anxiety is interfering with daily life will guide answers to such questions as whether the anxiety is typical for the child's age, whether it is limited to specific learning situations (such as mathematics or foreign-language classes), or whether it appears across a range of activities in the child's life.

Fourth, the physical symptoms associated with anxiety may be caused by a range of other diseases and disorders; thus it is important to rule out such disorders before giving the child a psychological evaluation. In addition, side effects to some medicine should be considered. For example, some cold or asthma medications may cause anxiety symptoms in some children.

If the physical examination gives normal results, and if children still have difficulty with homework or other school-related activities, they may need further evaluation by one or more professionals qualified to diagnose and treat anxiety-related problems in children or adolescents. They may give children one or more brief self-report instruments to screen for excessive anxiety as well as clinician-administered tests.

The State-Trait Anxiety Inventory for Children (STAIC), first used in 1973, is a widely used clinician-administered instrument for measuring state and trait anxiety in children. As of 2008, it was considered the standard in the field and had been translated into more foreign languages than any other measure of anxiety in children. The STAIC is designed for use in children from 9 to 12 years of age and requires about 10 to 20 minutes to complete. It has two 20-item scales: an S-anxiety scale that measures how the child feels at the specific point in time when completing the inventory, and a T-anxiety scale that elicits the child's general feelings of anxiety over time. The STAIC has been used to measure differences in trait anxiety between boys and girls as well as differences between children from different social classes. It has also been used to evaluate the effect of state anxiety on children's ability to recall information accurately.

Another clinician-administered instrument, the Beck Anxiety Inventory (BAI), is used to distinguish between anxiety and depression in children over the age of 7. The STAIC and the BAI are used in psychological research as well as in clinical diagnosis.

Common screening measures include the Screen for Child Anxiety Related Disorders (SCARED), which consists of 41 items; or the Multi-dimensional Anxiety Scale for Children (MASC), which consists of 39 items. These two instruments are designed for children between the ages of 8 and 19 and can be completed in five to 15 minutes. The Spence Children's Anxiety Scale (SCAS), intended for children between 8 and 12 years of age, consists of 45 items and can be completed in five to 10 minutes. A 34-item version of the SCAS for children from 2.5 to 6.5 years of age is designed to be completed by parents. Muris and colleagues (2002) reported that these screeners are reliable and internally consistent instruments that yield results strongly correlated with scores on the STAIC.

ASSOCIATED FACTORS

One question that has surfaced repeatedly is whether children in the early 2000s are more anxious than their counterparts in previous generations. This question has been asked in connection with state as well as trait anxiety. Twenge reviewed three major explanations for the reported increase in trait anxiety in children between the 1950s and 1990s, namely an increase in overall threats to life and health; increased economic hardship; and loss of social connectedness. After analyzing a number of studies, she came to the conclusion that self-reported levels of anxiety have risen "about a standard deviation between the 1950s and 1990s, a result consistent across samples of college students and children and across different measures" (Twenge, 2000, p. 1018). She attributes the rise in children's anxiety to a combination of worry about personal safety and loss of social connectedness, with economic conditions having a smaller impact.

On the individual level, some children appear to be genetically predisposed to high levels of trait anxiety, as Eley and others have reported in twin studies. Children with a temperament marked by behavioral inhibition (avoidance of new stimuli) are also more likely to develop high levels of trait anxiety. By contrast, Degnon and Fox reported in 2007 that behavioral inhibition is itself a trait that changes over time in many children, with some who were extremely inhibited as toddlers becoming more resilient in later childhood. The researchers attribute these changes in temperament to the development of adaptive attention skills, the influence of parenting, and the child's gender. With regard to gender in particular, Huberty cites findings that girls have higher levels of

general anxiety than boys, as well as higher levels of anxiety related specifically to social acceptance. He attributes these findings to the social roles that girls are expected to maintain in contemporary society.

An external factor that increases children's risk of high levels of trait anxiety is low socioeconomic status (SES). According to Papay and Hedl, there is a clear correlation between higher levels of trait anxiety in schoolchildren and lower socioeconomic status.

Some parenting styles have been associated with an increased risk of high levels of trait and state anxiety in children. Parental verbal abuse has been associated with anxiety in children, as have overly controlling parental behavior and negative or rejecting attitudes toward the child. The combination of excessive control and emotional rejection by parents has been shown to have a particularly strong correlation with high levels of anxiety in school-age children.

ANXIETY AND CLASSROOM OUTCOMES

Anxiety in children is a major concern to educators because of its long-term toll on future academic success and social adjustment. High levels of anxiety increase the likelihood that a child will make mistakes in schoolwork, thus drawing criticisms from teachers and parents that typically reinforce the anxiety. Test taking, bullying, and other anxiety-provoking situations in school may lead to school refusal, which in turn has both short-term and long-term consequences. The short-term consequences include falling behind academically, weakened relationships with peers, and increased stress and conflict within the family. Over the long term, a child with a high level of school-related anxiety is at risk for lifelong academic underachievement, substance abuse, mental disorders in late adolescence or adulthood, recurrent difficulties in social relationships, and employment problems. Other possible outcomes include low self-esteem, underestimation of competencies, and poor problem-solving skills.

Anxiety related to specific intellectual tasks—mathematical problem solving and recitation in foreign-language classes—are the two most frequently mentioned—is known to affect eventual career planning. Some students decide against careers that require skill in these fields because they are made anxious by past experiences of difficulty or failure with math or foreign languages.

Bullying in the school environment is another factor in anxiety shown to affect classroom outcomes. According to Grills and Ollendick (2007), girls are more severely affected in their academic performance by anxiety related to bullying than are boys, even though boys are bullied more frequently.

MANAGEMENT OF ANXIETY

A multimodal approach is the most common recommendation for the treatment of anxiety in school-age children, in that anxious children vary widely in the nature and severity of their symptoms as well as the causes of their anxiety and the degree of their functional impairment. Teachers and other school personnel are usually consulted when a child's treatment is being planned.

Huberty recommends beginning the treatment of anxiety in children with psychotherapy rather than medications. Although the use of medications in treating anxiety in children is no longer controversial, these drugs should not be used as the only form of treatment. They are usually prescribed for children whose anxiety symptoms need to be reduced as quickly as possible, who suffer from concurrent diseases or disorders, or who have not responded to psychotherapy within a reasonable amount of time.

Several forms of psychotherapy have been shown to be effective in managing anxiety in children. Cognitive-behavioral therapy (CBT) is the approach most frequently recommended for children over the age of 6 or 7; between 70 and 80 percent of children respond favorably to it, with 50 percent maintaining their improvement over seven years. CBT helps children improve their sense of mastery and self-esteem as it reduces anxiety symptoms. It is also useful in correcting the cognitive distortions that contribute to anxiety in children; many studies indicate that anxious children tend to focus their attention selectively on threatening rather than positive or neutral features of their classroom. A CBT therapist teaches the child to identify anxious self-talk, to challenge it (with such statements as "That's just my fear talking"), and to substitute positive statements ("I can get through this!"). Key factors in the success of CBT include the child's willingness to practice the new behaviors when the child is not anxious and the parents' willingness to practice the new skills with the child.

A version of CBT introduced by Kendall in the 1990s is the Coping Cat program. The program teaches children to (1) recognize worry and physical reactions to anxiety; (2) clarify their feelings in anxiety-provoking situations; (3) develop a plan to cope effectively with a specific situation; and (4) evaluate their performance and administer self-reinforcement afterward.

Christophersen and Mortweet discuss the ways in which CBT can be used effectively in treating groups of anxious children as well as individuals. According to these authors, forms of psychotherapy that have been shown to be effective in anxious children include child psychoanalysis and psychodynamic psychotherapy. Parent-child interventions include family therapy for

parents with problematic parenting styles and inclusion of the parents in the child's CBT therapy.

The American Academy of Child and Adolescent Psychiatry recommended in 2007 that teachers should be involved in the treatment of anxious children when the child's anxiety is interfering with classroom work. Specific suggestions include tailoring the length of homework assignments to the student's capacity to complete them without increased anxiety; identifying an adult outside the classroom who can assist the child with problem-solving and coping strategies; administering tests in quiet or private environments; and writing such accommodations into the child's Individualized Education Plan.

SEE ALSO *Evaluation (Test) Anxiety.*

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APPLIED BEHAVIOR ANALYSIS

Applied behavior analysis is the application of behavioral science to address socially important problems. It is one element of the larger discipline of behavior analysis, which consists of the experimental analysis of behavior, radical behaviorism, and applied behavior analysis. The field of applied behavior analysis emerged in the 1950s and 1960s from early theory (Skinner, 1938, 1953; Terrace, 1966) and animal research identifying basic principles of behavior (Honig, 1966). Behavioral principles, such as positive reinforcement, generalization, and extinction, began to be applied to socially important human behavior with startling and encouraging results. Sidney Bijou and Donald Baer (1961), for example, demonstrated that children with intellectual disabilities and very limited communication skills could learn to interact effectively when provided with instruction based on behavioral principles. Children with self-injury and severe aggression learned alternative skills and reduced their dangerous behavior. These early examples of behavior change emphasized that behavior analysis was both a scientific approach for studying behavior and a technology that could be harnessed for positive social change. This distinction between applied behavior analysis as a field of science, and applied behavior analysis as a technology for intervention, is important. The core features of applied behavior analysis exist in both, but are emphasized differently when the goal is to advance the science of human behavior rather than address a personal intervention need.

Applied behavior analysis became a distinct field of study in 1968 with the launching of the *Journal of Applied Behavior Analysis* and the classic, inaugural article by Donald Baer, Montrose Wolf, and Todd Risley (1968). These authors used this article to describe eight defining dimensions of applied behavior analysis: (a) applied (b) behavioral, (c) analytic, (d) technological, (e) conceptually systematic, (f) effective, (g) generalizable, and (h) durable. These dimensions warrant review for anyone interested in understanding and contributing to the field.

MEANING OF APPLIED

Applied behavior analysis is a science guided by values. While behavior analysis as a field focuses on variables affecting behavior (and that can be any behavior by any organism) applied behavior analysis is the study of variables that affect socially valued human behavior. The very first feature of an applied behavior analysis research study is description of the social issue or concern under study. What is the behavior of study, and what criterion would make that behavior appropriate and acceptable for that individual in his context? Applied behavior analysis is a science/technology with an overt goal of improving society, of assisting people to achieve identified goals, and of applying the science of human behavior toward those ends.

It is worth noting that the initial dimension selected by Baer, Wolf, and Risley to define applied behavior analysis was that the analysis must focus on problems in which society shows a clear interest and concern. The applied element of applied behavior analysis is defined not in technology, procedure, or science, but in the social value of the issues under study. As such, research and practice in applied behavior analysis typically will not only focus on highly valued behavior (e.g., reading, speaking, social interaction, play) but will examine that behavior in the actual context where it typically occurs. One of the underlying messages from behavior analysis is the central role that contextual variables (prompts, social opportunities, consequences) have on behavior. Thus an applied understanding of human behavior requires study of that behavior in natural contexts. For example, an applied study of reinforcement would be more likely to occur with a valued behavior, such as reading, in a natural context, such as a school or home, rather than with a behavior such as lever pressing studied in a laboratory setting. Some applied behavior analysis research may occur in atypical contexts such as clinics when the goal is to isolate variables that are causing the behavior, but even then the ultimate goal is to apply what is learned to more natural settings. For example, a child who exhibits self-injury may receive assessment in a clinic in which

conditions can be managed with precision and safety to determine what triggers and maintains the behavior. The goal of the resulting intervention, however, would be to achieve behavior change in the child's typical home and school. The applied dimension of applied behavior analysis emphasizes valued behavior in typical contexts.

FOCUS ON BEHAVIOR

Applied behavior analysis focuses on observable human behavior. There are increasingly sophisticated definitions of behavior (Johnston & Pennypacker, 1980), but the basic message is that the focus of an applied behavior analysis is human behavior that can be observed and counted. The emphasis on observable behavior is part of the precision that makes applied behavior analysis a science. Importantly, observed does not necessarily imply a focus only on behavior that is observable by others simply that the behavior be observable at least by the person exhibiting that behavior (Skinner, 1953). Thus, thinking is considered a behavior but inferred, internal states such as anger would not be a focus for applied behavior analysis, but hitting, kicking, screaming, throwing would be observable and countable behaviors suitable for study. Because applied behavior analysis focuses on changing behavior via altering events around the behavior, the focus most often is on behaviors that are observable to others as well as to the person exhibiting the behavior.

The goal in applied behavior analysis is the direct study of behavioral phenomena. If eating were the focus of the analysis, then the study would likely involve observing and counting bites or calories ingested. The study would not, for example, focus on verbal descriptions of what was eaten. Verbal descriptions would be an indirect measure of what was eaten (though a direct measure of talking about eating). Similarly, if a study were examining a child's screaming, the analysis would not focus on fear or anxiety (which are not observable or countable) but on the behavior of screaming, and the conditions when screaming was most and least likely.

The emphasis on direct study of observable behavior reflects concern about the potential for confusion and miss-calculation that can occur when inferred emotions, intentions, and motivations are used as the heart of an analysis. A hallmark of applied behavior analysis is excruciating precision in the definition of, and direct observation of, the behavior under study.

ANALYTIC METHOD

Both as an approach to studying behavior and as a technology for behavior change, applied behavior analysis is analytic. As a science, applied behavior analysis incorporates a systematic process characterized by (a) valid, reliable measurement of behavior, (b) operational

description of intervention procedures, (c) utilization of research designs that allow demonstration of experimental control, and (d) replication of findings. In most cases, research examples of applied behavior analysis involve a process in which individuals are observed over time and the researcher manipulates a specific feature of the context or setting to determine if this feature (e.g. the consequence following a behavior) will affect the frequency, duration or form of the behavior under study. The presentation of a consequence, such as praise, for example, would be manipulated within a formal experimental design that allowed the researchers to determine (a) if the behavior changed when praise was provided as a consequence and (b) if change in the behavior was functional related (causally related) to manipulation of the consequence (presentation of contingent praise).

As a technology of behavior change, applied behavior analysis is analytic in that repeated and precise measurement of behavior continues to be essential. When the technology of applied behavior analysis is used in home, school, work, and community settings it is not always expected that a formal research study will be performed. Rather, the expectation is that the procedures used in the behavior change effort will be drawn from previous studies, that the behavior of the focus individual will still be measured directly to determine if desired behavior change is achieved, and implementation of the intervention or practice will be done with precision (and most often with measurement of fidelity).

TECHNOLOGICAL FACTORS

Applied behavior analysis is a technology as well as a science. As with any technology it is essential that the specific elements of an intervention or practice are described with sufficient clarity and precision that someone reading the description can replicate what was done. This is often easier to say than to do. It would be one thing for an individual to describe her morning routine for getting out of bed and preparing for the day. It would be another thing entirely to describe her routine with sufficient precision that it could be replicated by someone reading her account. The same is true for describing how to teach reading or how to respond to a behavioral tantrum. Both as a science and as an approach to behavior change, applied behavior analysis is characterized by careful, complete, and specific description of procedures.

CONCEPTUALLY SYSTEMATIC

Applied behavior analysis is the application of behavioral principles. Behavioral principles have been defined from research in the experimental analysis of behavior and have been shown to be useful for explaining the conditions under which a behavior will or will not occur. Principles

commonly applied in applied behavior analysis include reinforcement, punishment, extinction, stimulus control, generalization, and maintenance. There are countless ways these principles can be applied, and many examples of applied behavior analysis offer innovative applications. The use of positive reinforcement, for example, may include the delivery of praise and/or toys to develop toilet training skills with young children. But from a conceptual perspective it is not the praise or toys per se that are important, but the systematic application of positive reinforcement as a conceptual principle of behavior. Thus, applied behavior analysis should not be perceived as a particular procedure or set of intervention tricks (e.g., prompts to perform desired behavior; praise following correct behavior; correction, reprimand, or redirection following incorrect behavior), but the application of behavioral principles. It is this conceptual foundation that links the science and technology of applied behavior analysis.

EFFECTIVENESS

Applied behavior analysis is a pragmatic enterprise. The focus is on using principles of behavior to achieve not just improved behavior, but behavior that is improved to a level that it is socially important. It is useful, but unimpressive, to reduce bouts of screaming from 20 events in a day to 15 events in a day. This is clearly an improvement, but 15 bouts of screaming in a day will likely remain socially unacceptable. When screaming has reduced to once per week, the family may define the intervention as successful. Both the science and technology of applied behavior analysis are held to a standard of change defined by the values of the people in the applied setting. The goal is to change behavior to a socially important level. For example, in determining how many screams are acceptable those concerned with the child's screaming (e.g., parents, teachers, the child) need to say what is and is not acceptable. The task of someone using applied behavior analysis is to apply behavioral principles to create a context that produces acceptable and valued levels of behavior.

Generalized Effects. In their seminal article Baer, Wolf, and Risley (1968) established the expectation that applied behavior analysis should focus not just on isolated behavior change, but generalized behavior change. Socially important change seldom is contained in a single context. Working successfully with one teacher in one room is an excellent accomplishment for a young child who has autism and a history of severe self-injury. But for this accomplishment to meet the standards of applied behavior analysis one would look for an approach that produces student success across locations, across instructional contents, and across instructors. Most important behaviors must be performed across many contexts or settings to be practical, useful, and functional for the individual. The

focus on applied outcomes led the founders of applied behavior analysis to see generalization of behavior as a particularly valued achievement.

Maintenance of Effects. The strategies for producing a socially important change in behavior are not always the same ones used to maintain the effect across time. Although often discussed together, maintenance is different from generalization. Maintenance is based on a different outcome measure (durable responding across time) and also is affected by different variables (typically the type, level, and consistency of consequences). But like generalization, maintenance is important for applied behavior analysis due to its applied relevance: behavior change typically becomes socially important only if it endures for socially significant periods of time. It is wonderful to demonstrate that a child who previously refused to eat has learned to eat new foods and has been eating a healthy diet for a week. But the social importance of that demonstration lies in maintenance of the effect for months and years. Applied behavior analysis is a science and technology focused on practical, socially important behavior change. As such applied behavior analysis includes careful attention to the variables that affect maintenance.

CONTRIBUTIONS OF APPLIED BEHAVIOR ANALYSIS

Between the 1950s and the early 2000s applied behavior analysis demonstrated increasing value both as a science for understanding human behavior and as a technology for helping people achieve desired behavior change. Early applications of applied behavior analysis were most common with children and adults with severe disabilities, for whom other intervention approaches had proven less effective. As successful demonstrations of behavioral and lifestyle change became more common, the application of applied behavior analysis to typical work, school, and community contexts has increased. Descriptions of applied behavior analysis addressing extreme aggression by individuals with severe intellectual disabilities are now matched by examples of applied behavior analysis being used to teach social play skills, to decrease classroom talking out by children without disabilities, and to affect the quality and quantity of organizational outcomes.

An overarching message from this work is that the setting or context matters. Human behavior is more than personal willfulness. The physical conditions, social interactions, activities, and consequences within a setting do, over time, affect how people behave. Understanding why, when, and how these effects occur is at the heart of applied behavior analysis, and this is the promise that applied behavior analysis brings to help people understand both

their current patterns of behavior and how to change dangerous and undesirable patterns of behavior.

TWO PART LEGACY

Amidst the scientific legacy of applied behavior analysis two messages warrant emphasis. The first is that the consequences that follow a behavior will, over time, affect the likelihood of that behavior in the future. If a behavior (e.g., crying) is followed by a positive consequence (e.g., attention), then it is likely that under similar conditions in the future crying will become more likely. If a behavior (e.g., hitting) is followed by negative consequences (e.g., reprimand), then it is likely that under similar conditions in the future hitting will become less likely. Importantly, positive or negative cannot be determined a priori; what is negative for some people may actually be very reinforcing for others. This “law of effect” (Herrnstein, 1970) has an extensive research foundation and has been characterized in applied behavior analysis as the “function of the behavior.” Research indicates that an individual need not overtly define that he is engaging a behavior to achieve a particular function (i.e., to get or avoid something) for that function to occur. A person’s behavior is being changed continually by the consequences in his world, whether he is aware or not of that process.

The importance of understanding the function of a behavior has become especially important for those using applied behavior analysis as a behavior change technology. Building on the basic research and philosophical foundations of B. F. Skinner and others, Sidney Bijou is recognized as among the first to encourage the careful recording and manipulation of antecedents and consequences in his early research on child communication (Bijou, Peterson & Ault, 1968). Then in 1977 Edward Carr wrote a compelling analysis of how access to positive and negative consequences affects the self-injurious behavior of children with severe disabilities. The model proposed by Carr created a taxonomy of behavioral functions that has direct relevance for both assessment of behavior problems and development of behavioral interventions. Carr’s paper was followed in 1982 by a research analysis conducted by Brian Iwata and his colleagues (Iwata, Dorsey, Slifer, Bauman & Richman, 1982) that has become foundational reading for all students of applied behavior analysis. Iwata et al. (1982) documented effects of different behavioral consequences on the self-injury of adolescents and adults with severe intellectual disabilities. Their results were consistent with Carr’s model and provided the foundation for both future research and clinical intervention. Iwata et al. found that when designing interventions for an individual with problem behavior, it is as (if not more) important to understand the behavioral function of the problem behavior (the specific consequence maintaining the behavior) as

it is to define the type of disability or clinical diagnosis. An intervention that may be effective for a person who engaged in kicking maintained by attention may be completely ineffective for a different person who also engages in kicking but does so to avoid unpleasant tasks.

The impact of the vision, theory, and research that Bijou, Carr, and Iwata provided resulted in a major transformation in applied behavior analysis. Any current research or clinical intervention employing applied behavior analysis is in the early 2000s likely to include a functional analysis (the systematic analysis of behavioral function) or a functional behavioral assessment (the use of interviews, direct observation, and/or systematic analysis to define behavioral function). Because the consequences following a behavior are so important, it has become a professional expectation (and in many states a legal requirement) that care will be taken to assess the behavioral function of a behavior prior to designing behavioral interventions and supports.

The second major message in applied behavior analysis research in the early 2000s has been emphasis on investing in prevention of problem behavior. This means understanding and changing the events and conditions that occur before problem behaviors are performed. Since H. S. Terrace (1966) first summarized the scientific understanding of how stimuli (events, actions, and objects perceptible to the senses) can control behavior, there has been on-going study of how stimuli come to influence when and how behavior patterns develop. This research is important for understanding practical issues such as how the stimulus *b* comes to control the sound /*b*/ for a child learning to read, and how the stimulus “please help wash the dishes” from a parent comes to control the response “whine and cry” from a child who does not find dish washing reinforcing.

Applied behavior analysis emphasizes the important role of consequences, but research results also demonstrate the key role of events that precede target behaviors. Events that reliably precede behavior are important if specific consequences differentially occur in their presence or absence. For example, if a student’s talking out is ignored by substitute teachers but reprimanded by the regular teacher, then the presence of who is teaching comes to control the behavior: The student is more likely to talk out when the substitute is there. Clinical applications of applied behavior analysis now regularly involve (a) manipulating the antecedent stimuli in a setting, and (b) investing in teaching new skills that produce functional outcomes for an individual, as ways to prevent problem behaviors. If a child with autism, for example, finds the background hum of florescent lights highly aversive, she may engage in screaming, throwing, and hitting as behaviors that result in her removal from the room with the aversive noise.

Attention to prevention would suggest (a) remove the aversive noise by using lights that do not produce the negative hum, and (b) teach the child a communication skill that she can use to tell adults when she is in distress (without engaging in aversive histrionics). Changing the lights removes the aversiveness of the room and hence the function of screaming, throwing, and hitting removal from the situation no longer is relevant. Teaching her an alternative communication skill that produces the same effect (removal from aversive noise) gives her a socially appropriate (and more efficient) strategy for achieving the maintaining function.

The message from this example is that applied behavior analysis has matured beyond just the manipulation of positive and negative consequences. Both the research being done in the early 2000s, and the clinical applications of the technology, focus extensively on (a) the events that set the occasion (or prompt) problem behavior, and (b) alternative skills that can be taught to make problem behaviors unnecessary. In essence applied behavior analysis is being used to apply the principles of human behavior to the design of effective school, work, play, and home environments. This is an exciting development in that applied behavior analysis is being used as a technology to create situations that prevent problems as well as a technology to address problems when they develop.

The field of applied behavior analysis remains promising, but under-utilized in U.S. society. The contributions that basic principles of behavior can make to improve living and learning opportunities far outstrip current applications. The early decades of the twenty-first century are anticipated to show elaboration and scaling of these contributions. For the first years of the 2000s, however, (a) research in applied behavior analysis can be expected to improve the on-going understanding of how the environment affects human behavior, and (b) any clinical application of applied behavior analysis can be expected to (1) be based in application of basic behavioral principles, (2) include an initial functional behavioral assessment or functional analysis to identify the consequences maintaining the target behavior(s), (3) employ behavioral interventions that combine manipulation of prevention variables (e.g. antecedent stimuli and instruction on new skills) in addition to consequences, and (4) include measurement of behavior over time to assess effects.

SEE ALSO *Classroom Management*.

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APTITUDE TESTS

Perhaps no other construct in psychology or education has elicited as much debate as the question of what constitutes mental ability, how one might go about measuring it, and even how the resulting tests should be labeled. Most tests of mental ability include in their title some reference to intelligence (i.e., IQ) or aptitude. At the same time, some authors are moving away from the use of either of these terms for fear of the negative connotations they often elicit regarding their historically incorrect associations with invariant heritability. An example would be the change in how the SAT is known. That “the *Scholastic Aptitude Test* became the *Scholastic Assessment Test*, and later simply the *SAT*” (Hogan, 2003, p. 279) is an example of an organization’s move away from these highly charged terms.

Beyond labels, different theories of mental abilities focus on different aspects of and emphases on mechanisms and processes. There is no universal agreement or clear consensus as to which human processes are responsible for giving rise to intelligent behavior. It is, however, fair to say that most definitions and theories of mental ability include the use of the term *capacity* in one or more ways. For example, the capacity to learn, process information, learn from experience, adapt to one’s environment, and think abstractly. Tests of mental ability are

designed to quantify a variety of cognitive processes that underlie individual capacity.

INTELLIGENCE AND APTITUDE

Differentiation of mental ability in terms of intelligence and aptitude is often very subtle and difficult to disentangle. The problem is further complicated by the fact that scientists and test authors often use the terms synonymously, frequently making a separation between the two concepts a matter of semantics. However, examination of the content and purported uses of tests that include either intelligence or aptitude in their title allows for some differentiation between the two terms. Examples of intelligence and aptitude tests are presented in many major psychological measurement and testing texts such as Anastasi and Urbina (1997) and Kaplan and Saccuzzo (2005). Perhaps the most obvious difference relates to the purposes of their intended use. Both are primarily useful for predicting future outcomes or gauging potential for success. Whereas intelligence tests are typically used for predicting classroom or scholastic achievements, aptitude tests tend to be used more for gauging occupational success (e.g., informing job selections and military placements). Another distinguishing feature is that tests that in title purport to measure aptitude tend to be group administered, whereas those tests that advertise themselves as measuring intelligence are more often individually administered.

Beyond these differences related to use and administration, there are often only slight differences in the content of the measures. Most aptitude tests are comprised of large doses of content devoted to the measurement of cognitive ability constructs that would typically be found on an intelligence test (e.g., verbal ability, perceptual ability). Historically, aptitude tests were differentiated from intelligence tests by providing a broader assessment of abilities than the single IQ score afforded by intelligence tests. However, later developments resulted in an explosion of cognitive theories and accompanying IQ batteries that provide a much broader assessment of individual strengths and weaknesses, causing this line of distinction to become increasingly blurred. These same theories also provide the foundation underlying tests of aptitude. In addition, although aptitude tests may contain portions that are more obviously (i.e., as indicated by subtest labels) achievement related, many intelligence tests require acquired knowledge on the part of the examinee. These issues are addressed in greater detail below.

HISTORY OF MEASURING MENTAL ABILITY

The first attempt at measuring mental ability can be traced back to the early 1800s and the work of Sir Francis Galton (1822–1911). Galton's first attempts at measuring mental

Popular Aptitude Battery Subtests (and their Linkages to CHC Constructs)

Differential Aptitude Tests - Fifth Edition (DAT) and the Differential Aptitude Tests - Computerized Adaptive Edition (DAT Adaptive)

Verbal Reasoning (Gc), Numerical Reasoning (Gq), Abstract Reasoning (Gf), Perceptual Speed and Accuracy (Gt), Mechanical Reasoning (Gv), Space Relations (Gv), Spelling (Grw), Language Usage (Grw)

General Aptitude Test Battery (GATB)

General Learning Ability (Gf), Verbal Aptitude (Gc), Numerical Aptitude (Gq), Spatial Aptitude (Gv), Form Perception (Gv), Clerical Perception (Gv), Motor Coordination (Gp), Finger Dexterity (Gp), Manual Dexterity (Gp)

Multidimensional Aptitude Battery (MAB)

Information (Gc), Comprehension (Gc), Arithmetic (Gf), Similarities (Gc), Vocabulary (Gc), Digit Symbol (Gs), Picture Completion (Gv), Spatial (Gv), Picture Arrangement (Gv), Object Assembly (Gv)

Occupational Aptitude Survey and Interest Schedule - Third Edition (OASIS - 3)

General Ability (Gf), Verbal Aptitude (Gc), Numerical Aptitude (Gq), Spatial Aptitude (Gv), Perceptual Aptitude (Gv), Manual Dexterity (Gp)

Note: Gf = Fluid Intelligence, Gq = Quantitative Knowledge, Gc = Crystallized Intelligence, Grw = Reading and Writing, Gv = Visual Processing, Gs = Processing Speed, Gt = Reaction Time, and Gp = Psychomotor Abilities.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES.
CENGAGE LEARNING, GALE.

ability were met with criticism and largely failed to stand the test of time. This was most likely the result of his failure formally to understand and define the construct he was attempting to measure. Further, Galton's measures were primarily physical and sensory rather than mental or cognitive in nature. Modern theories of mental ability can be traced back to the mid to late 1800s and the theoretical work of Alfred Binet (1857–1911), Victor Henri (1872–1940), and Theodore Simon (1872–1961). Binet's early theories were operationalized in the Binet-Simon Intelligence Scale (1905), an instrument that was largely successful in identifying children with mental retardation. Success of the Binet-Simon Scales of Intelligence led to their translation and adaptation for use in the United States, and ultimately led to the first Stanford-Binet Intelligence Scale (Terman, 1916). Soon to follow were the group administered Army Alpha and Army Beta tests of mental ability. The former consisted of 10 scales designed for use with examinees proficient and literate in English, and the latter seven scales designed for use with those unfamiliar with or lacking proficiency in English literacy.

The eventual declassification of the Army Alpha-Beta scales led to a proliferation of commercially available tests through the mid 1900s, including the first Scholastic Aptitude Test (SAT; 1926). Wasserman and Tulskey

(2005) give a more detailed historical account of the origins of cognitive assessment.

Many of the historical attempts at measuring cognitive ability were often criticized for lacking a strong underlying theoretical basis. In addition, the primary benefit of these measures was largely in the prediction of academic outcomes and in the identification of children in need of special services. Despite the importance of these objectives, educators often sought ways in which the results of cognitive assessments could inform instructional practices. These attempts, however, largely failed to obtain empirical support. Several contemporary theories of human abilities have been proposed that hold greater promise for informing instructional interventions. The advantage of mapping test designs onto models of cognitive development that are both theoretically meaningful and empirically supported is that the assessment results hold greater promise for academic interventions that can be more directly applied to optimize student success in the classroom.

THEORIES AND MODELS OF COGNITIVE ABILITY

New and revised theories of cognitive ability, which are strongly rooted in the more empirically researched paradigm of information processing, have paved the way for new instruments and revisions of past traditions. Broadly, information processing theories are concerned with the cognitive processes involved in performing various tasks. Most contemporary theories operate within this paradigm, differing largely in terms of the number of processes believed to be involved, how the processes are related to one another, and the level of detail required for a proper assessment of children's strengths and weaknesses that are useful for informing interventions and predicting future success. Examples of operational models of mental ability that derive roots within the information processing paradigm include the Planning, Attention, Simultaneous, and Successive (PASS) theory (Naglieri & Das, 1990); the Gf-Gc theory (Horn & Cattell, 1966); Carroll's 1993 three-stratum theory; and the Cattell-Horn-Carroll (CHC) theory of cognitive abilities.

Although no single representation of the structure of cognitive ability is universally accepted among researchers, the CHC model appears to be drawing the most attention in terms of academic research and its influence on the development and revision of cognitive tests. (Interested readers may consult McGrew's 2005 study for a fascinating discussion of the birth of the CHC model.) The CHC model integrates the Gf-Gc (Cattell & Horn) and three-stratum (Carroll) models. Gf-Gc originates from the earliest model of the theory that consisted of only two abilities: fluid (inductive and deductive) reasoning (Gf) and

crystallized intelligence (Gc) largely characterized by knowledge acquired through acculturation. Evolutions of both the original Gf-Gc model and Carroll's three-stratum theory have occurred over time.

The CHC model is characterized by several broad-band abilities, including fluid intelligence (Gf), quantitative knowledge (Gq), crystallized intelligence (Gc), reading and writing (Grw), short-term memory (Gsm), visual processing (Gv), long-term storage and retrieval (Glr), processing speed (Gs), reaction time (Gt), and psychomotor abilities (Gp). Underlying each of these broad-band abilities are numerous narrow abilities that are useful for operationalizing the multidimensional aspects of the broad-band ability constructs. For example, fluid intelligence (broad-band ability) is influenced by several narrow abilities including general sequential reasoning, induction, quantitative reasoning, Piagetian reasoning, and speed of reasoning. Interested readers may consult Alfonso, Flanagan, and Radwan (2005); and McGrew and Flanagan (1998) for a more detailed description of the CHC model.

MEASUREMENT INSTRUMENTS

Recent decades have witnessed a swelling of cognitive tests on the market. The majority of these new or recently revised instruments are rooted within the CHC model of cognitive ability and measure, to varying degrees, at least some of the broad-band and narrow-band abilities represented in the CHC model. Examples of such instruments that are appropriate for use with children and adolescents in school settings include Kaufman Adolescent and Adult Intelligence Test (KAIT; Kaufman & Kaufman, 1993), Kaufman Assessment Battery for Children, second edition (KABC-II; Kaufman & Kaufman, 2004), Reynolds Intellectual Assessment Scales (RIAS; Reynolds & Kamphaus, 2003), Stanford-Binet Intelligence Scales, fifth edition (SB-5; Roid, 2003), Wechsler Intelligence Scale for Children, fourth edition (WISC-IV; Wechsler, 2003), Wechsler Preschool and Primary Scale of Intelligence, third edition (WPPSI-III; Wechsler, 2002), Wechsler Adult Intelligence Scale, third edition (WAIS-III; Wechsler, 1997), Wide Range Intelligence Test (WRIT; Glutting, Adams, & Sheslow, 2002), and Woodcock-Johnson III Tests of Cognitive Abilities (WJ-III; Woodcock, McGrew, & Mather, 2001). The 2005 study by Alfonso and colleagues contains descriptions of the specific CHC model components and influences embedded within these psychodiagnostic measures.

It is notable that the same CHC ability constructs that serve as templates for the development of tests that feature "intelligence" in their titles also factor prominently into measures of "aptitude." Table 1 lists several popular

aptitude batteries along with the subtests that comprise them. It is also shown that each of the components of these batteries aligns with one of the broad or narrow constructs of the CHC model. As described in an earlier section of this entry, this illustrates the substantial overlap in the constructs typically assessed by labeled tests of intelligence and aptitude. Similarly, although aptitude tests may contain portions that are more obviously (i.e., as indicated by subtest labels) achievement related, many intelligence tests also require acquired knowledge on the part of the examinee. The popular Wechsler Intelligence Scale for Children, for example, contains several subtests that assess previously learned material (e.g., vocabulary, information).

IMPLICATIONS FOR LEARNING

The prediction of academic achievement and future occupational success remains a common practice in education as a means for guiding decisions related to student selection, diagnosis, and placement. Historically, interest in the prediction of academic achievement emerged from a variety of sources. One of these sources was the need for institutions of higher education to select students who demonstrated academic potential (Laven, 1965). A second source was from interest in the early diagnosis of students likely to suffer from academic failure, so that remedial interventions could be provided in a timely fashion (Keogh & Becker, 1973).

A variety of variables have been linked to school achievement, including cognitive ability, academic skills/readiness, language abilities, motor skills, behavioral-emotional functioning, achievement motivation, peer relationships, and student-teacher relationships (Tramontana, Hooper, & Selzer, 1988). As a result, it is important to note that any assessment of children's potential strengths and/or weaknesses should consider multiple inputs and sources. Nonetheless, evaluations of children's capacity to learn as measured by many tests of cognitive ability remain at the forefront of developing hypotheses about potential learning problems.

Psychodiagnostic tests have a rich history of accounting for meaningful levels of achievement variance (Bracken & Walker, 1997; Brody, 2002; Flanagan, Andrews & Genshaft, 1997; Grigorenko & Sternberg, 1997; Jensen, 1988; McDermott, 1984). In fact, it is often said that one of the most important applications of such tests is their ability to predict student achievement and future outcomes (Brown, Reynolds, & Whitaker, 1999; Weiss & Prifitera, 1995). From this perspective, cognitive tests can be considered useful for identifying children who are at risk for academic failure.

At the same time, there has been movement in the field to inform users of alternative ways in which aptitude

tests can be more directly tied to individual educational treatment plans. A few examples of the many ways in which aptitude test results can be used to guide individual instruction, enhance academic success, and suggest useful accommodations are provided below, and interested readers may consult Mather and Wendling's 2005 study for more details. Drawing from this source, the following examples illustrate how cognitive assessment results can be useful for guiding instruction and enhancing the learning of children. The examples are not contained within any one of the many available aptitude tests listed above, rather, they are general processes involved in different ways to student learning. As noted above, most of these contemporary tests have been constructed to tap into some aspect of the information processing system responsible for learning. As a result, these processes are largely measured in one way or another by most contemporary tests of intellectual processing.

Early language development is dependent upon children's phonological processing capacity. Children with identified deficits in phonological processing often benefit from direct instruction emphasizing linkages between phonemes and graphemes. The ability to retain and recall information over long periods of time is an important component of cognitive functioning. Children with identified long-term retrieval problems are likely to benefit from additional practice when learning new material. Including dynamic visual instruction diagrams or organizers will benefit children struggling with visual-spatial thinking, and children with processing speed deficits will often require more concise definitions of required tasks and longer periods of time to complete them.

It is important to note, however, that children at risk may have more than one type of aptitude deficit, and may also possess one or more strengths. As a result, it is important that educators take into consideration how these processes may be operating in concert. In addition, it is important to emphasize that while aptitude tests hold much promise for helping to understand the needs of children, no single test score should be used as the sole basis for decisions. A complete understanding of the potential influences of learning problems involves multiple inputs from multiple sources. It is equally important to remember that while aptitude tests explain a good portion of the variance in student achievements, they are in no way self-determining of academic success. Children's motivation, personality, classroom environment, self-image, peer relationships, student-teacher relationships, teacher instructional effectiveness, and so on also contribute to student success.

SEE ALSO *Accountability; High Stakes Testing; Intelligence: An Overview.*

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AR

SEE *Attributional Retraining*.

ARGUMENTATION

Argumentation is a form of discourse in which individuals take a position, justify that position with claims and evidence, and address possible counterarguments. In school settings, argumentation may involve contrasting alternative hypotheses in a lab, questioning the sources used to construct an historical account, or revising a

literary analysis to include more textual support. In each of these activities, students engage in dialogue with a peer, an author, or themselves to evaluate claims and evidence. Whether it occurs socially, as it would in conversation or debate, or privately, as in writing or thought, argumentation involves building knowledge by considering claims in a framework of alternatives. Seen in this light, argumentation holds at least two important benefits for classroom learning: First, it can be used as an instructional tool to enhance learning. The process of argumentation can be used to prompt students to build and test the explanatory foundations of their knowledge. Second, argumentation can serve as a context for developing students' disciplinary thinking skills. Argumentation lies at the heart of all academic discourse, and when students learn to argue in the classroom, they learn to adopt the language, standards, and procedures for building knowledge in that discourse community.

ARGUING TO LEARN

Argumentation can help students develop a strong base of content knowledge in a number of ways. First, it provides a context within which students can elaborate their knowledge. When students engage in elaborative processing, they seek to understand the reasons why something is the case, rather than simply accepting that it is the case. They go beyond what is explicitly stated in a text or conversation to produce knowledge that is more complex, integrated, and, ultimately, more meaningful to them. This deeper processing of information, in turn, promotes memory and comprehension of the material to be learned. When students argue, they engage in a form of elaborative questioning in which they ask partners to clarify statements, justify claims, and respond to counterarguments (Kuhn, 2005). In these argumentative exchanges, students must move beyond accepting or advancing a simple assertion to questioning, critiquing, or establishing the grounds on which the assertion rests (Chinn, Anderson, & Waggoner, 2000). This process of argumentation, in turn, allows students to fill in gaps in their understanding, examine claims and evidence, and consider alternative perspectives. Students can gain similar benefits from the elaborative effects of writing arguments. For example, when students write arguments to link information in the texts they read, they are more likely to grasp the underlying causal relationships between events described in the text than when they write narratives, summaries, or explanations (Wiley & Voss, 1999). Thus, engaging in argumentation, whether collaboratively or on one's own, prompts students to make sense of content knowledge in a way that other more processes do not.

Argumentation can also be used to address student misconceptions in content knowledge. Science educators,

The basic elements of a two-sided argument

Position	The author's stand on the issue under discussion.
Claim	An argument used to support the author's position.
Opposing claim	An argument used to support a position that opposes the author's position.
Evidence	Grounds used to support a claim or opposing claim.
Counterargument	A critique of a claim, implied or explicit.
Rebuttal	A response that aims to neutralize a counterargument.
Qualification	A modal or modifier that communicates the force of the author's position.
Reservation	A reference to the conditions under which the author will hold or abandon a position.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

for example, have long struggled with the problem of how to promote conceptual change when students hold misconceptions that interfere with learning. Challenging students to confront misconceptions can be exceedingly difficult because students may ignore conflicting information, misinterpret it, or, in some cases, even accept incompatible beliefs as true without realizing. Early research in promoting conceptual change yielded mixed results in part because confronting students with an experience that contradicts their beliefs does not prove to be enough to advance their understanding (Limón, 2001). Several studies have explored the effects of argumentation as an intervention for helping students to address prior misconceptions. When students argue with peers about the meaning and implication of conflicting data, they can prompt one another to re-examine their beliefs and assumptions (Bell & Linn, 2000), reconcile discrepancies in their collective understanding (Nussbaum & Sinatra, 2003), and fortify their conceptual knowledge (Zohar & Nemet, 2002). Studies such as these suggest that argumentation encourages conceptual change by making students' beliefs explicit and open to evaluation (Kuhn, 2005).

Of course, not all argumentation is conducive to learning. Social psychologists have long been aware of the potential in argumentation for polarizing people, making individuals resistant to examining or revising their beliefs (Lord, Ross & Lepper, 1979). These negative effects are heightened by a phenomenon called *confirmation bias*, or the tendency for individuals to seek out evidence that supports their beliefs, while overlooking, ignoring, or undervaluing evidence that contradicts their beliefs (Wason, 1960).

Here it is useful to distinguish two overlapping activities: dispute and deliberation. These kinds of discourse

involve contrasting alternative claims, but they can be distinguished by their goals. In dispute the goal is to win the argument, whereas in deliberation the goal is to choose a best explanation or course of action. These divergent goals affect how individuals respond to alternative claims and evidence. In dispute, alternatives must be effectively eliminated, neutralized, or ignored. In deliberation, alternatives may be rebutted, but they may also be adopted, integrated, or change through compromise. However individuals choose to respond to them, alternatives are addressed in such a way that avoids bias and seeks coalescence of the arguments and evidence (Gilbert, 1997).

In the classroom context, students may have difficulty grasping the deliberative goals of argumentation. Many students have little experience with deliberation before they enter school, and by habit they follow the goals and structure of dispute. But in many ways, the classroom is the ideal context in which to introduce older children and adolescents to deliberation. Because it is so rare in everyday argument and because it goes against certain mental habits, students need to have deliberation taught in school where teachers can assist them in the process.

LEARNING TO ARGUE

Learning how to argue begins in the home and on the playground long before children come to school (Eisenberg & Garvey, 1981). Typically, by age five, when most children enter formal schooling, they have had extensive experience with argumentation in their everyday dialogue with adults, siblings, and peers. Whether fighting with a playmate over a toy or pleading with parents to stay up a little later, children come to understand that people can hold conflicting goals and desires. At some time during preschool, they realize that they must be able to produce reasons and evidence to substantiate their requests in response to the questions and claims of others. In these early conflicts, children often invoke personal preferences and motives to justify their assertions (e.g., "I want to play with the truck now because it's fun for me"). But as they develop, they come to recognize that arguments must be won not only by asserting a position, but also by addressing the legitimacy of that position in light of alternatives. They realize that they must appeal to mutually acceptable justifications to prevail and they must demonstrate that one position is better substantiated than others (e.g., "I want to play with the truck now, because you've had a turn with it and we all have to share.") This advance marks a critical turning point in two-sided thinking and lays the foundation for academic forms of argumentation in two ways: children begin to recognize the need for evidence to support their claims, and they recognize the need to address alternatives.

By middle school, most adolescents have learned to advance, contrast, and reconcile perspectives, pushing themselves and their peers to strengthen arguments by asking questions, requesting evidence, or proposing counterclaims in conversational contexts (Felton & Kuhn, 2001). In dialogue, young adolescents demonstrate a clear competence in producing the basic elements of argument as they respond to their peers' claims, questions, and challenges. But these sophisticated skills of argument are often limited to the highly supportive context of dialogue on familiar and generally non-academic topics (Stein & Miller, 1991). Despite the growing consensus that students come to school with the basic skills in argumentation intact, in academic contexts, they nonetheless produce simple, unsubstantiated claims that fail to address alternative claims and evidence. This gap seems to result from the unique demands that academic argumentation places on learners. Ultimately, students must learn how to adapt their basic skills of argument to meet the academic demands of classroom argumentation.

ADDRESSING DIFFERENCES IN CONTENT KNOWLEDGE

Due to differences in content knowledge, some students are better prepared than others to argue in academic contexts. When two children argue about who is the best pitcher in a baseball league, the quality of their discourse will depend on their knowledge of performance statistics and the qualities of good pitching. Similarly, to argue well in school, students need ready access to disciplinary knowledge in order to construct valid and effective arguments (Stein & Miller, 1991). For this reason, teachers should embed argumentation in units that offer students direct access to information and evidence in classroom discussions.

Limited content knowledge can also have a negative effect on students' ability to process and recall arguments that contradict their own views. More knowledgeable students have extensive resources to support the processes of encoding, retrieving, and reconstructing opposing side arguments, while less knowledgeable students are left to rely only on their position. As a result, less knowledgeable students are less likely to represent two-sided arguments in memory. However, presenting students with alternative arguments, especially when they are juxtaposed on point-counterpoint fashion, can reverse the biasing effects of limited content knowledge on memory (Wiley, 2005). Therefore, teachers should take care that students have direct access not only to information and evidence when they argue, but also to claims and counter-claims. Over time, with access to claims and evidence, students will be equipped to engage in effective argumentation and gain access to its beneficial effects on knowledge building.

DEVELOPING STANDARDS FOR EVIDENCE USE

Successful students produce better arguments because they are more familiar with content knowledge and because they understand how to use evidence to advance and evaluate claims in a discipline. In history class, for example, students must learn to cite primary and secondary sources while taking the biases of these sources into account. They also learn to draw legitimate cause-and-effect relationships and to argue effectively from historical precedent. Argumentative dialogue in the classroom creates a context for students to develop these skills. In the process of arguing with peers, students discover what questions need to be asked, what claims need to be proven, and what evidence might be used to prove it (King, 1990). They have evidence-use modeled for them by peers, and they also have the opportunity to make judgments about the legitimate use of evidence to support a claim. A history student, for example, might cite a textual source to prove a point, only to have a partner question the reliability of that source. A science student might cite data to support a hypothesis, only to have a peer use the same data to support an alternative hypothesis. Such exchanges provide more than a forum for testing understanding: They offer an opportunity for students to explore questions about why, when, and how evidence can be used to advance claims in a discipline.

But argumentative dialogue in this case is only the impetus for learning about evidence use. Teachers must follow up peer dialogues with discussions about disciplinary sources of evidence and standards of evaluation as students discover a need for them. In the history example above, teachers might follow up an argument about source bias with samples of two conflicting accounts and a discussion about detecting bias. The science teacher in the example above might prompt students to argue alternative hypotheses and then discuss the experimental control of variables. In short, argumentation can enhance the existing curriculum by providing anchor experiences that illustrate the essential role that evidence and its analysis play in knowledge construction. It gives students a concrete and immediate context in which to learn about evidence. Coordination of peer-dialogue and teacher-led discussion is essential for advances in the use of evidence. Without the addition of teacher-guided reflection, argumentative dialogue among peers runs the risk of perpetuating low standards and misconceptions about the appropriate use of evidence (Anderson, Howe, Soden, Halliday, & Low, 2001).

INTERNALIZING ARGUMENT STRUCTURE

To be successful in academic tasks, students must also learn to transfer the skills of argument from collaborative

to independent settings. Whether they are writing an essay, taking a test, or preparing a report, students must be able to produce claims, evidence, counterarguments, and rebuttals without relying on their peers to prompt them. They must internalize the dialectical process, so that they can independently advance and critique opposing perspectives. Argumentative dialogue offers an excellent opportunity for students to discover that they already produce the elements of argument spontaneously. This discovery, in turn, can serve as a point of entry for developing a model of what complete arguments must include. To harness these skills of argument, teachers must introduce students to the vocabulary and structure of argument, helping them to see beyond the content of dialogue to its underlying structure.

In his seminal work “The Uses of Argument” (1958) Stephen Toulmin offers a useful framework for describing the elements of argument that has been adapted for use in a variety of instructional contexts and disciplines. Simplified versions like the one in Table 1 have been effective in introducing students to the basic elements of argument. But it is essential to introduce these elements in the context of real argumentation—either in dialogue or in written materials. Without reference to concrete argumentation, terms such as these are vague and offer few benefits to students. In a single introductory lesson, teachers can introduce students to these elements by helping them apply them to a brief conversation. With practice applying these terms to their dialogues (Felton, 2004; Osborne, Erduran & Simon, 2004), as well as prompts from teachers to include these elements during whole-group discussions (Reznitskaya et al., 2001) students can learn to produce the elements of argument more consistently on their own. The combination of firsthand experience in argumentation, and critical reflection on the strengths and weaknesses of the arguments they produce, sets the stage for internalizing dialectal reasoning.

Once teachers have introduced students to a vocabulary for describing argument and modeled its application to dialogue, they can then scaffold the transfer to writing. There are a number of reasons why argumentative writing is particularly challenging for students. First, novice writers often have difficulty discerning the underlying goals and purposes of writing tasks. Without direct instruction embedded in content, they misrepresent the purpose of writing, or more often, they write without elaborated goals to guide the planning and composing process. However, with explicit directives in goal setting, students can write more complete arguments (Graham, MacArthur, & Schwatz, 1995). In addition, students often have difficulty with the structure of genre-specific writing. Argumentative writing calls for new text structures that require greater organizational and linguistic processing than is required from genres emphasized

earlier in the school curriculum (Coirier, Andreissen, & Chanquoy, 1999). Therefore, most students need support in developing the text structures that allow them to organize and examine their writing. This can be accomplished with the use of question stems, graphic organizers, or mnemonic cues (King, 1990; Osborne, Erduran, & Simon, 2004). Whatever the method, teachers should provide support to help students structure their essays. With consistent exposure to scaffolds like these, students learn to produce written arguments that acknowledge alternative viewpoints, cite and rebut counterarguments, and provide evidence to support their claims.

CLASSROOM IMPLICATIONS

To optimize its effects on student learning, teachers must make argumentation an integral part of the classroom experience. The questions teachers pose and the conversations that ensue have a direct impact on what students see as the purpose and form of academic work in general and argumentation in particular (Halldén, 1994). Through classroom discourse, teachers communicate their assumptions about the degree to which students must draw on evidence and justification to undergird their knowledge of the content. They also set implicit expectations on what it means to know or understand the content. Studies suggest that when readings, writing, and classroom discourse align regarding the goals of argumentation, students show measurable improvements in their ability to produce elaborated arguments (Nystrand, 1997). Conversely, when there is a lack of alignment in the curriculum, students do not show comparable improvements. Direct instruction in argumentative text structures and the goals of argumentative writing are insufficient in promoting change when classroom discourse lacks opportunities for authentic argumentative discourse.

Unfortunately, all too often, classroom discourse is dominated by direct instruction or recitation with few opportunities for students to engage in the meaningful examination of knowledge (Nystrand, 1997). Driven by the demands of a dense curriculum and high-stakes testing many teachers may feel that they cannot afford the time to teach thinking skills. Nonetheless, when compared to traditional recitation-based lessons, student-centered argumentative discourse is more effective in promoting student engagement and deeper cognitive processing of the content (Chinn, Anderson, & Waggoner, 2001). When students have the opportunity to collaborate in constructing arguments and examining evidence, they are more likely to find meaning in the content. A growing body of research suggests that while argumentation may take time away from coverage in the curriculum, it may also promote lasting effects in both content knowledge and disciplinary thinking.

SEE ALSO *Constructivism: Inquiry-Based Learning: Critical Thinking: Reasoning.*

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Mark K. Felton

ASSERTIVE DISCIPLINE

SEE *Classroom Management: Assertive Discipline*.

AT-RISK STUDENTS

The construct of being at-risk originated in the field of epidemiology. When epidemiologists conduct studies, they try to identify so-called risk factors (e.g., obesity), which are characteristics of people or environments that are predictive of health problems (e.g., heart disease). After risk factors have been identified in the first wave of studies, epidemiologists then create interventions to reduce the incidence of health problems by targeting the risk factors that are both highly predictive and modifiable.

When the term at-risk is applied to the field of education, it pertains to children who are identified as being more likely than other students to experience undesirable educational outcomes such as low achievement, suspensions, or dropping out of high school. After identifying the children who are particularly at risk for such outcomes, the goal then becomes one of creating interventions to help these children be more successful.

EVOLUTION OF THE CONSTRUCT

In the 1970s and 1980s, the phrase *at-risk students* slowly replaced the phrase *disadvantaged students* in the educational, psychological, and sociological literatures (though the latter continued in use into the early 2000s). Since the early 1990s, however, an increasing number of scholars have advocated using the phrase *students placed at risk* instead of *at-risk students*. The reasons for these multiple shifts in reference pertain to arguments that have been made regarding the implications of these expressions for the causes of educational failures, optimal research methodologies, and intervention strategies. For example, it could be argued that the term *disadvantaged* conveys the idea that group differences in achievement are primarily due to differences in family income and educational opportunity. This term does not seem to commit the speaker to a particular research strategy for revealing the nature of achievement differences, but authors who use the term would presumably agree that achievement differences could be ameliorated by providing increased opportunity to the disadvantaged group.

In contrast, the descriptor *at-risk for educational failure* focuses the reader's attention on the outcome rather than on the cause of learning problems and does not necessarily imply that income and opportunity are the primary or sole factors that are predictive of educational failure. In addition, authors who use the *at-risk* phrase seem (intentionally or unintentionally) to commit themselves to endorsing the idea that the epidemiological model is a useful approach for understanding ways to promote educational achievement and prevent educational failure. Endorsement of the epidemiological model, in turn, commits one to acknowledging the benefits of a research strategy in which researchers (a) take a longitudinal, developmental perspective in which they follow children from the time they enter school until they experience educational problems, and (b) gather data on various characteristics of students and their environments to see which factors are most predictive of subsequent educational problems (i.e., risk factors). Moreover, the epidemiological model specifies that interventions should target the most predictive risk factors that are modifiable (as noted earlier).

Although the standard epidemiological approach has remained prevalent in the literature, some scholars have rejected it for several reasons. First, they argue that it seems to place the blame on students themselves by focusing on their personal characteristics (e.g., their poverty or lack of readiness) instead of focusing on the characteristics of schools and other societal institutions (e.g., communities; school systems; legislators and policy makers); in so doing, schools and other societal entities are apparently freed from having any responsibility for children not succeeding. Hence, the perspective suggests

that students should be the targets of intervention, and schools do not have to change how they treat at-risk students. Advocates of the *placed at risk* phrase argue further that many of the predictors of failure that have been identified in epidemiological studies (e.g., poverty) pertain to what is lacking in children and their families. As a result, the focus becomes one of remediating deficiencies in children and using the deficiencies as a reason for restricting access to quality educational experiences.

Critics of the *at risk* phrase argue for using the substitute phrase *students placed at risk* because it carries the connotation that others (e.g., teachers, school systems) have placed students at risk by treating them in certain ways. Instead of merely remediating deficiencies, they argue, school systems should focus on building on the strengths that students bring to school (e.g., their knowledge, talents, and interests). Moreover, advocates of the *placed at risk* phrase argue that educational failure is really the result of a poor fit between student characteristics and the classroom environment. To improve the fit and help students be more successful, interventions should focus on creating changes in both students and the classrooms in which they find themselves.

Other scholars have pointed out two further aspects of the epidemiological model that they believe to be problematic. The first is that the model seems to assume that risk factors work in an additive fashion rather than in an interactive fashion. For example, in an additive model, factors such as poverty and inadequate instruction each increase the risk of failure by a certain amount and the total amount of risk is determined by adding together the amount supplied by each of the two factors. However, if risk is defined by the lack of fit between student characteristics and characteristics of schools, such an additive account fails to capture what is really going on. A more apt account, they argue, would be one that describes the interacting effects of multiple factors. If a school uses ability grouping, for example, and a student comes to school with a high degree of aptitude for learning the material presented to the top ability group (i.e., the student has the prerequisite knowledge and motivation needed to take advantage of this enriched environment), such a combination would lead to highly favorable outcomes. Other combinations, in contrast, would lead to much less favorable outcomes because there would be a poorer fit between students and classrooms.

One additional problematic aspect is that the epidemiological model tends to ignore the fact that risk categories are not perfectly predictive, that individual cases fail to conform to expectations. Although it may be true that many or most children from low-income families fail to attain adequate levels of competencies in reading and mathematics, for example, some do achieve in spite of their circumstances. Conversely, although it is true that

many or most children from affluent families attain adequate levels of competence in reading and mathematics, some do not in spite of their access to high quality environments. The focus on the degree of fit between individual children and their potentially unique circumstances at home or school allows one to explain both the cases that conform to expectations and cases that do not conform.

FURTHER ELABORATIONS

The phenomenon in which children attain favorable developmental or educational outcomes in spite of the adversity they face is called resilience. As noted earlier, variables that increase the probability of negative outcomes (e.g., low achievement) are called risk factors. Studies suggest that the likelihood of academic failure increases dramatically each time additional risk factors accumulate in a child's life. In contrast, variables that counteract or buffer the effects of risk factors are called protective factors. As the level or number of protective factors in students' lives increases, students are increasingly likely to demonstrate resilience. A third class of factors called promotive factors also increase the likelihood of favorable educational outcomes but do not operate to buffer the effects of risk factors per se. Instead, they promote academic achievement in both disadvantaged children (who are exposed to multiple risk factors) and advantaged children (who are not exposed to the same risk factors). The fact that variables in the third category promote achievement in advantaged children means that they are not working to buffer the negative effects of risk factors.

The risk factors that have been found to be predictive of academic failure include poverty, race, gender, presence of a learning disability or attentional disorder, mental health problems, inadequate levels of prerequisite skills upon school entry, exposure to multiple stressful events, living in a single-parent family, alliance with non-academically oriented peers, and repeatedly transferring to new schools. More specifically, children are more likely to experience educational failure if they (a) come from a low-income home, (b) are African American, Hispanic, or Native American, (c) are male, (d) have a learning disability, attentional disorder, or emotional disorder, (e) enter first grade without foundational abilities in language (i.e., a large spoken vocabulary and knowledge of syntax), literacy (i.e., the ability to identify sounds in words and recognize letters), and mathematics (i.e., counting skills), (f) have to repeatedly deal with stressful events such as marital discord, parental job losses, and violent acts, (g) live with just one parent, (h) have friends who are not good role models for academic achievement and engagement, and (i) move to new schools multiple times throughout their elementary school years.

COMPARISON OF SCHOOL ENVIRONMENTS FOR STUDENTS OF DIFFERING ECONOMIC STATUS

Low Income: Administrators encourage teachers to emphasize basic skills and mastery of those skills before higher level thinking is introduced. **Middle/Upper Class Income:** Classroom teachers are encouraged to emphasize both basic skills and high level thinking skills.

Low Income: The goals or expectations seem to be lower than the state benchmarks. **Middle/Upper Class Income:** State mandated benchmarks are the goals for at risk students in this group.

Low Income: Skills in subject areas are taught as distinct and usually in isolation from each other. **Middle/Upper Class Income:** Skills and subjects are integrated and students have the opportunity to experience a more balanced curriculum.

Low Income: An ideal classroom is one where the students are sitting at their desks, quietly working. The teacher is in charge of all information and the dispenser of information. **Middle/Upper Class Income:** The teacher often sets up situations where there is collaborative learning is encouraged. There is a great deal of conversation and guided practice. Independent learning is the goal in this situation. Peer coaching, group discussions, hands on activities, differentiated instruction are just a few of the ways that teachers secure success for at risk students.

Low Income: Programs for at risk students in Title One or low income schools often involves the implementation of pull out programs taught by Special Education Teachers where special skills are addressed away from the context of the regular education classroom. **Middle/Upper Class Income:** Programs in these schools tend to use the Special Education Teacher as a resource in the regular education classroom. Often the Special Education Teacher acts as a Collaborative Teacher in the regular education classroom. In addition, Special Education Teachers are used as pedagogical consultants.

Low Income: Although individual educational assessment meetings occur, it is difficult to evaluate the effectiveness of the plan by the regular classroom teacher. Often the classroom teacher does not know the accommodations. **Middle/Upper Class Income:** Because students are usually in a regular education classroom, the teacher is able to monitor the plan developed in the individual educational assessment.

Low Income: For various reasons, lack of parent in the home, transience, and unsettled living situations, there

is very little family participation in learning. It is difficult to communicate with parents because they may not have a phone or are unavailable during the school day. **Middle/Upper Class Income:** Family participation in learning seems to be a key factor in success of students in this group. There are frequent phone calls and parent conferences. In addition, parents are encouraged to volunteer in the school.

Low Income: The Core Curriculum is static and doesn't reflect current thinking in pedagogy. Although encouraged to do so, the opportunity to attend workshops and seminars is not often presented to the teacher. **Middle/Upper Class Income:** The Core Curriculum is dynamic and reflects the needs of the school community and the community at large. Teachers are encouraged to investigate new and different ways to make learning happen. Workshops, seminars are made available to classroom teachers.

Low Income: The teacher is the holder to the key to the information or a dispenser of knowledge. **Middle/Upper Class Income:** As a partner in learning, the teacher is respected as the "go to" person for information on how to help the child be more successful.

Low Income: There is higher level of violence and non standard social behavior in the classroom and the school community. **Middle/Upper Class Income:** In higher income level school communities, programs like Alternative Education or Alternative Schools are possible because of the additional funds available for such programs.

Low Income: For a variety of reasons, students in this population spend more time at home. Some researchers believe that this isolation causes poor academic success. **Middle/Upper Class Income:** Students who have neighborhood and community support can also find success in school.

Low Income: Students living in areas of extreme poverty often distrust adults, avoid making friendships, seem hopeless or disinterested, and respond only to orders. **Middle/Upper Class Income:** Students in this population are more open, seem to have a number of friends inside and outside the classroom.

Low Income: Teachers incorporate multicultural elements into the lesson plans. **Middle/Upper Class Income:** Teachers accept and encourage students' racial, ethnic and cultural differences.

Elizabeth Soby

In contrast, the factors that have been found to play either a promotive or protective role include average or above average levels of general intelligence, average or above average levels of specific academic skills (e.g., math skills), high levels of self-efficacy, positive relationships with teachers and other adults (e.g., clergy, counselors, coaches), engagement in and attachment to, school, alliance with academically oriented peers, parental monitoring and parental engagement in offspring learning process, adaptive coping skills for dealing with stressful life events, and ethnic identity.

These variables, described more fully in the next section, operate at different ecological levels. Whereas some are characteristics of neighborhoods, others pertain to family, peers, classrooms and schools. Moreover, some are modifiable and others are not. Of particular importance are those factors that have been found to mediate between risk factors and undesirable educational outcomes. Studies suggest, for example, that some children manage to fare well in school even though they live in low-income, high crime neighborhoods and attend schools that are plagued with staffing problems and lack resources. Those children who achieve in spite of such circumstances come from homes in which their parents demonstrate optimal parenting practices and utilize community resources (e.g., sport teams, church groups, libraries). School improvement programs can also be effective for mediating between risk and outcomes.

However, researchers are still in the process of determining the complete and definitive list of such factors and their relative importance (i.e., which ones are more strongly predictive than others). The provisional state of knowledge in this regard derives from the fact that researchers have generally not taken a comprehensive approach in which they assessed the role of all of the above factors in the same study. It has often been found that certain factors (e.g., parent involvement in their child's school) are predictive of academic outcomes when examined alone or in combination with a few other factors that do not predict strongly, but are no longer predictive when a larger list of factors is examined or when particularly powerful predictors are included in addition to the focal factor (e.g., prior achievement). Moreover, many of the risk factors listed above co-occur in the same individual. For example, African American students (risk factor 1) are more likely than European American students to enter school without the foundational skills they need to be successful (risk factor 2) and are also more likely to live in a low-income (risk-factor 3), single parent home (risk factor 4) and attend a school with a higher percentage of uncertified teachers (risk-factor 5) and peers who eventually drop out of school (risk-factor 6). When only one of the risk factors is studied in isolation and is found to be predictive (e.g.,

race), its predictive role may actually reflect its association with other predictors that are more authentically connected to, or causally responsible for, academic failure (e.g., poverty or lack of foundational skills).

THE IMPORTANCE OF A COMPREHENSIVE THEORY

Identification of the complete set of authentic and modifiable factors in the risk, promotive, and protective categories is the first step in creating more effective forms of intervention. The second step is to identify the most powerful of these predictors so that interventionists can know which factors should be specifically targeted as a means of producing more immediate or larger effects. The third step is to combine the set of identified factors into a coherent causal story using an integrative theoretical model. In other words, it is useful to know that particular factors are predictive, but it is even more useful to understand why these factors are predictive and how they conspire over time to produce educational outcomes. When the association between a predictor and an outcome is somewhat mysterious, it is not clear how one should intervene and some inferences could lead to the implementation of ineffective strategies. For example, in the association between poverty and low achievement, it does not follow that higher achievement would immediately ensue if additional funds were to be supplied to low-income families. The association may be due to the fact that high income parents provide opportunities at home that instill prerequisite skills in their preschoolers before they start first grade. If so, a more effective form of intervention than simply providing funds would be one in which parents of low-income preschoolers are taught how to instill reading and math readiness skills in their children.

A number of scholars have suggested that Urie Bronfenbrenner's Ecological Model can be used to integrate various factors into a coherent explanatory account of educational success or failure. In this model, factors are categorized in terms of the sociocultural level at which they influence developmental outcomes. The most proximal factors that operate within a student's immediate environment are said to be part of the microsystem of influences. This level includes factors such as a student's personal characteristics and behaviors (e.g., current knowledge and beliefs) and relationships with others such as parents. Operating at a more distal level are factors that influence other students in the same community and subculture such as local cultural norms, local educational policies, and belief systems shared by the local community. Collectively, such variables comprise the mesosystem of influences. At the most distal level are influences that comprise the macrosystem of the model such as national school policies and the belief systems shared by the larger

culture of an embedded local subculture. Advocates of the Ecological Model argue that interventions must target factors from each of these levels in order to be effective and that certain factors at specific levels can mediate between risks and outcomes.

Alternatively, factors can also be integrated within an Opportunity-Propensity framework. Opportunity factors are those variables pertaining to the provision of high quality educational experiences. Students have been given excellent opportunities to learn when they are presented with the content required on achievement tests in an accurate and effective manner by a skilled teacher. Propensity factors are characteristics of students that pertain to their ability and willingness to take advantage of opportunities to learn (e.g., intelligence, prerequisite skills, motivation, and self-regulation). Factors in a third category explain the emergence of opportunities and propensities (i.e., why some students are given more opportunities and are more likely to take advantage of these opportunities): family socio-economic status, parental expectations, gender, race, and school policies regarding ability grouping. Because the latter factors operate earlier in time than opportunity factors and propensity factors, they are called distal factors. The Opportunity-Propensity framework suggests that interventions are more effective when they target opportunity factors, propensity factors, and distal factors.

EFFECTIVE PROGRAMS FOR AT RISK STUDENTS

Arthur J. Reynolds of the University of Minnesota examined the extensive literature on early interventions and developed the following eight principles of effective early childhood programs: (1) target the children who are at highest risk of school difficulties, (2) begin participation early and continue until second or third grade, (3) provide comprehensive child development services, (4) encourage active and multi-faceted parent involvement, (5) use a child-centered, structured curriculum approach, (6) limit class size and teacher/child ratios, (7) include regular staff development and in-service training for certified teachers, and (8) engage in systematic evaluation and monitoring. Programs that conform to these principles and produce significant effects (according to meta-analytic reviews) include the High Scope/Perry Preschool program, the Abecedarian Project, and the Chicago Child-Parent Center program. All of these programs target a number of factors identified earlier as being promotive, protective, or relevant to educational opportunities and propensities.

In terms of programs for elementary and middle school students, Olatokunbo Fashola and Robert Slavin in 1997 published a best evidence synthesis of the effectiveness literature in which they included any program in

which (a) the performance of students in the intervention schools was compared to the performance of students in appropriate comparison schools, (b) the program was implemented in more than one school and success did not appear to depend on unique or specifically favorable conditions at one school, and (c) the program was found to be effective for low-income and minority students. Thirty programs were found to meet these three criteria for inclusion. Fashola and Slavin concluded that programs tend to be more successful when they (a) have clear goals and monitor student progress toward these goals, (b) have well specified programs, materials, and professional development procedures, and (c) are disseminated by organizations that monitor fidelity of implementation.

In terms of interventions for older students, Fashola and Slavin published a follow-up best evidence synthesis of the literature on dropout prevention programs and college attendance programs for at-risk high school students. Two dropout prevention programs met the inclusion criteria for having credible comparison groups, being effective, and being replicable across settings: the Coca Cola Valued Youth Program and the Achievement for Latinos for Academic Success program. Four college attendance programs met these criteria as well: Upward Bound, SCORE, Project Advancement via Individual Determination, and Graduation Really Achieves Dreams. These programs were apparently successful because they focused on multiple causes of these educational outcomes such as self-efficacy, relationships with others, school-parent connections, and enhancement of prerequisite skills.

SEE ALSO *Bronfenbrenner, Urie.*

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James P. Byrnes

ATTACHMENT

Emerging in the 1940s, attachment theory is the joint work of John Bowlby (1907-1990) and Mary Ainsworth (1913-1999). Attachment theory relates to strong, affectionate bonds that human beings share with each other. Bowlby specifically defined parental attachments as inherent, affectionate bonds between infants and their primary caregivers. Attachment relationships tend to be relatively enduring throughout the lifespan and serve two primary purposes. First, they provide infants with the comfort, care, and security that they need for survival. Second, they serve as templates for relationships that infants develop later in life with others such as friends, teachers, colleagues, and romantic partners. Since its inception, attachment theory has been examined by a number of scholars and continues to be researched in new areas. For instance, research regarding attachment relations among persons of color has begun to emerge. In addition, beginning back in the 1980s, several contemporary, key scholars began examining of the influence of attachment relationships on numerous outcomes such as motivation, student-teacher relationships, transitions to college, psychological health, and social adjustment, to name a few.

Several key figures in the attachment literature beyond Bowlby and Ainsworth have emerged throughout the decades (from the 1940s to the early 21st century), and new scholars continue to supply meaningful contributions. Ellen Moss, who examines attachment relationships and behavioral problems among school age students, has published numerous academic articles on the subject. Diane St. Laurent studies the influence of parental attachment relationships on peer relationships, academic outcomes, and behavioral outcomes among primary and elementary school children. Kathryn Wentzel examines the influence of parent and peer attachments, and teacher pedagogical caring (perceptions that students have of their teacher providing care and support) on motivation, student adjustment, and academic adjustment among students from a variety of ages. Other key figures include Maureen Kenny, who researches the influence of parental attachment relationships on mental

health outcomes among adolescents and young adults. Lastly, Kenneth Rice examines the influence of parental attachment relationships on outcomes such as psychological, social, and emotional well-being to predict students' adjustment to college. A review of the work of any of these scholars will provide an insightful, informative look into the theoretical and practical aspects of attachment theory. However, the following entry provides a basic understanding of attachment relationships and their relation to various outcomes.

FORMATION OF ATTACHMENT BONDS

Parenting behaviors are said to give rise to the formation of the relationships. Attachments are based upon two primary behaviors that caregivers display towards their children: (1) the caregiver's accessibility and responsiveness, and (2) the caregiver's ability to provide protection and security. Attachment relationships are represented in the form of cognitive working models (i.e. thoughts) that infants hold of themselves and others based upon the two primary caregiver behaviors. Infants whose caregivers are affectionate, warm, and responsive to their basic needs for care develop a positive self-view, for they know that they are worthy and deserving of love. Conversely, infants whose caregivers are cold, aloof, neglectful, or inconsistent develop a negative view of themselves because they think that they are not worthy or deserving of love. The extent to which the caregivers provide security and protection shapes infants' view of others and the world. On the one hand, caregivers who protect their infants from harm and provide security prime their infants to develop positive views of others and the world for they see others as reliable and trustworthy and view the world as safe for exploration. On the other hand, caregivers who do not provide security prime their children to view others as unreliable and untrustworthy and to view the world as unsafe.

INDIRECT INFLUENCES OF ATTACHMENT RELATIONSHIPS

While parenting behaviors are the primary catalysts that shape attachment relationships, other contextual (i.e. environmental) factors have also been found to indirectly contribute to the formation of attachment relationships, making attachment bonds complex. For instance, parents with better psychological health provide their infants with higher quality care. Hence, infants of these caregivers tend to be attached more securely (or positively) than infants whose caregivers are psychologically maladjusted or distressed. For instance, clinically depressed mothers or caregivers who engage in intrusive, hostile, and/or unresponsive care giving due to their depression are likely to have children who are insecurely attached (negatively attached).

Greater marital or relationship satisfaction is also associated with attachment security, as these caregivers tend to display more sensitive parenting skills that contribute to the formation of secure attachments.

Both Bowlby and Ainsworth argue for the universality of attachment relationships, stating that attachment relationships occur cross-culturally due to their biological basis. However, demographic factors, including race/ethnicity and socioeconomic status (SES), have also been shown to contribute to the formation of attachment relationships, and even influence views of the ideal attachment relationship. As Robert Hinde (1991) states: "what is biologically best in one situation may not be so in another. Natural selection tends to produce not rigid types of behavior, but alternative strategies . . . so while a secure mother-child relationship may be best in some instances, other types of relationships may be better in others" (pp. 160-161). The presence of attachment relationships has not been challenged, but the criteria utilized to classify individuals as secure or insecure has been challenged. For instance, caregivers in Japan would fault caregivers in the United States who encourage their infants to be explorative and autonomous because Japanese caregivers value continuous, close proximity and contact with their infants. Therefore, cultural contexts must be considered when evaluating attachment relationships.

Caregivers from lower incomes often have to contend with added stressors such as financial worries and being able to provide adequate clothing and shelter for their children. Continuous exposure to these stressors has been known to create psychological maladjustment (e.g. depression and/or anxiety) that negatively affects the quality of the attachment relationship. Despite the negative influence that a lack of resources may have on attachment security, additional support from extended family and friends may minimize these negative influences. Social support networks can provide children with the opportunity to form secure bonds with other adult caregivers or may afford parents the opportunity to provide better quality care for their children by lessening the burden of fulfilling other obligations that may detract from providing quality care.

A majority of research related to attachment theory focuses on parents' influences on their children. However, attachment relationships are bi-directional in that parental and infant characteristics influence the attachment bond. For instance, oftentimes overlooked, infants' temperament is one such factor that is said to influence attachment bonds. While numerous definitions of temperament exist, temperament generally refers to basic, inherent dispositions that guide human behaviors, such as expression, reactivity, emotionality, and sociability.

Thomas and Chess identify three temperament styles: Easy, Difficult, and Slow-to-Warm. Children with Easy temperaments develop regular sleeping and feeding schedules, smile at strangers, are interpersonally pleasant and joyful, adapt easily to new situations, accept most frustration with little fuss, and are typically easy to parent. By contrast, Difficult children are irregular in their biological functions, irritable, fussy, non-adaptive, withdraw from new stimuli, and are generally difficult to parent. Slow-to-Warm children have mild intensity in expression, are somewhat regular in their biological functions, and tend to approach new situations, but they also tend to take longer to adapt to new situations and are slower to warm interpersonally than Easy children are. Thomas and Chess estimate that 40-50% of infants are Easy, 10-20% are Difficult, and 15-25% are Slow-to-Warm.

How does temperament relate to attachment relationships? Caregivers often report that it is more challenging to interact meaningfully with Difficult children because they are fussy, irritable, and non-adaptive. Therefore, it is difficult to form an affective bond with these children. However, children with Easy or Slow-to-Warm temperaments are interpersonally pleasant, adaptive, and not fussy, which makes bonding easier, so children with these type of temperaments help facilitate bonding.

CLASSIFICATION AND MEASUREMENT OF ATTACHMENT STYLES

Ainsworth identified three types of attachment styles based upon observations of caregivers interacting with their infants (roughly 1 year of age) during a research experiment called The Strange Situation. The attachment styles include the insecure-avoidant (pattern A) style, the secure (pattern B) style, and the insecure-ambivalent (pattern C) style. The Strange Situation is a 20-minute experimental drama designed to reveal infants' attachment style (Ainsworth, 1978). During the experiment, the mother and infant are introduced to a laboratory playroom in which the infant is allowed to explore the room and play with toys while the mother watches. After a brief period, an unfamiliar woman enters the playroom, initially speaks with the mother, and then proceeds to interact with the infant. While the stranger plays with the infant, the mother leaves the room briefly but returns. A second separation occurs in which the infant is left completely alone for a brief period. The stranger returns first, and then the mother returns. The infant's responses to the separations from his/her mother and the reactions upon the mothers' return were documented and used to classify infants as securely or insecurely attached. Infants who were comfortable exploring the room in their mother's presence, cried in their mother's absence, and were comforted by their mother's return to the room were labeled "secure." Infants who

refused to leave their mothers to play with the toys, cried in their mother's absence, and failed to be consoled by their mother's comfort upon returning were labeled "insecure-ambivalent (anxious)." Infants who seemed unaffected by their mother's presence or absence in the room were labeled as "insecure-avoidant."

Methodologies similar to The Strange Situation are commonly used to measure attachment styles from infancy to kindergarten. Among older elementary school children, self-report questionnaires are commonly used to measure attachment styles. Self-report questionnaires, which solicit information directly from children, or their parent(s), hence the name self-report, require children to read or listen to a set of statements or questions and choose the response that most closely applies to them. For instance, the Parental Attachment Questionnaire, a self-report questionnaire, has been widely used among children to measure attachment styles. Among adolescents and adults, several self-report questionnaires such as the Parental Attachment Questionnaire, the Parental Bonding Instrument, the Inventory of Parent and Peer Attachment, and West and Sheldon's (1988) Measure of Insecure Attachment are commonly used to measure attachment relationships.

OVERVIEW

According to Ainsworth, secure infants experience warm, responsive relationships with their primary caregivers that are encouraging of autonomy. Infants with secure attachments cognitively have positive views of themselves and others because they know that they are worthy of love and equate security and protection with their caregivers. As adults, these infants are comfortable with closeness and separateness in their relationships with others, are self-reliant and self-confident, cooperative, helpful toward others, have high self-esteem, tend to be successful, and view the world as a place to be explored. Data have consistently demonstrated that a majority of children worldwide, roughly 65–70%, have secure attachment relationships. For instance, approximately 67% of children raised in the United States and Britain have secure relationships. Likewise, among Gusi women of Kenya, Kermorian and Leiderman classified 61% of infants as secure, 20% as anxious, and 19% as ambivalent.

Insecure-ambivalent (anxious) infants tend to experience warmth from their primary caregivers, but their caregivers do not respond to their needs for basic care promptly and consistently or provide security and protection (Ainsworth, 1989). These infants learn that they are worthy of love, but view their caregivers as unreliable and untrustworthy, which tends to paint their view of the world as unsafe. As a result, these infants tend to develop "clingy" behavior toward their caregivers and fear aban-

donment because they never know if the caregiver will be available to respond to their needs. As adults, they tend to fear being separated from or abandoned by their romantic partners or friends; they may become overly dependent on others and tend to act immature. Furthermore, under times of stress, these individuals are apt to develop symptoms such as depression or phobias. Roughly 15% of infants have an avoidant attachment style. Among a sample of Chinese infants in China, Hu and Meng found that 68% of infants had secure attachments with their maternal figures, 16% were considered ambivalent, and 16% were considered avoidant.

Insecure-avoidant infants tend to experience neglectful relationships with their primary caregivers. These infants' caregivers are unresponsive and do not provide warmth or a sense of protection and security. These infants learn that they are not worthy of love and view others as unresponsive, unreliable, and unsafe. As adults, these individuals have difficulty trusting others, do not believe that they are worthy of love, and do not expect others to be responsive to their needs (Ainsworth, 1989). These infants are prone to having later interpersonal difficulties with others due to difficulty bonding, tend to suffer from low self-esteem, lack confidence, and have difficulty adapting. Roughly 15% of children have an avoidant attachment style.

Based upon interviews that they conducted with individuals, in the early 1990s, Bartholomew and Horowitz created more contemporary classifications of attachment styles. Four different categories of attachment styles emerged from Bartholomew and Horowitz's research and they labeled them: secure, preoccupied, dismissing, and fearful. According to Bartholomew and Horowitz, individuals with a "secure" attachment style cognitively have a sense of worthiness and lovability (a positive view of the self) and believe other people are accepting and responsive (a positive view of others). Individuals with a "fearful" attachment style have a sense of worthlessness and feelings of being unloved (a negative view of the self) and believe others will be untrustworthy and rejecting (a negative view of others). Individuals with a "dismissing" attachment style tend to have a sense of worthiness and lovability (a positive view of the self) but have a negative disposition towards others (a negative view of others). Individuals with a "preoccupied" attachment style have a sense of worthlessness and feelings of being unloved (a negative view of the self) but have a positive disposition of others (a positive view of others).

THE INFLUENCE OF ATTACHMENT STYLES ON EDUCATIONAL OUTCOMES

In addition to influencing psychological, social, and emotional outcomes, parental attachment relationships influence students' academic success through several mediums.

For instance, children's attachments to their parents serve as templates for relationships in which they engage with others such as teachers. Given this affiliation, teacher-child attachments, or bonds that children form with their teachers, are likely to mirror the attachments that children have with their parents. In essence, children with secure parental attachments are likely to have secure teacher-child attachments, while those with avoidant or ambivalent attachments are likely to have the same type of relationship with their teachers.

O'Conner and McCartney found support for this claim by demonstrating that students with insecure parental attachments also had insecure teacher attachments in three independent samples of preschool, kindergarten, and first-grade students. Teachers are likely to have a more difficult time bonding with students with insecure attachments because these children tend to harbor negative views of the teacher that will impede the bonding process. Subsequently, it may be difficult for teachers to learn about these children's needs to respond to them in a manner that facilitates learning and adjustment. As a result, insecure children are more likely to struggle academically than secure children are because secure children are able to successfully establish secure attachments with their teacher, view their teacher favorably, have the confidence necessary to succeed, and utilize the teacher as a secure base from which to explore and engage in academic tasks and challenges.

Furthermore, studies have demonstrated that parental attachments strongly influence attachments that students develop with their peers. Similar to teacher attachments, peer attachments often mirror those of parental attachments. Peer attachments have been linked to a number of educational outcomes through various studies, thereby indirectly connecting parental attachments to educational outcomes in yet another facet. For instance, students with secure peer attachments typically demonstrate greater motivation, academic achievement, and prosocial behaviors. In contrast, students with insecure attachments are more prone to exhibiting problematic behaviors and typically achieve less academic success.

Attachment also influences self-efficacy (individuals' belief in their ability to successfully complete tasks), self-confidence (individuals' positive perceptions of their general abilities), and self-esteem (individuals' feeling of self-worth and satisfaction with oneself), all of which are vital to academic success. Secure children have the confidence, esteem, and security that they need to complete academic tasks successfully, are more likely to be engaged in classroom activities, and tend to be more motivated than their insecure peers are. Soares, Lemos, and Almeida found that secure adolescents are more likely to engage in goal-oriented behavior, engage in active problem solving, and

be motivated to attempt challenging academic tasks than insecure children. As a result, secure children often attain greater academic achievement than their insecure counterparts do.

Among a sample of sixth grade and ninth grade students, Wong, Wiest, and Cusick found that children who had high self-esteem, high scholastic self-efficacy (confidence in their ability to academically excel), and secure parental attachments preferred to be academically challenged and were motivated to learn for the sake of mastering the course content. By contrast, their insecure counterparts who lacked self-esteem and scholastic self-efficacy did not achieve at as high a level. Additionally, among the ninth grade students, teacher support was associated with greater academic achievement, which is consistent with findings from others who have demonstrated positive associations between teacher attachment security and higher grade point averages.

Lastly, attachment styles are associated with various behavioral outcomes that influence educational outcomes. For instance, secure children tend to be resilient, confident, and independent, which facilitates learning and academic success. However, avoidant children are likely to be clingy and unsure, while ambivalent children are likely to exhibit problem behaviors (e.g. hostility and aggression) and have interpersonal difficulties with their peers. All of these behavioral difficulties may hinder educational success. Furthermore, attachment insecurity has also been associated with attention problems such as Attention Deficit Disorder and/or Attention Deficit-Hyper Activity Disorder. Jacobson and Hofmann found insecurely attached children at ages 9, 11, and 15 had decreased attention spans, resulting in these children having difficulty attuning to instructions and engaging in classroom activities for extended amounts of time, both of which have been shown to impede learning.

In conclusion, attachment relationships influence numerous aspects of our lives from learning and achievement to psychological and social outcomes. Attachments are not just limited to parental attachments, as peer attachments and teacher attachments have also been shown to predict numerous outcomes. Therefore, fostering attachment styles that promote healthy, adaptive functioning throughout the lifespan is critical to well being.

SEE ALSO *Parenting Styles; Temperament.*

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Keisha Love

ATTENTION-DEFICIT/ HYPERACTIVITY DISORDER (ADHD)

Problems with attention, impulse control, and activity level are among the most common behavior difficulties exhibited by children and adolescents in the United States (Barkley, 2006). In fact, approximately 3 to 5 percent of school-aged children could be diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD), a psychiatric condition applied to individuals who exhibit developmentally inappropriate levels of inattention and/or impulsivity/overactivity (American Psychiatric Association, 2000).

DEFINITION OF ADHD

To meet DSM-IV-TR (American Psychiatric Association, 2000) criteria for ADHD, individuals must exhibit at least six inattention or at least six hyperactive-impulsive symptoms prior to the age of 7, for at least 6 months, and with concomitant academic and/or social impairment. Boys with ADHD outnumber girls with this disorder at about a 2:1 to 5:1 ratio (Barkley, 2006). Given that most public school classrooms in the United States include 20 to 30 students, approximately one to two students in every

classroom will have ADHD. Further, ADHD symptoms typically persist from early childhood through at least adolescence for a majority of individuals (Barkley, Murphy, & Fischer, 2007). Thus, ADHD typically is viewed as a lifelong disorder that must be addressed through ongoing intervention that is developmentally appropriate and addresses the unique needs and specific impairment of individual children (DuPaul & Stoner, 2003).

CHARACTERISTICS AND ASSOCIATED DIFFICULTIES

Children and adolescents with ADHD typically exhibit a variety of difficulties with school functioning. First, students with this disorder frequently are inattentive and exhibit significantly higher rates of off-task behavior relative to their non-ADHD classmates (e.g., Vile Junod, DuPaul, Jitendra, Volpe, & Cleary, 2006). Second, hyperactive-impulsive behaviors that characterize ADHD typically lead to disruptive behaviors (e.g., talking without permission, bothering other students, and leaving assigned area) in the classroom and other school settings. Third, ADHD frequently is associated with deficits in academic skills and/or performance. On average, children with ADHD score between 10 to 30 points lower than non-ADHD control children on norm-referenced, standardized achievement tests (e.g., Barkley, 2006). In fact, approximately 20 to 30 percent of children with ADHD are classified as having learning disabilities because of deficits in the acquisition of specific academic skills (DuPaul & Stoner, 2003). Further, the results of prospective longitudinal investigations of children with ADHD into adolescence and adulthood indicate significantly higher rates of grade retention, placement in special education classrooms, and school drop-out relative to their non-ADHD classmates as well as significantly lower high school grade point average, enrollment in college degree programs, and socioeconomic status (for review, see Barkley et al., 2007).

Children and adolescents with ADHD are at higher than average risk for a variety of behavioral difficulties including defiance toward authority figures, physical and verbal aggression toward peers, and antisocial acts such as lying, stealing, and vandalism (American Psychiatric Association, 2000; Barkley, 2006). As a result of defiant and aggressive behavior, individuals with ADHD often have significant difficulty developing and maintaining positive relationships with peers, teachers, and other school personnel. Not surprisingly, several investigations have found children with ADHD to be less well-liked, more often rejected, and have fewer friends than their non-ADHD peers (e.g., Hoza, Gerdes, Mrug, Hinshaw, Bukowski, Gold et al., 2005).

SUBTYPES OF ADHD

The DSM-IV identifies three subtypes of ADHD: combined type, predominantly inattentive type, and predominantly hyperactive-impulsive type (American Psychiatric Association, 2000). Individuals with ADHD combined type exhibit significant symptoms of both inattention and hyperactivity-impulsivity, while those with predominantly inattentive and hyperactive-impulsive types display significant symptoms of only one of the two dimensions. Prevalence figures in the child population are approximately equal for ADHD combined and predominantly inattentive types, with these two subtypes outnumbering hyperactive-impulsive type by a 2:1 margin (Hudziak, Heath, Madden, Reich, Bucholz, Slutske et al., 1998).

Most of the research on ADHD conducted as of the early 2000s has focused on children and adolescents with ADHD combined type. Between 1985 and 2005, studies examining individuals with predominantly inattentive type have found that the latter are more likely to exhibit learning problems and possibly internalizing disorder symptoms, and less likely to have comorbid disruptive behavior disorders relative to children with ADHD combined type (Barkley, 2006), although these findings are not consistent across studies. Given that the predominantly hyperactive-impulsive type was not included in the DSM nomenclature until 1994, very little research has focused on this subtype. What little data are available suggest that the hyperactive-impulsive subtype may be more prominent in younger children and could be an early childhood manifestation of what eventually will be ADHD combined type (e.g., Riley, DuPaul, Pipan, Kern, Van Brakle, & Blum, in press). Importantly, very little research has examined differential treatment response across subtypes; thus, as of 2007, treatment components are not modified based on ADHD subtype.

ASSESSMENT OF ADHD

The assessment of children and adolescents suspected of having ADHD involves the use of multiple assessment tools (e.g., rating scales and diagnostic interviews) to obtain information on symptomatic behavior and associated functioning from the perspectives of multiple individuals (i.e., parent, teacher, and child) (Barkley, 2006). No single assessment method or source alone is adequate for making the diagnosis; clinicians must examine child functioning as comprehensively as possible (American Academy of Child and Adolescent Psychiatry, 2007).

The assessment process can be viewed as a five-stage process, including screening, multimethod assessment, interpretation of data, treatment design, and treatment evaluation (DuPaul & Stoner, 2003). The goal of this assessment process is not only to determine if an individual

has ADHD, but also to identify possible comorbid conditions, delineate potentially effective treatment strategies, and evaluate whether intervention is successful.

The first stage of the assessment process is screening for ADHD symptoms in all cases where an individual is reported to have problems with attention, impulsivity, or activity level. Typically, screening entails obtaining parent and/or teacher report on the extent to which ADHD symptoms are evident in home or school settings. For example, the parent or teacher could complete an 18-item rating scale that contains the DSM-IV ADHD symptoms. If a significant number of inattentive and/or hyperactive-impulsive symptoms are reported, then more assessment data will be gathered at the next stage of the process.

The multimethod assessment stage involves gathering extensive information about symptoms of ADHD and other psychopathological disorders; the child's developmental, medical, and family histories; and the extent to which academic and social functioning are impaired by symptoms (Barkley, 2006; DuPaul & Stoner, 2003). A major component of the assessment is a diagnostic interview with the child's parent (and teacher, if possible). There are various interview formats available, but the key information to obtain is parental perception of the frequency and chronicity of ADHD symptoms, presence of symptoms of other disorders (e.g., oppositional defiant disorder), prior attempts to treat these difficulties, developmental history, and family history (Barkley, 2006). Behavior ratings also must be obtained from parents and teachers. Ideally, rating scales that assess a broad band of psychopathological behaviors (e.g., Child Behavior Checklist; Achenbach, 1991) and a narrow band of behaviors related to ADHD (e.g., ADHD Rating Scale-IV; DuPaul, Power, Anastopoulos, & Reid, 1998) should be used. If possible, direct observations of classroom behavior should be used to assess the degree to which ADHD-related behaviors are evident as compared to classroom peers as well as to identify possible environmental factors that could be eliciting and/or maintaining challenging behaviors. Finally, data regarding social (e.g., Social Skills Rating Scale; Gresham & Elliott, 1990) and academic (e.g., curriculum-based measurement probes) functioning should be gathered to determine the degree of impairment associated with ADHD symptoms.

It should be noted that traditional psychological and neuropsychological tests (e.g., Wechsler scales) have limited value in the assessment of ADHD symptoms. Although individuals with ADHD may perform below their non-ADHD peers on some of these instruments, score profiles specific to ADHD have not been identified and these data have limited ecological validity (Barkley, 2006). In similar fashion, medical assessment procedures

(e.g., MRI, EEG) do not provide specific data to inform diagnostic decisions at the individual level.

The next stage in the assessment process is to interpret the data obtained through multiple measures. Specifically, one must determine the degree to which clinically significant ADHD symptoms are evident across settings and the degree to which these symptoms are associated with academic, social, and/or occupational impairment. Further, alternative hypotheses for the display of apparent ADHD symptoms should be considered. For example, attention difficulties may be due to an anxiety or depressive disorder. Finally, possible comorbid diagnoses should be considered given that most individuals with ADHD will have one or more additional disorders (Barkley, 2006). The disorders most commonly associated with ADHD include oppositional defiant disorder, conduct disorder, and learning disabilities.

The final two stages of the assessment process are designed to move beyond diagnosis and are focused on treatment development and evaluation. Assessment data are used to determine the most appropriate course of action for intervention. For example, the more severe the ADHD symptoms and the more these symptoms are associated with multiple comorbid disorders, the more likely that a combination of psychotropic medication and behavior modification will be necessary (Jensen, Hinshaw, Kraemer, Lenora, Newcorn, Abikoff et al., 2001). Also, data regarding the antecedent and consequent events that serve as a context for classroom disruptive behavior can aid in determining the function of target behaviors and, ultimately, can lead to the development of an intervention that directly addresses this behavioral function (DuPaul & Stoner, 2003). Finally, once a treatment plan is developed and put into action, assessment data are collected periodically to determine whether the plan is successful and to delineate potential treatment modification.

INTERVENTIONS AND INSTRUCTIONAL STRATEGIES

The two primary interventions for ADHD are psychostimulant medication (e.g., methylphenidate) and behavior modification strategies implemented in home and school settings (Barkley, 2006). These intervention strategies have been found to reduce ADHD symptoms and associated behavior difficulties (e.g., noncompliance and aggression) as well as enhance peer interactions and academic performance for most study participants (for review see Barkley, 2006).

Psychotropic Medication. Central nervous system (CNS) stimulants are the most common and widely studied class of psychotropic medication used in the treatment of

ADHD (Connor, 2006). In fact, methylphenidate and other CNS stimulants are the single most effective treatment for reducing ADHD symptoms in children (MTA Cooperative Group, 1999, 2004). Further, numerous studies have shown methylphenidate and amphetamine compounds to improve classroom attention, behavior control, and interactions with peers and authority figures as well as enhance productivity and accuracy on academic tasks and curriculum-based measurement probes (for review, see Brown, Antonuccio, DuPaul, Fristad, King, Leslie et al., 2007; Connor, 2006). Alternatively, long-term effects on academic achievement (as measured by standardized achievement tests) have been either very small or non-existent (e.g., Jensen, Arnold, Swanson, Vitiello, Abikoff, Greenhill et al., 2007; MTA Cooperative Group, 1999, 2004). Because some individuals may experience limited success and/or adverse side-effects with CNS stimulants, several non-stimulant medications have been studied. For example, atomoxetine (Spencer et al., 2002) and clonidine (Connor, Fletcher, & Swanson, 1999) have been successful in reducing ADHD symptoms. The effects of non-stimulants on academic performance and social interactions with peers have not been studied extensively and are as of 2007 essentially unknown.

Interventions Based on Behavioral Principles. Contingency management interventions that manipulate consequences to change specific target behaviors are widely used to treat ADHD symptoms and comorbid behavioral difficulties. The two consequence-based interventions that have the strongest empirical support are token reinforcement and response cost (Pelham, Wheeler, & Chronis, 1998). Token reinforcement programs involve providing individuals with immediate reinforcement in the form of tokens contingent on the display of appropriate behavior (e.g., Pfiffner, Rosen, & O'Leary, 1985). Alternatively, response cost involves the removal of token reinforcers following the display of inappropriate behavior (Rapport, Murphy, & Bailey, 1982). Both of these strategies have been found to reduce inattentive, disruptive behaviors to a significant degree relative to baseline conditions. When possible, behavioral interventions should be designed using functional assessment data (O'Neill, Horner, Albin, Sprague, Storey, & Newton, 1997). In fact, several single subject design studies that included students exhibiting ADHD symptoms (e.g., Eckert, Martens, & DiGennaro, 2005) have indicated the value of an assessment-based approach to the design of behavioral interventions.

Combined Medication and Behavioral Intervention. Investigations systematically comparing the combination of CNS stimulants, behavioral interventions and their combination (i.e., multimodal treatment) have found stimulants to be superior to behavioral treatments in

reducing ADHD symptoms (MTA Cooperative Group, 1999, 2004). Alternatively, the greatest effects on problems associated with ADHD (e.g., oppositional behavior and social performance difficulties) typically are obtained with the combination of stimulants and behavior modification (Conners, Epstein, March, Angold, Wells, Klaric et al., 2001). Further, children with multiple comorbid disorders (Jensen et al., 2001) and individuals from ethnically or socioeconomically diverse backgrounds (Arnold, Elliott, Sachs, Bird, Kraemer, Wells et al., 2003) are most successful when these treatment modalities are combined.

Academic Interventions. Stimulants and behavioral interventions are associated with small effects, at best, on academic achievement. Although academic interventions for students with ADHD have not been as widely studied as behavioral treatments, studies in the late 1990s and early 2000s have provided preliminary support for instructional and remediation strategies. Specifically, computer-assisted instruction (Mautone, DuPaul, & Jitendra, 2005), classwide peer tutoring (DuPaul, Ervin, Hook, & McGoey, 1998), home-based parent tutoring (Hook & DuPaul, 1999) or homework support (Power, Karustis, & Habboushe, 2001), self-regulated strategy for written expression (Reid & Lienemann, 2006), and directed note-taking (Evans, Pelham, & Grudberg, 1995) are associated with improvements in specific academic skills and outcomes. Further, a large scale examination of consultation-based academic strategies found significant growth in reading and math skills for elementary students with ADHD (DuPaul, Jitendra, Volpe, Tresco, Lutz, Vile Junod et al., 2006).

Children and adolescents with ADHD experience significant academic, social, and behavioral difficulties in home and school settings. The assessment of ADHD involves collection of data across settings and sources to identify whether significant symptoms are present, whether these are better accounted for by other disorders, and what environmental variables can be altered as part of the treatment protocol. Empirical studies support the use of psychotropic medication (most notably stimulants and atomoxetine), behavioral strategies in home and school settings, and modifications to academic instruction in reducing ADHD symptoms and enhancing academic and social functioning. Nevertheless, there are many important gaps in the extant treatment literature, including the need (a) to evaluate effects on academic and social functioning, (b) to assess treatment integrity and acceptability, and (c) to document how the combination of stimulant medication and behavioral interventions can be optimized.

SEE ALSO *Emotional Development; Learning Disabilities.*

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ATTRIBUTION THEORY

Attribution theory provides an important method for examining and understanding motivation in academic settings. It examines individuals' beliefs about why certain events occur and correlates those beliefs to subsequent motivation. The basic premise of this theory is that people want to understand their environments and, therefore, strive to understand why certain events happen. In the classroom, the understanding students have about the causes of past events influences their ability to control what happens to them in the future. For example, if students fail a test, they will probably attribute that failure to a specific cause, such as (1) lack of ability, (2) lack of effort, or (3) poor instruction. The selected attribution will affect their subsequent motivation to engage in similar learning activities.

WEINER'S MODEL OF ATTRIBUTIONS

The study of attribution was initially associated with Fritz Heider (1896-1988) (1958). Later Bernard Weiner (1935-) of the University of California at Los Angeles developed a more comprehensive and extensive model of human attributions. Weiner's model is particularly informative in research on student learning in school settings. In his model, Weiner outlined the processes through which learners form causal beliefs (Weiner 1985, 2005). A basic assumption of Weiner's model of attributions is that learners are affected by both environmental factors (e.g., characteristics of the students' home or school) and by personal factors (e.g., prior experiences and prior knowledge). These background variables affect the types of attributions that individuals are likely to make.

Weiner's original attribution model			
		Locus of causality	
Stability dimension	Stable	Internal	External
	Unstable	Ability Effort	Task difficulty Luck

Attribution diagram based on the work of Bernard Weiner.

When an achievement-related event occurs (e.g., a student fails an examination), especially if the outcome was unexpected, Weiner proposes that learners undertake an attributional search, trying to understand what happened. The perceived cause of the event is important regardless of any objective explanation because whatever learners perceive as being the cause of the event will affect their future motivation toward engagement with similar tasks. For example, suppose a group of students performs poorly on an examination because of poor instruction. Those individuals who attribute their failure to poor teaching will have a different level of motivation in subsequent examinations than those who attribute their failure to their own lack of innate ability.

One important feature of Weiner's theory is that the specific attribution being made (luck, effort, etc.) is less important than the characteristics of the attribution, which are classified along three causal dimensions: locus, stability, and controllability. These important dimensions affect learners' subsequent motivation toward the task or activity. The locus dimension refers to whether the cause of the event is perceived as internal to the individual or external. If a learner believes that she failed an exam because she lacks ability, she is choosing an internal cause because ability is internal to the learner. In contrast, if a learner believes that he failed an exam because the teacher is incompetent, he is choosing an external cause because teacher incompetence is external to the student. The stability dimension refers to whether the cause is stable or unstable across time and situations. If a learner believes that he failed a science exam because he lacks ability in science, then his cause is stable, particularly if he believes that his lack of ability in science is a permanent quality. In contrast, if a learner believes that he failed the exam because he was ill at the time of the exam, then the cause is unstable in cases in which the illness is a temporary factor. When a student experiences success, attributions to stable causes lead to positive expectations for success in the future. In the face of failure, however, attributions to stable causes can result in low expectations for the future. The controllability dimension refers to whether the cause of the event is perceived as being under the control of the individual.

If a runner believes that he lost a race because he did not get enough practice before the event, the cause is controllable because he could have decided to spend more time practicing; in contrast, if he feels that he lost the race because he simply lacks ability as a runner, then the cause is uncontrollable. By definition, only internal attributions can be considered controllable.

In addition to the effect of individuals' motivation and expectations on future success, Weiner's model also indicates that certain emotional responses are associated with various causal dimensions (Weiner 1985, 2006). Consideration of emotional outcomes is rare in the study of academic motivation, given that most current motivation theories do not examine emotions. Weiner and others have demonstrated that the locus dimension is related to feelings of pride and self-esteem: People are more likely to experience a sense of pride in accomplishment if they believe that the cause is due to an internal characteristic or behavior. The stability dimension is related to feelings of hopefulness or hopelessness; attributions to unstable causes, by contrast to stable causes, suggest the possibility of a different outcome in the future. Finally, the controllability dimension is related to such feelings as shame, guilt, anger, gratitude, and pity. For example, students who believe their poor performance in a class is due to a controllable attribution (such as lack of effort) may experience guilt, whereas classmates who believe their failure is due to an uncontrollable cause (such as lack of ability) are more likely to experience feelings of shame (Weiner 1985). Emotional consequences of attributions ultimately affect individuals' subsequent motivation to engage in a particular behavior.

Finally, Weiner's model posits that the aforementioned psychological processes lead to behavioral consequences. For example, students' decision regarding whether to enroll in a mathematics course in the future may be partially determined by their attributions for successes or failures on previous mathematics examinations; athletes' subsequent effort in a competitive sports event may be determined by their attributions for successes or failures in previous events.

HOW ATTRIBUTIONS INFLUENCE BEHAVIOR

Many studies indicate that the types of attributions that individuals make influence their subsequent behaviors in predictable ways. Both the expectancy beliefs and the emotions that individuals experience as a result of the attributional process tend to determine future behaviors. Research generally indicates that academic achievement is improved and enhanced when learners attribute academic outcomes to factors such as effort and the use of appropriate study strategies; in contrast, academic achievement

is hindered when learners attribute their failure to factors such as lack of ability or chronic health problems and attribute their success to luck. Consequently, a student who attributes failure on an examination to a lack of effort (e.g., she did not study enough the week before the exam) may be motivated to put forth additional effort when preparing for a subsequent exam. In contrast, a student who attributes failure on an examination to a lack of ability (i.e., she believes that she does not have adequate ability in the examination area) will be unlikely to exert effort for a subsequent examination.

HOW ATTRIBUTIONS ARE COMMUNICATED TO LEARNERS

Attributional information is communicated to learners in a variety of ways. Teachers communicate important information to their students through their feedback on assignments, on graded exams, and during classroom instruction. When teachers communicate to students that failures are due to the use of inappropriate strategies or due to inappropriate effort, students are likely to be motivated to try harder or to use more appropriate strategies in the future. Teachers provide this feedback to students in a variety of ways. One common way is through comments on written work. Some teachers provide general feedback, using phrases such as "Good work" or "Needs work." Research indicates that specific feedback is more useful to students because it can assist students in developing adaptive attributional beliefs. Therefore, it may be effective to write a more specific comment (e.g., "I know you can do better; you need to spend more time studying the night before a test") when a teacher knows that a student has not been putting forth enough effort. It is important, however, to be sure that lack of effort truly is the problem. Researchers such as Martin Covington caution that when teachers encourage students to make attributions to effort (i.e., "You didn't try hard enough"), some students may interpret such comments as an indication of the teachers' lack of belief in the students' true abilities. In many instances, helping students to attribute their failure to not using appropriate strategies or to their lack of specific content knowledge may be more appropriate than assuming students are not trying.

Teachers also need to provide differential feedback to students. Educators must acknowledge that progress and achievement will be different for individual students. If students raise their grades from a "D" to a "C," teachers might choose to offer praise, if this change represents an important, meaningful new accomplishment for the students. In terms of attributions, scholars who study the effects of feedback and learning, such as Jere Brophy, would argue that teachers should provide feedback that will promote attributions to effort or appropriate strategy

use (e.g., “You did great! I am proud of you. The fact that you used the correct formulas this time to solve the math problems shows me that you have really worked on learning when and why to use the appropriate formulas, good job!”).

Parents also communicate information to children and adolescents that affect their attributions. If a participant loses a gymnastics competition, one parent might comment, “It is okay; gymnastics is very difficult,” whereas another parent might state, “You didn’t use the techniques that your coach showed you last week.” The first statement might produce ability attributions (e.g., “This is difficult; I don’t expect you to be able to do well”), whereas the latter statement might encourage the gymnast to attribute the failure to a controllable cause, to something that can be altered for a better outcome next time.

The information that parents communicate to children and adolescents may be based at least in part on parents’ own attributions for their children’s successes and failures. When children succeed or fail at tasks in school, parents form their own beliefs about the causes of their children’s experiences. Some research suggests that there may be predictable patterns to these parental beliefs. For example, as indicated by Yee and Eccles, some research indicates that in the domain of mathematics, parents are more likely to attribute their daughter’s success to effort, but to assume the same success in their son is due to mathematical ability.

INDIVIDUAL DIFFERENCES IN ATTRIBUTIONS

Attributional patterns differ among individuals. Development also plays a role in attribution. For instance, according to Nicholls, young children and older adolescents have different understandings of concepts, such as ability, that are central to attribution theory. Younger children do not easily differentiate between concepts, such as ability and effort, whereas older adolescents are better able to understand such distinctions. Consequently, attributions may take on different meanings for students at different stages of cognitive development.

Although there has not been much research on ethnic differences in attributions, Sandra Graham has summarized the findings to date of research in this area. Graham notes African-American students tend to make external attributions more often than white students. Although internal attributions are generally considered more adaptive for white students, Graham suggests that greater belief in external causes may be adaptive for African American students (1994). Graham also notes that in order to truly understand the role of attributions in the study of motivation in minority students, it is

important to consider the complex relations between gender and ethnicity (1997).

Studies of gender differences in attributions have yielded somewhat mixed results. Some studies indicate that female students are more likely to attribute negative outcomes to internal and stable causes and to attribute successful outcomes to unstable, external causes (e.g., “My successes are due to good teaching and good luck; my failures are because I’m not good enough”); however, other research suggests that there are no gender differences in attributional patterns. Clearly, additional research on this topic is needed.

IMPLICATIONS OF ATTRIBUTION THEORY FOR EDUCATORS

There are many practical implications of attribution theory for educators. First, teachers need to realize that they can affect the types of attributions that students make. Teachers affect students’ attributions on a daily basis, through their comments to students, feedback on assignments and examinations, and the types of praise that they offer during instruction. These comments can have important long-term effects on student learning and motivation. A student who consistently learns to attribute failures to a lack of ability in a particular subject area is unlikely to continue to be motivated to achieve in that subject area in the future. Educators need to remember the power they have in shaping students’ attributions.

Second, teachers can educate parents about attributions. Since parents provide feedback and make comments to their children about performance on academic work, teachers can encourage parents to provide effective feedback. For example, teachers can send home a weekly newsletter to parents explaining what is being learned in class and offering specific suggestions to parents about providing appropriate feedback to children.

Finally, educators should be aware that students do think about the causes of their own successes and failures. Teachers can engage students in conversation to learn about their students’ attributions and to monitor potentially inaccurate and harmful beliefs. Teachers may be surprised by some of their students’ attributional beliefs; one-on-one conversations may provide insight to teachers and provide opportunities for shaping students’ beliefs about their performance.

SEE ALSO *Attributional Retraining; Student Emotions; Weiner, Bernard.*

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ATTRIBUTIONAL RETRAINING

Attributional retraining (AR) is a motivational treatment developed in the latter half of the 20th century in concert with social cognition theories that focused on how individuals explain life experiences (Heider, 1958; Weiner et al., 1972). AR is closely linked with Weiner's attribution theory (1974, 1985, 2006) which posits that negative, unexpected, and important outcomes trigger explanatory thinking in achievement settings. The ensuing explanations or causal attributions have three properties in common: locus of causality (within/outside the individual), stability (transient/enduring), and controllability (not modifiable/modifiable). Students' attributions for success and failure influence learning-related emotions, cognitions, and motivation because each dimension has unique cognitive and affective consequences.

The locus dimension fosters feelings of pride following an internal attribution for success. The stability dimension influences expectations about the reoccurrence of the event and feelings of hope for future success (hopefulness/hopelessness). The controllability dimension determines responsibility judgments concerning the event and guilt and shame emotions related to negative

events. Following failure, a low ability attribution is motivationally dysfunctional because it affirms the expectation that failure can reoccur (stable/uncontrollable failure), while increasing feelings of shame. Lack of effort enhances motivation because it promotes expectations that change is possible (unstable/controllable failure) and engenders feelings of guilt. Because of these attribution-affect-cognition linkages, unstable and controllable causes intensify motivation and persistence when failure occurs; uncontrollable and stable causes do the opposite.

In achievement settings, a variety of AR treatments have been used that differ in terms of attributional content, delivery formats, and audience targets (Försterling, 1985; Perry et al., 1993; Weiner, 1988; Wilson et al., 2002). AR content ranges from modifying individual attributions to changing the dimensional properties of attributions based on Weiner's theory (1985; 2006). Some treatments specifically encourage effort instead of ability attributions as explanations of failure; others seek to change ability from a stable to an unstable attribution that changes with time. Still others primarily seek to increase controllable attributions for negative experiences (effort, strategy), or to decrease uncontrollable attributions (test difficulty, luck). For example, an AR treatment focusing on controllable attributions may highlight lack of effort or poor note-taking as causes of failure because they can be increased by studying harder, taking clearer notes, or attending more classes.

AR treatments also differ in terms of the delivery format used to present the attributional content. Past studies have delivered the content via written material, videotape simulations, and structured lectures separately or in combination. These formats vary in length and in whether they are delivered to recipients individually or in groups. Individual presentations are often face-to-face and group presentations are some combination of written material, videotape, and lecture. In a typical experiment, recipients are encouraged to think about past performance outcomes (e.g., class tests, course grades) or receive feedback on a task designed to activate attributional thinking. The AR treatment is administered immediately thereafter via some combination of delivery formats. Prior to the activation task and following the AR treatment, attributional measures are administered to assess pre/post treatment effects.

The recipients of AR treatments can be differentiated largely in terms of age (children versus adults), and these can be further segregated into sub-groupings based on demographic and psycho-social variables. Depending on the target audience, the objectives and the format of the treatment will vary in accordance with audience characteristics. An AR treatment administered to college students, for example, can use more complex attributional content

than would be possible with children that may include a broader range of specific attributions and formats. It may also be more readily presented in a group context rather than in an individualized, face-to-face context as may be necessary with children.

With younger students, AR information is typically administered through repeated face-to-face or computer-based attributional feedback in response to performance. Attributional feedback often involves highlighting the importance of investing effort (“You’ve been working very hard”; Schunk, 1983) or noting insufficient effort following failure (“You should have tried harder”; Dweck, 1975). Examples of other AR techniques include the modeling of adaptive attributions during mock performance trials with learning-disabled children (Borkowski et al., 1988) and reinforcing student-generated statements involving effort (Fowler & Peterson, 1981).

With university students, AR typically comprises one-time, mass informational seminars presenting controllable attributions verbally, in written format, or via videotaped interviews (Perry et al., 1993). Following the presentation, an activity that encourages students to reflect concretely (e.g., by completing a difficult test) or abstractly (e.g., group discussion, writing exercise) on the information is administered, with both the presentation and consolidation typically required for AR to be successful (Perry et al., 2005).

AR IN SCHOOLS

In elementary classrooms, AR is effective in improving academic motivation and performance in struggling students, demonstrated originally by Dweck (1975) and Miller et al. (1975). An AR intervention encouraging effort attributions for failure improved performance on a mathematics problem-solving task, particularly for students who have learned helplessness. These findings have been replicated primarily with underachieving students, showing AR techniques not only to improve performance, but also to increase motivation, self-efficacy, success expectations, and controllable attributions, as well as to lower uncontrollable attributions (e.g., Andrews & Debus, 1978, Fowler & Peterson, 1981; Schunk, 1983). AR methods can also reduce aggressive behavior in school classrooms (Hudley et al., 1998) and can be beneficial for children with learning disabilities (Robertson, 2000).

These studies suggest AR procedures that promote self-talk concerning adaptive attributions may be better than direct persuasion by the instructor (e.g., “You should work harder”; Fowler & Peterson, 1981; Miller et al., 1975). Instructor-initiated AR in intact classrooms may be less effective than smaller experimenter-led sessions (Craven et al., 1991; Robertson, 2000). Many AR interventions for children are administered as part of

larger training programs focusing on learning or social skills, particularly for students with learning disabilities (e.g., Borkowski et al., 1988; Schunk, 1983). Although some results suggest that ability-related feedback following success may improve self-efficacy and performance (Schunk, 1983), other findings indicate the simultaneous combination of ability feedback (e.g., “You’re good at this”) and effort feedback does not improve AR effectiveness (e.g., Ho & McMurtie, 1991; Schunk, 1983).

AR research on middle- and high-school students shows that intensive, in-person AR programs can increase perceptions of control, persistence, and achievement (e.g., Dresel, 2000; Ziegler & Heller, 1998), particularly for failing or depressed students (Dieser & Ruddell, 2002). Computer-based AR can also improve mathematics performance by providing attributional feedback contingent upon students’ performance (failure equals effort; success equals ability; Okolo, 1992) and on their progress (success first attributed to effort, then ability; Dresel & Ziegler, 2006). Research by Heller, Ziegler, and colleagues further illustrates the effectiveness of brief AR techniques (e.g., videotape presentation) for gifted students, particularly for females in the natural sciences (Heller, 1999, 2003; Heller & Ziegler, 1996; Ziegler & Heller, 2000; Ziegler & Stoeger, 2004). AR also plays a critical role in resolving group discipline problems (Lapointe & Legault, 2004) and assisting with career-related decision-making (Szabo, 2006).

AR IN POSTSECONDARY EDUCATION

In college classrooms, AR researchers have focused extensively on students’ scholastic development, particularly the transition from high school to college. Since classic studies by Wilson and Linville (1982, 1985), AR programs that encourage the changeable nature of academic performance have improved motivation, emotions, and course performance (Perry et al., 1993, 2005; Wilson et al., 2002). Successful AR techniques for college students are typically brief and consist of two phases. The initial presentation phase often includes a videotaped dialogue between senior students (Noel et al., 1987; Perry & Penner, 1990; Van Overwalle et al., 1989; Wilson & Linville, 1982, 1985) or an informational handout (Haynes et al., 2006; Jesse & Gregory, 1986, 1987; Ruthig et al., 2004) outlining the benefits of attributing poor performance to, for example, insufficient effort and poor study strategies.

Following the AR presentation, a consolidation phase is administered that encourages students to elaborate on the information through exercises such as group discussions (e.g., Ruthig et al., 2004; Struthers & Perry, 1996), aptitude or achievement tests (e.g., Hall et al., 2007; Menec et al., 1994), or writing assignments (e.g.,

Hall et al., 2007). Similar to findings for younger students, AR conducted in intact classrooms by course instructors appears to be less effective than smaller-scale, experimenter-led sessions (Hladkyj et al., 1998), and computer-based AR involving the Internet can contribute to better course grades (Hall et al., 2005). AR can also facilitate career-related decision-making (Luzzo et al., 1996) and success in employment interviews for upper-level undergraduates (Jackson et al., in press).

AR research with college students has focused not only on the development of intervention techniques, but also on targeting students with specific risk characteristics. For example, AR is especially beneficial for students at risk of failure due to previous poor performance (Wilson & Linville, 1982, 1985; Van Overwalle et al., 1989), uncontrollable attributions (Struthers & Perry, 1996), an external locus of control (Menec et al., 1994; Perry & Penner, 1990), and insufficient use of elaborative learning strategies (Hall et al., 2007). Students with overly optimistic beliefs are particularly at risk and respond especially well to AR interventions (Hall et al., 2006; Haynes et al., 2006; Ruthig et al., 2004).

APPLICATIONS TO CLASSROOMS

As most educators know, attributional exchanges commonly occur in the daily functioning of classrooms. However, these informal, spontaneous, and anecdotal attributional exchanges are rarely informed by scientific theory and evidence and too often involve the communication of maladaptive (uncontrollable/stable) attributions for failure (e.g., low ability: "If you did poorly on the exam, this class isn't for you."). Such maladaptive attributional exchanges raise serious questions about the ethics of their use in teaching practices intended to foster motivation. In contrast, research-informed AR has several strengths as a motivation-enhancing treatment: It is derived from a well-established attribution theory (Weiner, 1985, 2006); it is supported by a solid body of empirical evidence (Perry et al., 1993, 2005), and it can be readily adapted to achievement settings (Perry, 1991, 2003; Wilson et al., 2002).

Assuming that AR is to be implemented in a classroom, four guiding principles are recommended. First, the attributional content should be strongly informed by the scientific evidence on effective AR procedures and reviewed by responsible professionals. Second, screening procedures should be used to identify students most likely to benefit from the program. Such diagnostic procedures may include course tests, informal teacher/student exchanges, formal questionnaires, etc. Third, the intervention format should be selected based on empirical evidence regarding effective procedures for specific student populations (e.g., one-time, seminars for gifted or older students; repeated performance feedback for younger or learning-disabled students).

Finally, follow-up assessments of subjective (e.g., attributions, motivation) and objective outcomes (e.g., attendance, performance) are required to accurately determine the effectiveness of AR on classroom adjustment and performance.

SEE ALSO *Attribution Theory; Learned Helplessness.*

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AUTHENTIC ASSESSMENT

Authentic assessment comprises a variety of assessment techniques that share the following characteristics: (1) direct measurement of skills that relate to long-term educational outcomes such as success in the workplace; (2) tasks that require extensive engagement and complex performance; and (3) an analysis of the processes used to

produce the response. Authentic assessment is often defined by what it is not: Its antonyms include: norm-referenced standardized tests; fixed-choice multiple-choice or true/false tests; fill-in-the-blank tests. Synonyms include: performance assessment, portfolios, and projects. Dynamic (Lidz, 1991) or responsive assessment (Henning-Stout, 1991) are other terms associated with authentic assessment. Authentic assessment has been a popular method for assessing student learning among specific populations of students such as those with severe disabilities (Coutinho & Malouf, 1993), very young children (Grisham-Brown, Hallam, & Brookshire, 2006), and gifted students (Moore, 2005). In addition, specific disciplines such as the arts (Popovich, 2006), science (Oh, Kim, Garcia, & Krilowicz, 2005) and teacher education (Gatlin & Jacob, 2002) have embraced authentic assessment for its emphasis on process over product. Grant Wiggins described authentic assessments as “faithful representations of the contexts encountered in a field of study or in the real-life ‘tests’ of adult life” (1993, p. 206).

THE HISTORY OF AUTHENTIC ASSESSMENT

Authentic assessment was a significant component of the 1990s education reform zeitgeist, and Wiggins was one its most prolific and convincing proponents (Terwilliger, 1997). Wiggins (1993) asserted that traditional methods of student assessment (i.e., forced choice tests such as multiple-choice, true/false test, etc.) fail to elicit complex intellectual performance valued in real life experiences and result in a narrowing of the curriculum to basic skills, including test taking skills. At a time when standardized minimum competency tests had been largely rejected for reducing or diminishing the curriculum, and content standards emphasizing higher-ordered thinking skills were articulated within many disciplines and states, authentic assessment gained considerable traction.

Subsequently, educators may have engaged in authentic assessment to rebel against the top-down accountability of high-stakes standardized testing (Salvia

& Ysseldyke, 2004). Since the 2002 No Child Left Behind (NCLB) Act, there has been a greater focus on large-scale standardized testing. There is a lack of connection between the federal and state policy makers and public school educators. In an ideal educational setting, professional educators in all arenas would guide the learners’ movement toward the standards. This would be developed in an organic process with student, site, and community input. However, the current practice is that standards are developed by remote government bureaucrats in state or federal buildings far removed from the students and those who are in contact with the students on a daily basis (Henning-Stout, 1996). There is a feeling of imposition on school site educators by state and federal officials, which compounds the challenges towards the ideal development of authentic assessment.

Educators’ desire for authenticity in assessment and learning is not free from the polemics of political climates that define that nature of modern education.

AUTHENTIC ASSESSMENT DATA ANALYSIS

Assessment data are used for multiple purposes, including making accountability, eligibility, and instructional decisions. The purpose of the assessment directs the analyses. For example, authentic assessment data collected for determining whether a school, district, or state is sufficiently educating students will require data to be aggregated at the systems level, as well as disaggregated by various sub-populations of students, in order to make such accountability decisions. Authentic assessment to determine whether a student meets specific state or national special education criteria must be corroborated by other types of data given the significant ramifications for the student (Lidz, 1991). Data collected to inform instruction must be analyzed relative to the curriculum and instruction provided to the students in a particular class. Authentic assessment data can be analyzed by qualitative or quantitative methods.

Examples of authentic assessments	
Assessment	Standard
Students writing to their councilperson about an improvement they could make in their neighborhood	Second grade social studies standards
Students work in teams to build small-scale models of California missions or Indian villages	Fourth grade history standard
Classroom presentation in the form of a play on civil rights struggle. The play is shared with the student body, civic organizations, and other schools (Hilliard, 2003)	Sixth grade history standard
Summative science fair presentation that integrates applying scientific method, mathematical problem solving, history of the area of study, writing, visual presentation, and public speaking skills (Meyer, 1992)	High school science standards
Reflective meta-cognitive journal entries about how artifacts in the school psychology formative program portfolio relate to the eight domains for training (Hass & Osborne, 2002)	National Association of School Psychologists training standards

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

A qualitative analysis of a student's performance typically describes skills that were demonstrated and errors that were made thereby providing a narrative of what the student knows and is able to do, and what the student needs to learn or improve upon. Narratives also allow the student's performance to be considered within the context of the assessment. For example, Alverno College is nationally recognized for its narrative assessments of eight core abilities in a manner that is contextually relevant for each discipline (Alverno College Faculty, 1994).

A quantitative analysis of authentic assessment data applies a scoring rubric or checklist to judge student responses relative to criteria within a restricted range of four or more proficiency levels (e.g., advanced proficient, proficient, partially proficient, and failure). Scoring rubrics can be either analytic or holistic. Analytic analyses require defining and assessing different dimensions of a task. For example, the spelling, sentence structure, vocabulary, accuracy, level of detail, and coherence of an essay may be judged independently. Holistic analysis assigns an overall score to a student's performance, like judging an Olympic gymnastic competition.

VARIATIONS OF AUTHENTIC ASSESSMENTS

Three variations of authentic assessments most frequently discussed are dynamic (Hilliard, 1995; Lidz, 1991), performance, and portfolio assessment (Salvia & Ysseldyke, 2004). Proponents of authentic assessment (Hilliard, 1995; Lidz, 1991; Meyer, 1992) have observed that many people think they are conducting it when in fact they are not. The multiple purposes for assessments and the general nature of many of the terms associated with authentic assessment has resulted in variation among researchers and practitioners in what is considered authentic or dynamic assessment (Cumming & Maxwell, 1999; Newton, 2007).

Dynamic assessment is conducted within a test-intervene-retest format or process. For example, an educator first administers a test to a student; then the adult intervenes by asking questions about the child's incorrect or unexpected answers to improve the student's cognitive processes. Finally, the adult administers the same or a similar test to the child to see if the child has developed a new strategy for solving the problem. Thus, dynamic assessment attempts to measure the student's level of modifiability.

Compared to dynamic assessment, performance and portfolio assessment are more commonly used in classroom settings (Salvia & Ysseldyke, 2004). Performance assessments require students to complete or demonstrate the behavior that educators want to measure (Meyer, 1992). For a performance task to be authentic, it must be completed within a real-world context, which includes

shifting the locus of control to the student in that the student chooses the topic, the time needed for completion, and the general conditions under which the writing sample is generated (Meyer, 1992). Portfolio assessments are an accumulation of artifacts that demonstrate progress toward valued real-world outcomes, are often produced in collaboration, require student reflection, and are evaluated on multiple dimensions (Salvia & Ysseldyke, 2004).

METHODOLOGICAL STRENGTHS AND LIMITATIONS OF AUTHENTIC ASSESSMENT

A major strength of authentic assessment is its connection to real-life skills (Meyer, 1992). Proponents of authentic assessment are quick to point out that life is not a series of isolated multiple-choice questions but full of complex, embedded problems to be solved (Wiggins, 1993). Accordingly, authentic assessments require students to solve complex problems or produce multi-step projects, often in collaboration with others. In this way, higher-ordered learning skills such as synthesis, analysis, collaboration, and problem solving are assessed. In fact, the purpose of authentic assessment is to measure students' ability to apply their knowledge and thinking skills to solving tasks that simulate real-world events or activities (see Table 1, for examples; Wiggins, 1993).

Authentic assessments attempt to seamlessly combine teaching, learning, and assessment to promote student motivation, engagement, and higher-ordered learning skills (Eder, 2004). Because assessment is part of instruction, teacher and students share an understanding of the criteria for performance; in some cases, students even contribute to defining the expectations for the task. The assumption is that students perform better when they know how they will be judged. Often students are asked to reflect and evaluate their own performance in order to promote deeper understanding of the learning objectives as well as foster higher order learning skills (i.e., self-reflection and evaluation).

Authentic assessments are often described as developmental because of the focus on students' burgeoning abilities to learn how to learn in the subject (Wiggins, 1993). For example, students' shortcomings in knowledge and how they apply their knowledge can be examined through carefully analyzing of their log books or by asking probing questions, in order to identify what needs to be taught or re-taught. Thus, the process by which students arrived at their final response or product is assessed (Mehrens, 1992).

Authentic assessments also have limitations. These include subjectivity in scoring, the costliness of administering and scoring, and the narrow range of skills that are typically assessed (Mehrens, 1992). By emphasizing

complexity and relevance rather than structure and standardization, inter-rater reliability can be difficult to achieve with authentic assessment. Inter-rater agreement is increased with clearly defined criteria, including exemplars and non-exemplars and initial and on-going training of the evaluators. Unfortunately educators rarely have adequate guidelines to help analyze and score student products (Ysseldyke & Salvia, 2004). The logistics and training demands of authentic assessment have made its wide-spread adoption among general education prohibitive. Selecting artifacts to include in a portfolio can also be a challenge. In order to avoid the portfolio's becoming a meaningless accumulation of student work, there needs to be some selection process that distinguishes critical works from mementos (Hass & Osborne, 2002). Lastly, the emphasis on assessing knowledge in-depth or in application, often limits the amount of content knowledge that is assessed. For example, an authentic assessment that requires students in a biology class to design the ideal zoo would not test what students know about photosynthesis. Terwilliger proposed that the specificity of authentic assessment evaluation criteria to a particular task may limit its value as a measure of general learning outcomes.

HOW AUTHENTIC ASSESSMENT INFORMS INSTRUCTION AND INTERVENTIONS

Henning-Stout (1996) stated, "Academic assessment is authentic when it reflects performance on tasks that are meaningful to the learner" (p. 234). One strength of authentic assessment is the strong connection to the development of lessons and interventions that have real-life applications. If the learners being assessed are aware of their ability to self-regulate (Dembo, 2004) and make the appropriate changes during the learning process, they will achieve the transfer of knowledge that is necessary for learning to occur (Lidz, 1991). More importantly, they should be able to solve real-world tasks and be able to process new information within the construct of that task.

When given clear standards (Henning-Stout, 1996) and reliable and valid methods (Salvia & Ysseldyke, 2004) for conducting authentic assessment, teachers can inform students of the level of expected performance and provide direct feedback about students' process towards meeting those standards. With dynamic assessment students receive immediate feedback about their process and their own problem-solving skills. The portfolio assessment provides individual students with an opportunity to physically and cognitively organize and monitor their learning process.

For educators concerned with social justice in the development of curriculum, pedagogy and assessment, authentic assessment provides ways for students outside

the norm of the standard assessment to express their understanding of material (Henning-Stout, 1996; Hilliard, 1995; Louise, 2007; Newfield, Andrew, Stein, & Maungedzo, 2003). For example, the government of South Africa has moved away from high stakes standardized assessments for categorizing, labeling, and tracking students towards portfolio assessments that are developed in conjunction with local communities (Newfield et al., 2003).

Authentic assessment has also been used to train professionals. School administrators and teachers have been evaluated using portfolio assessments (Gatlin & Jacobs, 2002; Meadows & Dyal, 1999) as well as school psychology graduate students (Hass & Osborn, 2002; Prus, Matton, Thomas, & Robinson-Zañartu, 1996).

SEE ALSO *Classroom Assessment*.

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Authentic Tasks

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AUTHENTIC TASKS

The instructional activities teachers provide for their students play an integral role in shaping what is learned in classrooms. These activities, often referred to as tasks, are what students do to learn academic content and skills. Tasks provide a structure and goal for learning in classrooms and require time to accomplish. They are meant to engage students in an action, or sequence of actions, that require the application and production of knowledge. Some types of tasks are authentic, which means they are situated in meaningful contexts that reflect the way tasks might be found and approached in real life. Authentic tasks can encompass everyday situations, such as organizing to make and sell t-shirts for a community fundraiser, or real-world activities undertaken in disciplines, such as conducting an historical inquiry into the Lewis and Clark expedition. Authentic tasks are not the norm in schools and classrooms, but research and contemporary perspectives on how students learn suggest that these types of tasks are powerfully effective for learning.

A distinguishing feature of authentic tasks is that they have value and meaning beyond the classroom. When students engage in authentic tasks, they do and experience what they, or other people, might do or experience in a real-life setting. In a classroom, this might mean participating in real-world tasks that are similar to the kind of tasks that experts engage in. For example, authentic tasks in a science classroom might require students to conduct scientific investigations in a manner

similar to how scientists conduct their work, but in ways that are appropriate and meaningful for students. In this kind of science classroom, students might investigate the air and water quality of their neighborhoods, examine how invasive species impact local habitats, or design and construct a model erosion management system for a city park. As students engage in these tasks, they learn important science content, develop skills that mirror the practices of expert scientists, and learn first-hand how to apply their skills and knowledge in real-life, problem-solving contexts.

Authentic tasks are important because they provide meaning and motivation for learning. They provide students with opportunities to relate to real-world situations, make connections to their own interests, and engage deeply with subject matter. One of the key benefits of authentic tasks is that they introduce students to ways of reasoning and problem solving that represent the work of professionals in practice, which has the advantage of helping students build real-world expertise. As students engage in authentic tasks, they create products or artifacts that showcase the skills and knowledge they have acquired. Often, these artifacts can be used for assessment purposes in a manner that reflects the complexity of how performance is evaluated in the real world.

THEORETICAL PERSPECTIVES

In the early 20th century, the educator and philosopher John Dewey (1933) advocated the use of authentic tasks to help students acquire and deepen subject matter knowledge and enhance their logical reasoning and self-regulation skills. Central to Dewey's view was that children learn best through purposeful activity and that real-world tasks are ideal for developing useful skills and knowledge. In subsequent decades, education researchers and learning theorists elaborated further on the notion of authenticity. Their work sought to explain how authentic tasks support thinking and to gain insight into the classroom conditions under which authentic tasks are most effective.

An important idea that emerged from learning theory and research is that students construct more useful, robust, and integrated knowledge when they are engaged in their learning and helped to develop sophisticated understanding. Requiring students to merely carry out a task will not ensure learning. All too often, classroom tasks result in the acquisition of discrete information that is not very meaningful, memorable, or usable. Psychologist David Perkins (1993) calls such information, which often results from rote memorizing and is not easily transferred to other situations, inert knowledge. For meaningful learning to occur, students need to be cognitively engaged, or intellectually invested, and active in applying ideas. Cognitive engagement depends not

only on the task itself, but also on the context in which the task is situated. This idea is referred to as situated cognition (Brown, Collins, & Duguid, 1989). Situated cognition emphasizes that the activity and the context in which the activity unfolds are integral to what is learned.

According to the situated cognition perspective, when students learn new information in the context of authentic tasks, they are able to make sense of the new information and relate it to what they already know or have experienced. In such cases new ideas are more likely to become intelligible because they are put in context. Context provides students with a mental frame for making sense of the learning experience. Without some framework in which to connect new ideas, students face difficulty in bringing together new information and organizing it in a way that can be easily recalled and put to use.

Situated cognition also suggests that when students participate in authentic tasks, they acquire information about the conditions and situations in which it is useful to know and apply what they have learned. As a result, they are more likely to be able to take what they have learned in one situation and transfer it to another. Additionally, students are more likely to make relevant connections between their academics and their personal lives. As viewed through the situated cognition lens, authentic tasks engage students cognitively by providing opportunities to actively think about, integrate, and apply ideas in situations that are relevant beyond the classroom. This experience often results in learning that is personally meaningful and motivating for students.

AUTHENTIC TASKS IN CLASSROOMS

Authentic tasks are used in a wide range of classroom settings, including mathematics, science, and history classrooms. Furthermore, an increasing number of instructional programs feature authentic tasks as a means to situate learning in real-world contexts (Blumenfeld, Marx, & Harris, 2006). One example is Project-Based Science (PBS), a program for middle-school science classrooms developed by Joseph Krajcik and colleagues at the University of Michigan (Krajcik, et al., 2000) in which students engage in authentic tasks in ways that are similar to how scientists conduct their work. In PBS classrooms, students take part in scientific inquiry projects that are framed by driving questions that guide instruction and serve to organize students' investigations. For instance, in a project focusing on the physics of collisions, students learn about force and motion by engaging in tasks pertaining to the question, "Why do I need to wear a helmet when I ride my bike?" This question situates the science topic in a context that is likely to be of interest to young students. As they pursue answers to the driving question, they conduct investigations, collect data, weigh evidence,

write explanations, and discuss and present findings. The authentic tasks help students learn scientific content and practices relevant and necessary to construct an evidence-based response.

Another instructional program that features authentic tasks is a video-based mathematics series called *The Adventures of Jasper Woodbury*, developed by John Bransford and his research group (Cognition and Technology Group at Vanderbilt, 1997). The program materials consist of video-based narrative adventures that present students in grades five and up with real-world mathematical challenges. For example, in a statistics and probability adventure called *The Big Splash*, students help a character develop and evaluate a business plan for raising funds for a student-run project. In another adventure called *Blueprint for Success*, students learn geometry as they help characters design a playground. A central purpose of the narrative adventures is to create experiences that are similar to the type of learning that takes place in real life. Additionally, the challenges provide students with opportunities to apply mathematics concepts and skills in realistic situations.

IMPACT ON LEARNING AND MOTIVATION

When tasks are authentic and situated in real-world contexts, students are more likely to be motivated. Motivation is important because it can lead to increased cognitive engagement and thereby enhance learning (Blumenfeld, Kempler, & Krajcik, 2006). For instance, authentic tasks often create compelling and relevant need-to-know situations for learning that heightens interest and motivates students to invest in their learning. More interest and investment in learning can lead to higher levels of engagement. In turn, sustained cognitive engagement helps students to acquire knowledge and skills as they go about working on tasks. A key benefit of authentic tasks, then, is that they provide a meaningful and motivating backdrop for learning that affords opportunities to actively think about and apply important ideas.

Research on authentic tasks indicates that when they are implemented they are associated with increased achievement and motivation for learning (e.g., Hickey, Moore, & Pelligrino, 2001). Authenticity may be particularly important for students from diverse backgrounds, especially those whose language and cultural backgrounds differ from the mainstream, and who may not perceive relevant connections between school and their everyday interests and lives. Luis Moll and colleagues (1992), for example, describe how teachers designed integrated science and mathematics projects that involved parents sharing their knowledge and expertise regarding topics connected to the surrounding community. Moll and his

colleagues found that when teachers draw from students' funds of knowledge—the cognitive, linguistic, and cultural resources that they bring to school—to create tasks that help students make connections, students find meaning in what they are learning and a reason to understand. Overall, the research evidence on authentic tasks with learners in diverse school settings is encouraging: Students benefit academically and show increased interest, motivation, and engagement. Tasks that help students make connections also appear to help them to develop a more comprehensive and nuanced grasp of new material as well as an appreciation for why it is important.

DEVELOPING AND USING AUTHENTIC TASKS

To develop authentic tasks, teachers need to know their students' backgrounds and interests, school and community resources, as well as disciplinary content and practices. A high quality authentic task has several features, including real-world relevance, accessibility, feasibility, sustainability, and alignment to learning goals. Real-world relevance refers to the extent to which the task connects to issues or experiences beyond the classroom. Authentic tasks are most effective when they have personal value and meaning that extends to the surrounding world, thus providing students with a sense of purpose for engaging in the tasks. Accessibility highlights the appropriateness of the task given the prior knowledge and skills of students and its potential for helping students advance in their understanding. An authentic task that is accessible will help students learn important content and develop skills and enhance understanding about the situations in which the newly acquired knowledge and skills can be applied. Feasibility addresses the available school and community resources and whether students can carry out the task given the resources and materials at hand. Sustainability is the ability of a task to sustain cognitive engagement over time. This feature is critical for ensuring that students learn while participating in authentic tasks. A final key feature is alignment to learning goals. Authentic tasks that do not match important learning goals found in district or state standards are unlikely to be usable in school settings.

Teachers can develop high-quality authentic tasks in various ways. One approach is to use learning goals as a starting point. With learning goals in mind, teachers can then brainstorm tasks that will interest students and encompass important ideas and skills. Another way is to use existing curriculum materials and identify opportunities within the materials to create authentic tasks that connect to students' everyday lives and curiosities. Teachers can also develop authentic tasks by listening to students and drawing directly from their ideas, interests, and experiences, as well as issues in their communities.

Another approach involves teachers collaborating with students to identify and structure possible tasks. Finally, teachers can work with community experts, such as writers, architects, scientists, engineers, and historians, to develop meaningful and engaging tasks that help students learn about professional practices.

Using authentic tasks effectively with students requires that teachers attend to several features of the classroom environment. Foremost, teachers need to create classroom conditions that support students in learning from authentic tasks (Newmann & Wehlage, 1993). It is necessary to provide guidance to students in how to engage in tasks and how to learn from them. Without specialized support, or scaffolding, from a teacher, students will not develop the skills and knowledge to successfully engage in authentic tasks. Teachers must also create a social climate that supports students in working together productively and encourages students to take risks and try hard on tasks. Another important feature is assessment. Teachers need to provide for authentic assessment of learning that is integrated within the tasks and reflective of the purposes and complexity of the tasks.

LIMITATIONS IN USING AUTHENTIC TASKS

Using authentic tasks in classrooms is complex and difficult. Teachers can be challenged because they may have never participated in authentic tasks and may not know how to enact them. In contrast to typical classroom tasks, authentic tasks are carried out over days or weeks rather than minutes or hours. Teachers need to carefully sequence activities so that students acquire the appropriate skills and knowledge as they work over time. They also need to orient their students to new ways of learning. Students are expected to take on more responsibility and be more self-directed in their learning. Participation alone is not sufficient: Students need to be interested in the task and find personal relevance in it. Yet not all students will find tasks personally meaningful. In such instances, teachers need to use instructional strategies to support students' motivation and cognitive engagement. Another challenge for students is that effective participation in authentic tasks often involves solving problems in which there are no quick and easy solutions. Students can become discouraged with the difficulty of completing tasks. If teachers are to use authentic tasks effectively, they must address the challenges of organizing instruction and supporting students.

A major limitation in using authentic tasks is that they do not fit well within existing school organization and culture (Resnick, 1987). The organizational features of schools, including teacher workload, class scheduling,

material resources, and assessments that measure knowledge of simple facts, are structured for traditional instruction and narrow assessment. Furthermore, school norms typically involve students in learning directly from either the teacher or textbook. Teachers, students, and parents expect tasks to fit this model of instruction. Authentic tasks involve a different way of thinking about tasks in classrooms. They require more instructional time and resources, a different instructional stance on the part of teachers, and more effort on the part of students.

Although the benefits in using authentic tasks are clear, the widespread use of these tasks will require changes in the roles of teachers and students, as well as changes in the structure of schools. Though formidable, such changes promise to transform classrooms into places where students engage in complex tasks that are meaningful to them, relate to real-world situations, and help them develop usable knowledge and robust understandings. This kind of learning environment may prove advantageous for all learners.

SEE ALSO *Goal Orientation Theory*.

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AUTISM SPECTRUM DISORDERS

Autism was first described in 1943 by child psychiatrist Leo Kanner. About fifty years later, in 1991, autism became its own eligibility category for special education services. Until the end of the twentieth century, autism was considered a low incidence disability. Over the years, research resulted in a broader definition of autism as well as better trained professionals who had increased knowledge and reliable tools to identify children with autism in the preschool years. Autism is recognized as a relatively common developmental disorder, more prevalent than childhood cancer, diabetes, and Down syndrome. Classroom teachers as well as school psychologists can expect to work with children with autism and related disorders.

AUTISM DEFINED

Autism is a neurodevelopmental disorder defined by behaviors rather than by medical tests. That is, there are no blood tests, brain scans, or medical procedures available to identify autism. Instead, a diagnosis is based on observation of social and communication behaviors that take into account a spectrum of symptom expression which ranges from severe to mild and also varies with age and developmental level. Autism is a retrospective diagnosis, and in order to make a differential diagnosis, careful assessment of developmental history is essential. Finally, the complexity of diagnostic assessment of autism is increased because it frequently occurs in association with other syndromes and developmental disabilities, such as Down syndrome, fragile X, and intellectual disability. Research suggests that the prevalence of autism may be about 1 in 600 children and when combined with related disorders, the incidence increases to about 1 in about 160 (Chakrabarti & Fombonne, 2001).

CHARACTERISTICS

The *Diagnostic and Statistical Manual of Mental Disorders, Text Revision* (4th ed., DSM-IV-TR; American Psychiatric Association, 2000) describes the diagnostic criteria for pervasive developmental disorders (PDDs) used by medical personnel. PDD is an umbrella term that includes the diagnosis of autism as well as four other



Autistic children and their teachers working on an art project AP IMAGES.

PDDs. The DSM is independent from the classification system established by State Departments of Education. Although autism has been defined in the Individuals with Disabilities Education Act (IDEA; 1997), classification criteria may vary considerably from state to state as states execute their own discretion in developing special education eligibility criteria using IDEA criteria as the minimal standard (see Table 1). Some states use DSM-IV criteria, and other states use their own criteria.

VARIATIONS AND SUBGROUPS

The PDDs have some features in common. But of the five PDDs, three have the most overlap with one another autistic disorder, Asperger disorder (AD), and pervasive developmental disorder not otherwise specified (PDD-NOS). The shared social impairments are the hallmark features of the PDDs that distinguish them from other childhood disorders. Also, instead of the term PDD, some researchers advocate for the term Autism spectrum disorder (ASD) to emphasize both the shared overlap and lack of clear distinctions between these PDDs and the fact that these children often benefit from the same services (Lord & Risi, 2001) even though AD and PDD-NOS are not recognized as independent special education eligibility cat-

egories. If a student is performing well academically, problems with social interaction with peers and pragmatic language use should be addressed in educational programs. These skills are critical for success on the job after high school. Therefore, it is suggested that these students be classified under autism for educational purposes (Schopler, 1998). The DSM-IV-TR criteria are presented below.

DIAGNOSTIC CRITERIA OF AUTISTIC DISORDER

Although autism becomes evident within the first three years of life, it often remains undiagnosed until 4 years of age. This delay is unfortunate because research indicates that children can be identified reliably before 3 years of age (Lord, 1995; Stone, 1999), and an early diagnosis is critical because it allows the child the opportunity to obtain specialized early intervention services that have been shown to result in significant developmental gains (NRC, 2001).

The first component of the definition of autism, social impairment, is characterized by significant impairment in at least two of the following four areas: (a) coordinated use of nonverbal behaviors to regulate social and communicative interactions (e.g., eye-to-eye gaze, gestures, facial

U.S. Department of Education criteria for autism

"Autism" means a developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before age 3, that adversely affects a child's educational performance. Other characteristics often associated with autism are engagement in repetitive activities and stereotyped movements, resistance to environmental change or change in daily routines, and unusual responses to sensory experiences.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES.
CENGAGE LEARNING, GALE.

expressions); (b) development of peer relationships appropriate to the child's developmental level; (c) active pursuit of shared enjoyment, interests, and achievements with others; and (d) establishment of social and emotional reciprocity (e.g., the ability to engage in social play for older children or peek-a-boo for younger children).

The second feature of autism, impaired communication, is characterized by significant impairment in at least one of the four areas: (a) problems in development of spoken language (also accompanied by a lack of compensation through other modes of communication such as gestures); (b) inability to initiate or sustain a conversation with others in individuals with spoken language; (c) the presence of stereotyped and repetitive use of language or idiosyncratic use of language (e.g., repetition of words or phrases without regard to meaning); and (d) a lack of varied, spontaneous make-believe play or social imitative play consistent to the child's developmental level.

The third and final area of impairment is restricted, repetitive, and stereotyped patterns of behavior interests, and activities in at least one of the following four areas: (a) preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal in intensity or focus; (b) inflexible adherence to specific nonfunctional routines or rituals; (c) stereotyped and repetitive motor mannerisms; and (d) a persistent preoccupation with parts of objects.

In addition to meeting the criteria described above, the child must also demonstrate abnormal functioning in at least one of the following areas prior to 3 years of age: (a) social interaction; (b) language as used in social communication; and (c) symbolic or imaginative play.

DIAGNOSTIC CRITERIA OF ASPERGER DISORDER

In the early 2000s debate continued whether Asperger disorder (AD) can be distinguished from high functioning autism (children with autism who do not have cognitive impairment) (Klin & Volkmar, 1997; Schopler, 1998). In order to meet criteria for AD, the child must

Comparison of autism spectrum disorders using DSM-IV-TR

	Autistic disorder	Aspergers disorder	Pervasive developmental disorder—not otherwise specified
Disordered social interaction	Present	Present	Present
Disordered communication	Present		Present ^a
Restricted and repetitive behaviors	Present	Present	Present ^a
Age of onset	Prior to 36 months		
Average intelligence		Present	
Incidence ^b	16.8/10,000	8.4/10,000	36.1/10,000
Male/female ratio	3 to 4:1	More common in males	More common in males

^aEither disordered communication or restricted behaviors must be present
^bChakrabarti & Fombonne, (2001)

Table 2 ILLUSTRATION BY GGS INFORMATION SERVICES.
CENGAGE LEARNING, GALE.

demonstrate impairments in two of the areas previously described for autistic disorder: (a) social interaction and (b) restricted, repetitive patterns of behavior, interests, and activities. The child must not demonstrate any clinically significant general delay in language and should use single words by age 2 and communicative phrases by age three. In addition, the child also must not exhibit any significant delay in cognitive development or adaptive behavior (except for social interaction), and show curiosity about the environment in childhood.

DIAGNOSTIC CRITERIA OF PDD NOS

Pervasive developmental disorder not otherwise specified (PDD-NOS) is diagnosed when a child does not meet criteria for autism because of late age at onset, atypical symptomatology, or subthreshold symptomatology. Children with PDD-NOS do demonstrate the (a) social impairments and either (b) communication impairments or (c) restricted, repetitive patterns of behavior, interests, and activities.

The other two PDDs, childhood disintegrative disorder (CDD) and Rett disorder, are degenerative disorders, a feature not present in the other PDDs. Table 2 provides a brief comparison between the most related of the ASDs.

National Research Council recommendations (2001)
<ul style="list-style-type: none"> • Immediate entry into intervention programs after the diagnosis • Active engagement in intensive programming for a minimum of 25 hours a week, equivalent to a full school day for 5 days a week, with full year programming based on a child's age and developmental level • Planned and repeated teaching opportunities appropriate to the developmental level and with sufficient attention from adults in varied settings to meet needs • Low ratio of students to teacher (at least 1 adult for 2 young children with autism) • Inclusion of family component and parent training • Ongoing assessment and evaluation to measure progress and make adjustments

Table 3 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Quality and content indicators analyzed
<ul style="list-style-type: none"> • Social skills to improve involvement in school and family activities • Expressive, receptive and non-verbal communication skills (as appropriate) • Symbolic functional communication system • Engagement in tasks or play that are developmentally appropriate, including an appropriate motivational system • Fine and gross motor skills to be utilized when engaging in age appropriate activities • Basic cognitive and academic thinking skills • Replacement of problem behaviors with appropriate behaviors • Organizational skills and other behaviors that underlie success in a general education classroom • Goals are individualized and adapted from the academic content standards

Table 4 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

ASSESSMENT OF CHARACTERISTICS

The development of appropriate and specialized intervention programs begins with a diagnostic assessment. One issue that may pose a barrier for children obtaining a diagnosis is the presumed stigma of labeling. Ideally, a label facilitates communication among professionals and families, allows access to intervention services, provides a basis for research and prevention, leads to appropriate treatment planning and intervention, and provides a framework for gathering information on outcome, etiology, and associated problems. Most importantly, a label allows teachers as well as parents to become informed. It gives professionals and families the basis to gather information, read, join support groups, advocate, and become organized in their efforts to obtain resources and improve outcomes. From the point of view of many helping professionals, the benefits of a diagnosis/identification far outweigh the liabilities.

Assessment of the characteristic features of autism social and communication impairments and restricted patterns of behaviors and interests require varied assessment approaches. Two gold standard tools are the Autism Diagnostic Observation Schedule (ADOS-G; Lord, Rutter, DiLavore, & Risi, 1999) and the Autism Diagnostic Interview (ADI-R; Lord, Rutter, & Le Couteur, 1994). The ADOS-G is a child interaction assessment and the ADI-R is a parent interview.

Social assessment consists of two main strategies: structured and unstructured observation and parent interview. In the very young child, the social impairments may be expressed by reduced play in baby games such as peek-a-boo; reduced attempts to draw attention to themselves for the purpose of showing off to adults; reduced ability to imitate vocal sounds, body movements, and actions with objects; and reduced ability to point to objects, show objects, and follow an adult's point to objects for purely social reasons.

Communication assessment consists of informal and formal testing, observational assessment, and parent interview. Assessment should also include information on the child's functional communication abilities, that is on the forms (how child communicates), the functions or purposes (what child communicates), and the contexts (where and with whom child communicates) of communication. Young children with autism demonstrate difficulty understanding and using nonverbal means, such as gestures, to communicate. Children with autism who have verbal speech may exhibit both the difficulty understanding the meaning of words and phrases (semantics) and using communication in a functional manner with others (pragmatics).

Assessment of repetitive behaviors and restricted range of activities and interests is best conducted by parent interview and observations. Resistance to change in environment and new routines and an insistence on following familiar routines characterize these behaviors. Parents can provide information on the child's narrow interests and unusual attachment to objects. Often sensory input that incorporates a visual, auditory, tactile, olfactory, or motor component is either excessively sought or strongly avoided. An example of a visual interest is a child who enjoys spinning objects, twirling, and watching fans or objects that rotate. The stereotypic behaviors of these children include jumping up and down and hand flapping when excited, flipping fingers in front of their eyes, and rocking their body.

INTERVENTION AND INSTRUCTIONAL PROCEDURES

Education is considered one of the primary methods of intervention for ASD (NRC, 2001). Recognizing its critical role in the education and treatment of children

with autism, the U.S. Department of Education's Office of Special Education Programs requested the National Research Council to report on the scientific evidence regarding educational interventions for young children with autism (from three to eight years) (see Table 3). The NRC also provided guidelines on content areas critical in the educational plans of students with autism (see Table 4).

Several types of teaching strategies have been evaluated for children with autism. These methods include structured teaching (Schopler, Mesibov, and Hearsey, 1995), incidental teaching (McGee, Morrier, & Daly, 1999), discrete trial training (Smith, Eikeseth, Klevstrand, & Lovaas, 1997), pivotal response training (Koegel, Koegel, Shoshan, & McNeerney, 1999), and functional communication training (Carr, 1993). All of these approaches are research supported and represent systematic and planned teaching techniques designed to increase desired behaviors, decrease undesirable behaviors, and teach new skills. Applied behavior analysis (ABA) is a framework that takes these techniques into account. No single teaching method, however, has been reported as of the early 2000s as being more effective than any other approach; in fact, all have demonstrated effectiveness, and it is likely that a multi-component approach is most effective. Regardless of which approach is selected, it is essential to first generate treatment goals based on the results of individualized assessments of the child's various areas of development and make adjustments of the treatment goals and methods based on the child's progress.

ISSUES OF ASSESSMENT AND INSTRUCTION

Not all children respond the same way to the same intervention. Children have individual learning styles and preferences and respond differently to various research supported approaches. The selection of an intervention must be based on individualized assessment of needs and ongoing monitoring of progress. It is not uncommon for a teacher to use many different methods to meet the needs of the children in the room (i.e., discrete trial, incidental teaching, and structured teaching).

The unique issues of autism require specialized planning on the IEP. The social and communication deficits in autism are often accompanied by intellectual impairment or issues with thinking and learning that often require the explicit teaching of skills that other children typically pick up naturally. These issues require that close attention be paid to the sequence of skills being taught and ensure that one skill builds upon another (Smith & Slattery, 1993).

Some teachers experience frustration understanding and managing the behavior of students with autism. They find that discipline strategies that work for other students do not work for these students. When confronted with challenging behaviors, it is necessary to consult a specialist in autism and behavior. The specialist can provide a functional behavioral analysis (FBA) to develop positive behavior supports. If problem behaviors are interfering with educational participation, it is necessary to have an FBA and a positive behavior support plan as part of the IEP.

School personnel have tools available to identify students with autism and select and implement effective teaching plans. The success of a teaching plan, however, depends on the quality of the teacher-student interaction as well as a teacher's ability to engage the student. Engagement is a key factor in an effective program (NRC, 2001), and research shows that both child and environmental factors influence engagement (Ruble & Robson, 2007). Establishing a collaborative relationship with former teachers of these children, their parents, and autism specialists is essential for optimal educational experiences and outcomes.

SEE ALSO *Mental Retardation; Special Education.*

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AUTONOMY SUPPORT

Autonomy is the experience of being the author and origin of one's behavior—the subjective sense that one's moment-to-moment activity authentically expresses the self and its inner motivation. Behavior is autonomous when students freely endorse what they are doing in the classroom, and this inner endorsement of one's actions is most likely to happen when students' inner motivational resources (e.g., needs, interests, preferences) guide their on-going classroom engagement. Given this understanding of the nature of student autonomy, a definition of teacher-provided autonomy support can be offered. Autonomy support is the interpersonal behavior teachers provide during instruction to identify, nurture, and build students' inner motivational resources (Deci & Ryan, 1985; Reeve, Deci, & Ryan, 2004).

The opposite of autonomy support is controllingness. Controllingness is the interpersonal behavior teachers enact during instruction to gain students' compliance

with a teacher-prescribed way of thinking, feeling, or behaving. As opposites, autonomy support and controllingness represent a single bipolar continuum of a teacher's motivating style toward students (Deci, Schwartz, Sheinman, & Ryan, 1981). When controlling, teachers have students put aside their inner motivational resources and instead adhere to the teacher's prescribed way of thinking, feeling, or behaving. Controlling teachers motivate students by using extrinsic incentives and pressuring language to the point that students' classroom participation is regulated by external contingencies and pressuring language, not by their inner motivational resources.

BENEFITS OF AN AUTONOMY SUPPORTIVE MOTIVATING STYLE

Compared to students in classrooms managed by controlling teachers, students with autonomy-supportive teachers experience a wide range of educationally and developmentally important benefits. These benefits include not only greater perceived autonomy and greater psychological need satisfaction during learning activities but also greater classroom engagement, more positive emotionality, higher mastery motivation, greater intrinsic motivation, a preference for optimal challenge over easy success, higher creativity, enhanced psychological well-being, active and deeper information processing, greater conceptual understanding, higher academic achievement, and greater persistence in school versus dropping out (Black & Deci, 2000; Koestner, Ryan, Bernieri, & Holt, 1984; Reeve, Jang, Carrell, Barch, & Jeon, 2004; Vallerand, Fortier, & Guay, 1997).

WHAT AUTONOMY SUPPORTIVE TEACHERS SAY AND DO DURING INSTRUCTION

Because autonomy support promotes students' positive functioning in so many ways, researchers have worked to identify what specific instructional behaviors teachers with an autonomy-supportive style enact that differentiates their style from teachers with a relatively controlling style (Assor, Kaplan, & Roth, 2002; Assor, Kaplan, Kanat-Maymon, & Roth, 2005; Deci, Spiegel, Ryan, Koestner, & Kauffman, 1982; Reeve, Bolt, & Cai, 1999; Reeve & Jang, 2006). Table 1 defines the central feature of both an autonomy-supportive and a controlling motivating style, and it lists the four essential features associated with both styles.

The essential core of an autonomy-supportive motivating style is the teacher's willingness to take the student's perspective during instruction and to deeply value, understand, and appreciate that perspective. When doing so, teachers work hard to identify, nurture, and build students' inner motivational resources. More concretely, the moment-to-moment expression of an autonomy-

Defining features of an autonomy-supportive (and controlling) motivating style	
Autonomy-supportive motivating style	Controlling motivating style
<i>Core feature of autonomy support</i>	<i>Core feature of controllingness</i>
Understands and highly values the student's perspective during instruction	A teacher-targeted agenda paired with some type of pressure to comply with that agenda
<i>Four aspects of autonomy support</i>	<i>Four aspects of controllingness</i>
<ul style="list-style-type: none"> • Nurtures inner motivational resources • Relies on noncontrolling, informational language • Promotes valuing • Acknowledges and accepts expressions of negative affect 	<ul style="list-style-type: none"> • Relies on extrinsic sources of motivation • Relies on controlling, pressuring language • Neglects valuing • Power assertion

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

supportive style can be seen in the instructional behaviors of nurturing students' inner motivational resources, relying on noncontrolling and informational language, promoting valuing, and acknowledging and accepting students' expressions of negative affect. Nurturing inner motivational resources means identifying and supporting students' needs, interests, and preferences during instruction. Relying on noncontrolling and informational language means uttering information-rich, competence-affirming messages that diagnose and explain why students are doing well and making progress. Promoting value means providing rationales to explain the underlying importance or usefulness of a requested activity, behavior, or procedure. Acknowledging and accepting students' expressions of negative affect means treating students' complaints and points of resistance as a valid reaction to imposed classroom structures and demands. These behaviors are all positively intercorrelated and, collectively, they set the stage for students to experience personal autonomy, psychological need satisfaction, and positive functioning in general (Ryan & Deci, 2000).

The essential core of a controlling motivating style is the teacher's insistence on a prescribed right or best way of thinking, feeling, or behaving. That insistence is routinely paired with the use of pressuring language and extrinsic incentives to gain students' compliance with that prescription. In practice, the moment-to-moment expression of a controlling style during instruction can be seen in teachers' reliance on extrinsic sources of motivation (incentives, consequences, directives, compliance requests), relying on controlling and pressuring language (uttering a steady stream of "shoulds," "have to's," "got to's," and "musts"), neglecting valuing (making little or no effort to explain why they are asking students to do unappealing or uninteresting activities), and power assertion (countering students' negative affect with authoritarian power assertions such as "Shape up" and "Just get the work done and quit your complaining").

AUTONOMY SUPPORTIVE PARENTING

As is the case with autonomy-supportive teaching, autonomy-supportive parenting revolves around involving and nurturing (rather than neglecting and frustrating) students' psychological needs, personal interests, and integrated values (i.e., their inner motivational resources; Grolnick, 2003). An additional aspect of an autonomy-supportive style that is especially important during parenting is sensitivity to children's and adolescents' temperament-related dispositions (e.g., shyness, sociability). Sensitivity to students' temperament is autonomy-supportive because it allows students to act in ways that fit their internal dispositions, including their preferred activities, preferred pace of instruction, and preferred way of doing things.

MEASURING MOTIVATING STYLE

Researchers assess motivating style with both self-report questionnaire measures and observational ratings from trained raters. Self-report measures include both teacher (and parent) reports of their own style as well as students' reports of the teacher's (and parent's) style. For the former, teachers rate their style using the Problems in Schools questionnaire. For the latter, students rate their teachers' style using questionnaires such as the Learning Climate questionnaire (Williams & Deci, 1996) and the Perceptions of Parents Scale (Grolnick, Ryan, & Deci, 1991). Most self-report measures of motivating style are available on-line. In addition, several studies rely on trained raters to objectively score teachers' motivating style during instruction. Raters score aspects of teachers' motivating style using the four bipolar scales summarized in Table 1.

IMPLICATIONS FOR TEACHERS

During class, students can be curious, proactive, and highly engaged, or they can be alienated, reactive, and

passive. Just how engaged students are during instruction and how much they develop themselves as autonomous learners depends, in part, on the autonomy supportive quality of the teacher's motivating style. From this point of view, students' motivation, engagement, and positive functioning during instruction are an interpersonally coordinated process between teacher and students. When teacher-student interactions go well—that is, when teachers support students' autonomy rather than control their behavior—teachers function both as a guide to structure students' learning opportunities and as a support system to nurture their existing inner resources and to help them develop new and constructive sources of autonomous motivation, such as internalized values.

The implication for teachers (and parents) is that supporting students' autonomy, rather than neglecting or even interfering with their autonomy, creates the conditions during learning activities in which students can experience an engagement-fostering congruence between what they want to do (their inner guides) and what they actually do during class. The positive implications of autonomy support, and the negative implications of teacher control, are many and wide-reaching. This is an exciting conclusion because classroom-based intervention research shows that teachers can learn how to be more autonomy supportive during instruction and also that the more teachers learn how to expand their style to incorporate a greater use of autonomy-supportive acts of instruction, the more their students benefit in terms of classroom engagement and academic achievement (deCharms, 1976).

TEACHERS' CONCERNS ABOUT AUTONOMY SUPPORT

Even when they acknowledge the strong relationship between supporting students' autonomy and students' positive classroom functioning, teachers often express two concerns over the practice of autonomy support. The first is the fear that if teachers' support students' autonomy, then student engagement would be uneven, off-task, or even irresponsible. But supporting autonomy does not mean removing structure. Instead, providing structure is a crucial aspect of effective instruction, so the crucial issue is not whether teachers provide structure but, rather, whether they provide that structure in an autonomy-supportive or in a controlling way (Reeve, 2006). The second concern is that autonomy-supportive instruction may not apply to all students in all educational contexts. This concern has been allayed by researchers showing the benefits of autonomy support for a diverse range of students, including students with special needs (Algozzine, Browder, Karovnen, Test, & Wood, 2001), international students in collectivistic cultures (Chirkov & Ryan, 2001), religiously motivated home school students (Cai, Reeve, & Robinson,

2002), and at-risk high school students in alternative school settings (Forstadt, 2006). The conclusion is that all students want and need autonomy and autonomy support and also that they benefit when teachers support their autonomy rather than control their behavior.

SEE ALSO *Classroom Environment; Intrinsic and Extrinsic Motivation; Self-Determination Theory of Motivation.*

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Johnmarshall Reeve

B

BANDURA, ALBERT 1925–

Albert Bandura was born on December 4, 1925, in a hamlet in northern Alberta, Canada, the only son in a family of five older sisters. In 1949 he graduated from the University of British Columbia. He attended graduate school at the University of Iowa and, while there, married Virginia Varns. Bandura received his M.A. degree in 1951 and his Ph.D. in 1952 under the direction of Arthur Benton. Al and “Ginny” became parents to two daughters, Carol and Mary.

Bandura joined the faculty at Stanford University in 1953, where he has remained throughout his career. In collaboration with Richard Walters, his first doctoral student, Bandura conducted studies of social learning and aggression. Their joint efforts illustrated the critical role of modeling in human behavior and led to a program of research into observational learning (part of which is known in the history of psychology as the “Bobo Doll studies”). The program also led to Bandura’s first book, *Adolescent Aggression*, written in collaboration with Walters and published in 1959. In 1974, Bandura became David Starr Jordan Professor of Social Science in Psychology. In 1977, he published the ambitious *Social Learning Theory*, which sparked the interest in social learning and psychological modeling that took place during the last two decades of the 20th century.

Bandura has collaborated in projects with internationally renowned scholars such as Jack Barchas and Barr Taylor in psychiatry, Robert DeBusk in cardiology, Halsted Holman in internal medicine, and Philip Zimbardo in psychology. One of these projects studied how people’s perceptions of their own ability to control what

they viewed as threats to themselves influence the release of neurotransmitters and stress-related hormones into the bloodstream. A major finding that resulted from these studies was that people can regulate their level of physiological activation through their belief in their own capabilities to do so, or their self-efficacy beliefs. In the course of investigating the processes by which modeling alleviates phobic disorders, Bandura again found that changes in behavior and fear arousal were mediated through the beliefs that individuals had in their own capabilities to alleviate their phobia. From the late 1970s, a major share of his research attention was devoted to exploring the role that these self-efficacy beliefs play in human functioning.

With the publication of *Social Foundations of Thought and Action: A Social Cognitive Theory* in 1986, Bandura put forth a view of human functioning in which individuals are agents proactively engaged in their own development and can make things happen by their actions. From this perspective, the beliefs that people have about themselves are critical elements in their exercise of control and personal agency. In his 1997 book, *Self-Efficacy: The Exercise of Control*, Bandura set forth the tenets of his theory of self-efficacy beliefs and its applications to diverse fields of human accomplishment.

Self-efficacy has generated research in areas as diverse as medicine, business, sports, and, of course, psychology. Research has been especially prominent in education, where researchers have established that self-efficacy beliefs and educational attainments are highly correlated and that self-efficacy is an excellent predictor of academic success. In fact, self-efficacy has proven to be a more consistent predictor of educational outcomes than has any other motivation construct.



Albert Bandura ARCHIVES OF THE HISTORY OF AMERICAN PSYCHOLOGY. THE UNIVERSITY OF AKRON.

As the new century dawned, Bandura broadened the scope of his thinking to expound a social cognitive theory capable of encompassing the critical issues of the new millennium. He has written on escaping homelessness, environmental sustainability, and population growth. He has proposed a social cognitive view of mass communication, explained the self-regulatory mechanisms governing transgressive behavior, and shown how perceived social inefficacy can lead to depression and substance abuse. Exploring the moral disengagement in the perpetration of inhumanities, Bandura outlined the psychosocial tactics by which individuals and societies selectively disengage moral self-sanctions from inhumane conduct and called for “a civilized life” in which humane standards are buttressed “by safeguards built into social systems that uphold compassionate behavior and renounce cruelty.”

As of 2007, Bandura has authored seven books and edited two others, and he has written over 250 articles and book chapters. In 1974 he was elected president of the American Psychological Association (APA). His contributions to psychology have been recognized in the many honors and awards he has received. He has received the Distinguished Scientific Contributions Award of the APA, the William James Award from the Association for Psychological Science, the Distinguished Contribution Award

from the International Society for Research in Aggression, and the Distinguished Scientist Award of the Society of Behavioral Medicine. He was elected to the American Academy of Arts and Sciences and to the Institute of Medicine of the National Academy of Sciences.

SEE ALSO *Self-Determination Theory of Motivation; Self-Efficacy Theory; Social Cognitive Theory; Teacher Efficacy.*

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Frank Pajares

BEHAVIORAL OBJECTIVES

Everyone has had some experience setting personal goals. Perhaps the most common goal people set is the New Year’s resolution when an individual identifies a broad goal to lose weight, stop smoking, or exercise more frequently as part of a personally valued way to begin the new year. The first consideration in setting such a goal is determining that it is truly a valued accomplishment for the person who resolves to achieve it.

The next important consideration in setting a broad goal is making sure that it is stated clearly in specific behavioral terms. Using these behavioral terms is one way to operationally define the goal, that is, by statements about the observable behaviors that are essential parts of attaining it. Making clear statements about these component behaviors requires careful analysis of the sequence of smaller units of behaviors that, when put together, lead to attainment of the broader behavioral goal. These statements define the goal for purposes of knowing when it is achieved. They also help ensure that the person working toward the goal knows which behaviors to perform to increase the likeliness of success in achieving the broader behavioral goal.

STEPS FOR REACHING EFFECTIVE GOALS

Many people who set a New Year's resolution fail at some point to keep working toward their goal. This outcome is often related to their earlier failure to break their broader goal down into a logical sequence of smaller achievable objectives, which can help them to keep working toward their broader goal because they experience success along the way. This approach to setting goals requires that individuals determine ways to evaluate both the achievement of their smaller successes and, ultimately, the accomplishment of their broader goal. Thus, a reason many people do not stick to New Year's resolutions is that they do not develop ways to evaluate their progress over time. Reaching an effective goal is particularly important in education. Teachers use goal-setting strategies to ensure students are learning and experiencing academic success.

Teachers and students are more successful when the goals they set a) are realistic (achievable), b) are publicly stated rather than private internal commitments, c) include deadlines, and d) include feedback on progress over time (Martin & Pear, 1996). In fact, research on goal setting has shown that the most effective goals are those that are broken down into smaller, clearly defined and achievable steps or components that facilitate reinforcement of success on a regular basis and evaluation of progress (Bandura, 1969).

BEHAVIOR GOALS AND OBJECTIVES IN EDUCATION

An effective way to break larger goals down into smaller units is to define and set behavioral objectives. Behavioral objectives are the smaller, observable, and measurable intermediate goals that build in a stepwise fashion toward the completion of the broader long-term goal that is often more complicated and comprehensive. Behavioral objectives that are stated in observable and measurable terms help goal setters understand whether the strategies they are using to achieve their goal are resulting in change or whether they need to modify their efforts to improve the likelihood of accomplishing the desired outcome.

Behavior change is not a new concern. Information about creating effective behavioral goals and objectives to facilitate behavior change has a very long history in areas such as industry, sports, human service organizations, and education (Mager, 1961; Sulzer-Azaroff & Mayer, 1977; Locke & Latham, 1985, 1990). Teachers use behavioral objectives to guide and improve classroom instruction for groups of students, manage classroom social behaviors, and support individual students in need of more intensive social and academic instruction and support (Alberto & Troutman, 1999; Maag, 2004). Behavioral goals and objectives are included in Individual Education Plans (IEPs) for students in need of special education services. The development

of educational goals and behavioral objectives was included as one of the mandates of the Education for all Handicapped Children Act of 1975 (PL94-142) and continued thereafter to be considered an important element for facilitating behavior change resulting from the instructional process.

CHARACTERISTICS OF BEHAVIORAL OBJECTIVES

According to Alberto and Troutman (1999), each behavioral objective should identify the following elements:

1. person(s) for whom the objective is written (the learner),
2. behavior targeted for change,
3. conditions under which a behavior will be performed
4. criteria for determining when the acceptable performance of the behavior occurs.

The learner(s) can be an individual person or a group of individuals. For instance, a learner identified within a behavioral goal could be a student, a classroom, a group of individuals participating in specific track and field activities, or an entire basketball team. Once the learner is defined, the behavior targeted for change must be likely to be repeated over time and must be clearly defined operationally in behavioral terms so that whenever it is performed, it can be observed and measured across repeated occasions. An effective definition of the desired behavior ensures that an outside observer will be able to confirm that the target behavior has occurred.

Thus, it is important when defining the target behavior to avoid words and phrases such as "being disruptive," "staying on task," or "enjoying a story" that have not been operationally defined in behavioral terms. These words and phrases can mean different behaviors to different people. For instance, a substitute teacher may define "being disruptive" as a student tapping a pencil on the desk loudly enough that it can be heard throughout the room. The student's teacher, however, may only be recording "being disruptive" when the child begins yelling so loudly that it can be heard out in the hallway. Behavior definitions that are not stated clearly enough (operationally in specific behavioral terms), for everyone to interpret in the same way, can confuse both the learner and the individuals monitoring the learner's performance. This confusion is likely to lead to further decrease in the likelihood that a goal will be achieved by the learner.

The definition of the behavior should also identify elements of the teaching/learning context that are important for determining the conditions in which a behavior is to occur. The circumstances, requests, materials, and instructions that are identified in the behavioral objective as important elements in the context in which a behavior

Behavioral Objectives

should be performed must be sufficiently detailed to allow a teaching/learning context to be provided repeatedly. The specific environmental cues that are present when a behavior is expected to occur must be described in enough detail to ensure there will be clear and consensual understanding of exactly what such cues include. Frequently the statement of an objective begins with condition statements, such as the following:

Given a map of the United States . . .

Given independent study time . . .

After reading this a paragraph about . . .

The final information necessary in an effective behavioral objective must be statements of the criteria for acceptable performance of the targeted behavior. This statement must define the minimal performance necessary to consider a behavioral response correct and sets a standard for evaluation purposes. There are a number of ways in which to evaluate a response: accuracy (number of items correct), frequency of occurrence (number of behaviors performed), duration (behavior occurring within a time period), or latency (time taken until a response occurs). Another consideration in determining criteria for successful accomplishment of behavioral objectives involves how many times a learner must meet a criterion before the behavior is considered learned. Information about the criteria for evaluating a correct response will guide the ways in which learner performance of the behavioral objective will be measured.

Alberto and Troutman (1999) suggest writing each element of a behavioral objective as a guideline or format, as the following example illustrates:

Goal: Cindy writes effective behavioral goals and objectives for all students needing additional academic support in her math class.

Learner: Cindy

Condition: Cindy identifies a student who is not succeeding on a math assignment in her class.

Behavior: Cindy will write a behavioral goal for that student, breaking the goal down into behavioral objectives that facilitate or assist the student in being successful.

Criteria: Cindy will write a behavioral goal that includes two or more behavioral objectives for two general education students who receive a D or lower on three consecutive assignments in her class with 100% accuracy for three months.

Over time, the criteria for successful accomplishment of each behavioral objective are raised until the learner is able to accomplish the long-term goal that has

been identified. Cindy may begin by writing behavioral goals and objectives for only two students in her class who are receiving a D on three assignments. Each subsequent behavioral objective will include criteria that increase in complexity until Cindy is providing support to all of her students who need individualized behavioral goals and objectives and Cindy can show that student performance is increasing using evaluation data for each student.

IMPORTANT CONSIDERATIONS FOR DESIGNING BEHAVIORAL OBJECTIVES

Behavioral objectives must be written in such a way that the aim is for the individual learner to remain positively motivated to continue working on the long-term goal by experiencing success on the smaller-scope behavioral objectives. If a behavioral objective is too broad, complex, and difficult, a learner may stop trying to perform the behavior. Behavioral objectives are intended to provide feedback for successful performance over time, and this progress can reinforce the learner with positive feedback. The learner's motivation also may decrease if behavioral objectives are too easy. The person working on a behavioral objective that is easily accomplished can become bored with the learning opportunity. Or it may take a long time to achieve the stated goal because there are too many objectives that must be met, which makes the goal seem unobtainable to the learner.

Individuals designing behavioral objectives must balance the number of objectives within each long-term goal as well as the level of difficulty involved in each behavioral objective to help ensure the learner will continue working on a long-term goal. Developing effective behavioral objectives can be challenging. Individuals who write behavioral objectives must monitor progress closely and make modifications as needed over time to help ensure that motivation on the part of the learner remains high, the criteria identified for judging success are effective for evaluating progress, and progress toward the overall goal is being made in a timely manner.

SEE ALSO *Direct Instruction; Mastery Learning.*

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Rachel L. Freeman

BEHAVIORISM

Behaviorism is the scientific study of observable behavior of living organisms in relation to environmental events. Behaviorists view observable behavior as an important subject matter in its own right and avoid interpreting behavior as a sign of some other psychological phenomenon as other psychological systems do (e.g., interpreting behavior as an indication of repressed psychological content in a Freudian model). Instead, behaviorists seek to identify predictable relationships between environmental events and behavior (Alberto & Troutman, 2003; Cooper, Heron, & Heward, 2007; Miltenberger, 2008). Although the totality of all possible environmental events is theoretically limited only by natural physical laws, behaviorism categorizes all environmental events into three types: neutral events, antecedents, and consequences. Only antecedents and consequences are of interest to behaviorists, who refer to them as stimulus events. Behaviorists study stimulus events that cause behavior to occur, stop occurring, or change in some way as a function of antecedents or consequences to behavior. Behavioral scientists recognize, however, that environmental events that affect behavior as antecedents or consequences often vary from person to person and have developed an experimental methodology that allows them to study these phenomena at the level of the individual organism (single-case experimental designs).

RESPONDENT AND OPERANT CONDITIONING

The two main traditions of behaviorism are respondent conditioning and operant conditioning (Alberto & Troutman, 2003; Cooper et al., 2007; Miltenberger, 2008). Respondent conditioning studies antecedent events that cause reflexive behavior to occur. For example, if an otherwise neutral stimulus (e.g., a pungent spice) is paired with a noxious stimulus (e.g., spoiled meat) that causes a reflexive action (e.g., upset stomach), the previously neutral stimulus may cause that response in the future (becoming a conditioned stimulus). A relationship between a stimulus and a

response that did not exist prior to the pairing has been created: the pungent spice now causes upset stomach.

Operant conditioning studies a different class of behaviors, behaviors that are caused by consequences. Behavior changes the environment in some way, and those changes can become consequences that affect future behavior. For example, if a child's inappropriate comments in the classroom result consistently in laughter such that a contingent relationship is formed and there is an increase over time in the frequency of those comments, then the laughter (social attention) is the consequence that causes the behavior to occur. There are four types of consequences that affect the future probability of behavior, two of which are reinforcers and two of which are punishers. A consequence that increases the future probability is a reinforcer. If an environmental stimulus is *added* following the occurrence of behavior and the behavior is more likely to occur in the future, the consequence is a positive reinforcer (Miltenberger, 2008). For example, laughter is the positive reinforcer that increases the future probability of inappropriate comments in the previous example. If an environmental event is *removed* following the occurrence of behavior and the behavior is more likely to occur in the future, the consequence is a negative reinforcer (Miltenberger, 2008). For example, if a child is sent to time-out for crying and screaming when asked to pick up toys and clean up the room, the child may be reinforced by the removal of the demand (picking up toys and cleaning the room) that occurs when the child is sent to time-out. As a result, crying and screaming are more likely in the future when the child is asked to pick up toys.

Punishment is the other consequence that affects the future probability of behavior. However, its effect is opposite that of reinforcement; it decreases behavior. If an environmental stimulus is *added* following the occurrence of behavior and the behavior is less likely to occur in the future, the consequence is a positive punisher (Miltenberger, 2008). For example, if a mother gives a stern look at her child when he is making noise in church and the child is less likely to make noise in church in the future, the stern look is a positive punisher. If an environmental stimulus is *taken away* following the occurrence of behavior and the behavior is less likely to occur in the future, the consequence is a negative punisher (Miltenberger, 2008). For example, when parents take driving privileges away from their adolescent daughter because she was late in returning home and the daughter is less likely to be late in the future, taking away privileges serves as a negative punisher.

Although the primary focus of operant research is on consequences that cause behavior to occur, behavioral scientists are also interested in antecedent influences on operant behavior (Alberto & Troutman, 2003; Cooper

et al., 2007; Miltenberger, 2008). An antecedent is any stimulus present when a behavior is reinforced that has a predictable relationship with the occurrence of reinforcement. For example, if laughter following a child's comment occurs only when a particular person (e.g., a friend) is present and does not occur when that person is not present, the antecedent stimulus (presence of friend) is said to exert stimulus control over the behavior (student comment). It is the laughter (social attention) that causes the behavior to occur; however, the antecedent stimulus sets the occasion for the occurrence of the behavior by virtue of its pairing with the consequence.

STUDYING ENVIRONMENTAL FACTORS AND THEIR EFFECT ON BEHAVIOR

Behaviorism assumes that behavior is governed by natural laws that can be meaningfully studied and identified (Bijou, 1970). Behaviorists seek scientific explanations that predict the occurrence of behavior as it relates to environmental events so that the environment can be arranged to foster the organism's (human or animal) ability to adapt to its environment. When a class of environmental events is shown experimentally to have a predictable effect on behavior, behaviorists say that a functional relationship has been established (Alberto & Troutman, 2003; Cooper et al., 2007; Miltenberger, 2008). For example, aberrant human behavior has been shown to increase in frequency as a function of different classes of stimulus events (consequences) such as contingent access to preferred stimuli (e.g., social attention, toys, food) and contingent removal of aversive stimuli (e.g., instructional demands) (Iwata et al., 1994). Behaviorism also assumes that deviant behavior can be treated through its learning paradigm by rearranging stimulus events.

For behaviorists, all types of problem behavior fall into one of two categories; behavioral excesses (i.e., too much behavior) or behavioral deficits (i.e., too little behavior). Identifying existing functional relationships, therefore, allows behaviorists to rearrange the environment to establish more adaptive functional relationships. In the earlier example of a functional relationship between a child's inappropriate comments in the classroom caused by laughter of a friend, the inappropriate comments constitute the behavioral excess and the presence and laughter of the friend are the controlling events. Rearranging the contingencies to reduce the problem through a behavioral treatment could occur in a variety of ways. For example, removing the friend removes the antecedent to problem behavior; rewarding the friend for not laughing eliminates the consequence for problem behavior; rewarding the child who makes inappropriate

comments for reducing or eliminating inappropriate comments by allowing him or her to have time with the peer is a means of offering a consequence that may compete effectively with the natural consequence supporting the occurrence of the behavior (peer laughter).

TWENTIETH CENTURY BEHAVIORAL RESEARCH

The assumptions, methods, and practices of behaviorism make it an ecological model of learning. Behaviorists spend as much time examining the context for the occurrence of behavior as they do behavior itself. This dimension of behaviorism has developed over time. Early behavioral research in the twentieth century gave rise to the tradition of the Experimental Analysis of Behavior, which used single-case experimental methodology to study a wide variety of types of behavior-environment relationships largely in animals. During this phase of the field's development, the research was largely conducted in carefully designed and controlled experimental contexts. Toward the middle of the twentieth century, behaviorists began to see potential application of the principles and methods to human environments, which resulted in the emergence of the tradition of Applied Behavior Analysis (Baer, Wolf, & Risley, 1968). The field of Applied Behavior Analysis was particularly concerned with addressing human problems (e.g., psychopathology, educational learning, work related difficulties) in their natural context.

Early behavioral treatments often imposed novel and complex generated reinforcement contingencies (e.g., token economies) on existing, natural conditions (Martens, Witt, Daly, & Vollmer, 1999). As the field matured, researchers and clinicians began examining contingencies (antecedents, reinforcers, and punishers) that were already in existence in the natural environment prior to prescribing behavioral treatments. As a result, behavioral treatments became less cumbersome and were better adapted to the environments in which they were being applied. The earlier example of how to respond to inappropriate classroom comments demonstrates how an analysis of classroom contingencies can lead to a treatment that is uniquely adapted to the context in which the problem occurs. An important and unique aspect of the tradition of Applied Behavior Analysis is that both the principles of behavior (e.g., positive and negative reinforcement, punishment, stimulus control) and the actual methodology for studying behavior (use of single-case experimental design elements) can be applied in educational and clinical situations.

BENEFITS OF APPLIED BEHAVIOR ANALYSIS IN EDUCATION

Applied Behavior Analysis is the version of behaviorism that is best suited to educational settings because it has produced the most useful technologies for addressing student learning and problems students typically encounter in schools. Applied Behavior Analysis is the standard of practice in the field of developmental disabilities, both in terms of teaching adaptive behavioral repertoires (e.g., self-help skills, safety behaviors, vocational training) and addressing maladaptive problem behaviors (e.g., self-injury) that are all too frequent in this population (Miltenberger, 2008). Functional analysis of behavior is a well-developed protocol (based on hundreds of studies) for identifying stimulus events that control problem behavior as a basis for developing behavioral treatments and has been studied extensively regarding individuals with developmental disabilities, behavioral disorders, educational disabilities, and those at-risk for learning and behavior problems (O'Neill et al., 1997). In schools, functional behavioral assessment (which involves intensive and systematic study of functional relationships in natural classroom settings using methods of Applied Behavior Analysis) is a requirement of federal special educational law under some circumstances. Positive Behavior Support is an outgrowth of functional behavioral assessment that applies methods of Applied Behavior Analysis at the school building or district level for reducing the overall level of problem behaviors.

There are also teaching models that have been developed based on the science of Applied Behavior Analysis. Direct Instruction, an instructional package that has been shown to produce strong academic learning effects over thirty years of implementation and evaluation (Adams & Carnine, 2003), was originally developed based on a stimulus control paradigm: Instructional materials and lessons are designed to assure the clearest possible presentation of instructional tasks and occasion high rates of student responding to foster strong functional relationships between academic tasks and student responding.

A related development in instructional technology is Precision Teaching (Johnson & Layng, 1992), which uses behavioral fluency training and frequent student monitoring to produce generalizable skill repertoires that make harder tasks easier to learn as students progress through the curriculum. In the field of autism, discrete trial training has achieved enormous popularity. The Comprehensive Application of Behavior Analysis to Schooling (CABAS) is another model used for children with autism and other disabilities (Greer, 1994). CABAS applies frequent and systematic prompting and consequences (learn units) to student academic responding. Behaviorism in its early 21st century form has developed into a number of applications

that share a common view of the importance of measuring observable relationships between behavior and the natural contexts in which it occurs.

SEE ALSO *Applied Behavior Analysis*.

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Edward J. Daly, III

BELIEFS ABOUT LEARNING

Beliefs about learning (BLs) make up the belief system that learners have about learning anything. BLs are central to children's formal education. BLs are not domain or task specific, but general about oneself as a learner. Although researchers may have referred to BLs previously,

Jin Li used the term to study European American (EA) and Chinese students' BLs systematically in the early 2000s. BLs include four broad areas: (1) one's own purposes of learning, (2) understanding of one's learning process, (3) affect associated with one's learning, and (4) social perceptions surrounding one's learning. These four areas jointly influence learners' motivation, self-regulation, and ultimately their achievement.

DEFINING THE CONCEPTS OF BELIEFS ABOUT LEARNING

One's purposes pertain to the central question "why do I need to learn?" to which all learners can respond. Some learners may believe that learning is for a better job in the future; others may believe that learning enables them to understand the world. Some learners may have few purposes whereas others may have multiple purposes. Understanding of one's learning process addresses what learners believe it takes for them to learn something. This set of beliefs includes those about how one's mind works, about the steps one takes to tackle a learning task, and about more abstract approaches of planning, self-monitoring, and overcoming challenges. Affect associated with one's learning is the range of emotions and other feelings learners have about their own learning. These responses can be positive and negative. Joy, excitement, passion, interest, flow, confidence, and pride are examples of positive affects. Dread, anxiety, low self-esteem, embarrassment, shame, guilt, and jealousy are examples of negative affects. Affect is part of the belief system because learners' beliefs are linked to these affective experiences in learning situations. Finally, social perceptions surrounding one's learning concern how learners perceive social aspects in their own learning. All students have such perceptions, for example, regarding what teachers are supposed to do, how learners are supposed to relate to teachers, what good versus poor teaching is, what high versus low-achieving peers are like, how oneself relates to them, how learners view parental and school pressure for learning, and how learners understand the social resources available to themselves.

INDIVIDUAL DIFFERENCES AMONG STUDENTS

Large individual differences exist in all four areas of BLs. Few BLs are attributable only to the individual him- or herself, but are subject to developmental, social, and cultural/ethnic influences. With regard to purposes, EA preschoolers, for instance, believe that learning makes them smart because they learn concrete pieces of knowledge such as names of animals. Older children believe that learning makes them understand things, but not necessarily that it makes them smart. Middle-class students may focus on developing their personal talents; low-income students may be more concerned about

changing their economic status. A given student may have one clear purpose; another may have a combination of purposes (Li, 2006; Li & Fischer, 2004). For example, a Chinese American student may have the individual purpose of studying medicine but at the same time may purposefully intend to fulfill her family's expectations.

Individual learners also vary greatly in what they think it takes for them to learn something. Young children believe that if a person wants to learn something, that person will learn it. Older children realize that desire alone may not guarantee successful learning; one needs to be exposed to the knowledge and to have the intention to learn it. Some students may not see any utility in learning things by heart; others may believe that memorization is a helpful step. Whereas older EA students may focus on thinking, active involvement, and verbal communication, Asian students may stress the so-called personal virtues of diligence, endurance of hardship, concentration, quiet contemplation, persistence, and humility (Li, 2003; Sobel, Li, & Corriveau, 2007).

How learners feel about learning in school is essential to their actual engagement in learning. Individuals' affective experiences with learning vary widely, and they are strongly shaped by their social and cultural context, particularly their home. For example, if a child's personal curiosity is allowed to flourish, that child is likely to grow up feeling that it is natural to ask questions. If a child is socialized to take pride in overcoming challenges, that child may be more inclined to persist through challenges. However, if a child is shielded from making mistakes and failing, that child may develop an aversion toward failure and be less ready to face setbacks. Or if a child is made to feel that not making great effort to learn brings shame to his or her family, that child may be willing to work harder (Li, 2002).

Individuals' perceptions of social aspects of learning can also differ largely. For example, while younger children view teachers as authority figures who must be obeyed, regardless of the teachers' quality, older children may not have such a generalized view of teachers. Instead, they judge teachers individually according to the standards teachers should display and personal qualities such as professional responsibility, integrity, and the care they give to students. Different students may also have different attitudes toward parental pressure for learning. Whereas African American students may regard parental demand as a form of caring, EA students may regard the same parental behavior as interference with their autonomy (Delpit, 1995).

Of particular significance are learners' perceptions of their high- versus low-achieving peers. Social comparison for learning is common among children of all ages. Yet, EA preschoolers are not concerned about how their self-celebratory announcement of their achievement can

negatively impact their lesser achieving peers. However, older children, while seeking information about others' achievement, will try to conceal their own higher achievement to avoid negative social consequences for themselves (e.g., peer rejection). Lower achievers also conceal their achievement in order to avoid negative opinions of their lack of ability. Instead, students with similar achievement reveal their information to each other because the perceived negativity for the self is minimal. In contrast, Chinese higher achievers do not feel a need to conceal their level, and their disclosure is taken as an offer of help extended to the lower achievers. Similarly, lower achievers disclose their information to higher achievers to solicit help from them. These differences reflect diverging cultural values and norms, with EA culture emphasizing the self as unique and stable, while the Chinese culture stresses the self as in constant need of improvement (Li & Wang, 2004).

HOW BELIEFS ABOUT LEARNING GUIDE STUDENT PERFORMANCE

Conscious human behavior is guided by human beliefs. However, how specifically BLs guide student learning has not been well studied. Because BLs are conceptualized as the core of the student's self-view as a learner, not necessarily to a particular learning task or achievement situation, BLs are assumed to guide student learning more broadly. Available evidence suggests that the more numerous and the longer-term purposes students have, the more readily they are engaged to pursue those purposes. For example, if students believe that learning makes them understand the world, gives them good grades for college, and prepares them for a desirable career, allows them to serve their community better, and to earn respect from people, then those students are likely to be more ready to learn. If, however, students believe that school is only about getting a diploma, they may be less motivated to learn.

Similarly, if students believe that keeping an open-mind, always questioning, collecting and using a variety of study skills, paying attention to what is taught, resisting distractions, persisting through the task without giving up, and seeking help when they need it, they are more likely to learn well than students who want to get through each task as quickly and effortlessly as possible. The former students have a set of beliefs that will allow them to meet most academic challenges; the latter hold BLs that foster resignation and avoidance.

Learning without affect is boring. Unfortunately, many students pass through school with such indifference. Students learn much better when they are affectively attuned. Research shows that both positive and negative affects promote learning, depending on how these affects are organized. Self-defeating affects such as low self-esteem

and learned helplessness are detrimental to learning. However, having a sense of shame or guilt for not working hard or for not taking responsibility can motivate a student to seek ways to improve. This tendency is especially true for students from cultural/ethnic backgrounds such as Asians who emphasize social accountability and self-improvement. Regardless of their cultural background, it is better for students to have both positive and negative emotions that are activated appropriately. If students have passion for learning, they will learn better. If students learn well, they should feel proud. If they behave irresponsibly, they should feel a sense of remorse and strive to improve (Li & Fischer, 2004).

Students' perceptions of teachers, peers, and parental and school demands can influence their learning emphatically. In fact, the social world has the most impact on children's BLs. If children view their high achieving peers as models to emulate, they will not reject such peers. If low-achieving students can be encouraged to seek help from their peers without the risk of being viewed as unintelligent, those students will learn much more (Li & Wang, 2004). If teachers teach with deep understanding, appropriate pedagogy, and moral embodiment, students are likely to view them as serious, responsible, and caring adult exemplars. Parental attitude toward school learning is also essential in influencing children's attitudes. If parents emphasize open-mindedness, inquiry, thinking, hard work, perseverance, concentration, and perhaps even a degree of humility, and if they act consistently, their children are likely to follow their examples and act accordingly in school.

SEE ALSO *Epistemological Beliefs*.

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Jin Li

BERLINER, DAVID CHARLES 1938-

Experimental psychologist, educational researcher, psychometrician, teacher educator, policy wonk, activist, administrator David Berliner realized a full life during seven decades during the 20th century and into the 21st, and as of 2008 showed little sign of slowing his pursuit of enhancing the quality of U.S. public schools and of searching out, understanding, and remedying inequities in the system. Seen by some as a troublemaker, he is viewed by many as a mover and shaker.

Born in 1938 in New York, Berliner moved west for academic work at University of California, Los Angeles, Los Angeles City College, and a 1968 doctorate at Stanford University. In 1977 he moved to Arizona, first to Tucson, and in 1997 to Arizona State University for several years as dean and subsequently as regents professor. In 1985 he was elected president of the American Educational Association; his awards and honors are numerous and come from various places around the world. This entry organizes Berliner's accomplishments by the four seminal topics that emerged over the decades: (1) academic learning time; (2) looking at classrooms; (3) classroom expertise; and (4) the public image of teachers and teaching.

Schools have a plentitude of learning time; in the United States, most students spend almost 12,000 hours in classrooms, surely enough time to learn. In the 1980 Beginning Teacher Evaluation Study (BTES), Berliner and his colleagues used ethnographic methods to document the details of classroom life (Fisher & Berliner, 1985). The result was a rich and textured account of how individual teachers moved the minds and motives of students toward mandated academic and social outcomes. They discovered that time was a critical but complex metric. In a mindless application of the *time-on-task* principle, administrators in the early 2000s mandated prescribed time to specified tasks. For example, they might specify that the teacher spend two hours daily on reading. Berliner showed time to be an essential ingredient, often lost through poor management practices. But he also found that how time was spent was an equally if not more important consideration.

BTES was unique as a large-scale ethnographic study, relying on qualitative methods to collect generalizable data. It was also an example of a *mixed-methods* strategy, where many claims relied on qualitative (statistical) techniques. The data included classroom observations, along with psychometrically designed student outcomes, teacher interviews, and focus-group techniques. At about this time, an acrimonious debate emerged between quantitative and qualitative camps. Berliner finessed this debate. Focused on understanding the contextual influences on classrooms, he relied on the mix of methods best suited to a particular problem.

Berliner's interest in expertise emerged from observations and interviews during the BTES study (Berliner, 1994). The new approaches of cognitive psychology revealed that expertise could illuminate the exploration of well-organized minds. His decade of work in this field brought out that pedagogical expertise was wonderful to behold, could be studied experimentally, and appeared across a broad spectrum of contexts.

Findings from the annual Gallup poll on the state of U.S. schools (Phi Delta Kappan) are remarkably consistent. In general, respondents say that U.S. schools are in a sorry state. Parents view their local schools as good, but schools in general as quite bad. The poll, a crude index, raises puzzling questions. For instance, how does a non-parent form opinions of schools? In a seminal work with Bruce Biddle (*Manufactured Crisis*, 1995) and with Sharon Nichols (*Collateral Damage* [2007]) Berliner analyzed media portrayals of public school. Reporters spend little time in classrooms and rely on the opinions of opinion-makers. Bad news sells. Driven by anecdotes more than evidence, the policy environment of the early 2000s portrays schools as poorly managed, teachers as incompetent, and graduates as lacking basic skills. To ensure that "no child is left behind," the corrective is the use of multiple-choice tests to pressure public schools to raise test scores by whatever means possible, threatening dire consequences for those who fail to attain ever-increasing levels. Berliner's work raises questions about every aspect of this policy environment but most significantly, Berliner takes to task the media especially those who persist in reporting so-called facts that are demonstrably false.

Berliner's influence comes about in several ways. He is a prolific writer. For example, he wrote the bestselling textbook, *Educational Psychology*, with mentor and colleague Nate Gage (Gage & Berliner, 1998) and co-edited the larger volume, *The Handbook of Educational Psychology* with Robert Calfee (1996). His numerous journal articles and readings, many with Ursula Casanova, have reached large audiences. He is at his best with a live audience, combining an avuncular style with passion and sensitivity. He has a remarkable ability to match style with audience general public, researchers, practitioners,

legislators. He does not lack for detractors, quite the contrary, but he persistently presses for equal and quality public education, through policies more than politics, through cumulative evidence more than quick fixes, through reasoned analysis more than one best answer.

A final anecdote illustrates Berliner employing evidence to cut to the core of a problem, simultaneously confounding all parties. Shortly after he became dean at Arizona State, the Arizona legislature asked him how to reduce the costs of public schooling. Berliner told the committee that they could reduce costs substantially by one simple act—eliminate retention in grade. The evidence is clear: Keeping a student behind has no positive effect on learning, but rather a variety of negative motivational and social consequences. The economic consequences are obvious: Retention adds another year of costs to the education. The legislators were confounded. The evidence was unassailable, but the recommendation was unacceptable. Berliner's delivery was calm but persistent: If the legislators really wanted to save money, then they would do away with retention and find more cost-effective ways to help students who were not doing well. The legislative committee thanked him for his words and moved on to other issues. But Berliner was not discouraged, for there was much for him to do.

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Robert Calfee

BILINGUAL EDUCATION

Bilingual education refers to instruction in two languages. Typically, bilingual education is offered in the societal language and in another language. In the United States, bilingual education usually refers to the type of

instruction provided to students who are limited-English-proficient, also known as English language learners. These students receive instruction in their native or home language and in English. Most programs focus on Spanish and English because the majority of English language learners are Spanish speakers. In international contexts, bilingual education is offered to students who do not know the societal language and to students who are native speakers of the societal language. When the latter students are given the opportunity to learn a second language, bilingual education becomes prestigious and is viewed as an educational advantage.

HISTORY OF BILINGUAL EDUCATION IN THE UNITED STATES

Although James Crawford reports that bilingual education existed during the early history of the United States, it was not until 1968, when the United States Congress authorized bilingual education through the Bilingual Education Act, or Title VII of the Hawkins-Stafford Elementary and Secondary Education Act, that it became an approved means of education for students who were limited-English-proficient. A Supreme Court ruling, *Lau v. Nichols* (1974), contributed to the spread of bilingual education when the Court declared that placing Chinese students who were limited-English-proficient in regular classrooms, without special efforts to address their second-language status, was a violation of their civil rights. The Office of Civil Rights in the United States Department of Education then decided that the preferred method to address students' second-language status was bilingual education.

Crawford explains that after 1987, the types of programs funded under the heading of bilingual education expanded to include English instruction without a native-language component. For example, in 1987–1988, Congress allowed up to 25 percent of federal funding to be used for all-English programs. In the late 1990s and early 2000s, a few states restricted or outlawed bilingual education programs with native-language instruction, providing English-language learners only with some form of English instruction. In 2002, with the passage of the No Child Left Behind Act, the English Language Acquisition Act (Title III), replaced the Bilingual Education Act. States now could choose how to address the second-language needs of English-language learners, as long as they established English proficiency standards, quality academic instruction in reading and mathematics, and quality language instruction based on scientific research for English acquisition. They also had to provide English-language learners with highly qualified teachers and annually assess the English proficiency and reading and

mathematics performance of English-language learners. In 2005, forty states still had bilingual education programs that used the native language and English, with the rest offering some type of English-as-a-second-language (ESL) instructional program.

BILINGUAL EDUCATION VERSUS INSTRUCTION IN THE SOCIETAL LANGUAGE

Opponents of bilingual education often claim that their grandparents were immigrants who learned the societal language and acquired jobs without bilingual education. They warn that students will not learn the societal language if they are not immersed in it at an early age. They voice concerns about students not acquiring the societal language as fast as possible and argue that time on task is important for language acquisition.

Katharine Davies Samway and Denise McKeon explain that past immigrants had less need for a high school education and could survive with lower levels of English proficiency than current immigrants due to the types of employment available. Diane August and Kenji Hakuta counter the early immersion and time-on-task warning by explaining that older students, who already have acquired their native language, are more effective second-language learners than younger students. The older students can use what they have learned about their native language to approach learning about a second language. Additionally, Stephen Krashen explains that mere exposure to a second language is not enough for second-language acquisition because students need to receive structured course content that is comprehensible to them.

Jim Cummins (1979, 1981) points out that it takes time for English language learners to acquire the type of language needed to perform at grade level in English. He distinguishes between the skills needed to communicate orally in English and academic language proficiency—the skills needed to read and write in English and learn new material at grade level in English. Cummins observes that English-language learners can acquire English oral proficiency in two to three years of instruction but may need four to seven years of instruction to acquire academic language proficiency.

Cummins (1979) also argues that students who have developed academic language proficiency in one language can make use of this proficiency for learning in a second language. Virginia Collier's synthesis of research with immigrant children from advantaged backgrounds provides some evidence that supports Cummins's theory. Collier found that English-language learners who had no formal instruction in their home countries, needed seven to ten years of instruction in English to reach grade-level in English, whereas English-language learners

who had two to three years of formal schooling in their home countries and who entered schools in the United States between ages 8 and 12 needed five to seven years of instruction in English to reach grade level. In a review of empirical data, Diane August and her colleagues (2008) also support Cummins's claim. They concluded, "Language minority children who are literate in their first language are likely to be advantaged in the acquisition of English literacy. Studies demonstrate that language minority students instructed in the native language (usually Spanish) and English perform, on average, better on English reading measures than language-minority students instructed only in English" (p. 171).

TYPES OF PROGRAMS

There are different types of bilingual education programs. The most common program is Transitional Bilingual Education, which typically is offered to English-language learners in the elementary grades for up to three years, most often from grades 1 to 3. Students usually receive some amount of native language instruction so that they do not fall behind in their literacy or content learning as they are acquiring English. The percent of time that they are taught literacy and content in the native language changes so that by the end of third grade, most, if not all of their literacy and content instruction is in English. Teachers in these programs are supposed to be proficient in both English and the native language and state certified for teaching at the particular grade level and in bilingual education. Although funding for this type of program is available for three years, individual students are exited from the program as soon as they are classified as English proficient. Once exited, they are placed in all-English classrooms without additional second-language services.

Another type of program is called maintenance, developmental, or late-exit bilingual education. English-language learners typically stay in these programs throughout elementary school, or from grades K 5 or 6. Similar to those teaching in transitional bilingual education, teachers in this program should be proficient in English and the native language and state certified at the respective grade level and in bilingual education. Students learn literacy and content areas in their native language as they are taught ESL. However, their transition to instruction in English is more gradual than in transitional bilingual education, and they continue to receive instruction in their native language throughout elementary school. For example, beginning in fourth grade, students usually receive 40 percent of their instruction in the native language and 60 percent in English. When students graduate from elementary school to middle school, they usually are placed in all-English classrooms and no longer receive bilingual education services.

Dual language or two-way immersion is a third type of bilingual education program. In these programs, two types of students are enrolled in the same classroom or program: native English-speaking students and English-language learners. Instruction is presented in two languages: English and the native language of the English-language learners. The goal of the instruction is for both groups of students to become fluently bilingual. A certified bilingual education teacher or a pair of teachers—one fluent in English and with grade-level and ESL certification, and the other fluent in the native language and English with grade-level and bilingual education certification—teach the students, making sure to use second-language techniques to introduce content and literacy to the students not fluent in the specific language of instruction. Typically, students in first grade receive 80–90 percent of their instruction in the native language, and 10–20 percent of their instruction in the other language. By fourth grade, students receive instruction for half the school day in each language. In a few programs, starting with first grade, students receive instruction in both languages 50 percent of the time. Students stay in this type of program throughout elementary school.

A fourth type of program is structured English immersion. This program is only for English-language learners and does not involve any formal instruction in the native language. All of the students' instruction is in English. To help students understand the instruction, the teacher adapts her instruction by using ESL techniques. However, in some classrooms the teacher may speak the native language and allow the students to interact with each other in the native language. Students typically are in this program for one to three years. Once exited from the program, students no longer receive any second-language services.

When students are not in one of the above bilingual education programs, they may participate in an ESL pullout program for part of the school day, or be placed in an all-English classroom without any second-language services. The latter is called submersion, or sink-and-swim, because students either do not do well (sink) in school or do well in school (swim).

In Canada, majority native-English speaking students may enroll in French immersion programs. These programs are similar to structured English immersion in terms of the teacher's qualifications and the use of second-language techniques to present instruction in a second language, in this case, French. However, beginning in first grade, a native-language or English component often is included, making them more similar to transitional bilingual education or late exit/maintenance bilingual education. Also, these programs tend to serve middle or upper class students rather than students of immigrant families.

EVALUATIONS OF PROGRAM EFFECTIVENESS

One reason that bilingual education has continued to be controversial in the United States is that large-scale evaluations are difficult to conduct due to the lack of random assignment of students to instructional programs and the range of variables that need to be controlled, such as variation in program design, amount of native-language and English used for instruction, previous student experience in bilingual education, and differences in teacher qualifications and students' levels of English proficiency and socio-economic status. The conclusions of national evaluations that have reported non-significant or negative findings for bilingual education have been questioned due to serious flaws in their evaluation designs. Meta-analyses of bilingual education programs, which statistically control for many design problems noted above, have favored bilingual education programs.

Critics of bilingual education usually cite two early evaluations of bilingual education programs. In 1977–1978 the American Institutes for Research (AIR) conducted a national evaluation of 38 bilingual programs. Crawford explains that the AIR evaluation compared the performance of Spanish-background students enrolled in bilingual education to that of Spanish-background students enrolled in all-English classrooms on pre- and post-measures in English in reading, oral comprehension, and mathematics, and in Spanish on reading and oral comprehension. AIR concluded that bilingual education had not had a positive impact because there were no differences in performance between the two groups in oral English comprehension and mathematics, and children in the all-English classrooms outperformed those in bilingual education on standardized measures of English reading. However, one of the major flaws with the AIR evaluation was that two-thirds of the Spanish-background students included in the all-English sample had previously been enrolled in bilingual education.

In 1983 Keith Baker and Adriana de Kanter published their evaluation of bilingual education. They used 28 of 300 program evaluations, excluding most of the program evaluations because they deemed them methodologically unsound. They included the AIR evaluation and evaluations of Canadian French immersion programs. To determine effectiveness, Baker and de Kanter counted the number of program evaluations that reported higher test scores for students in transitional bilingual education classrooms compared to students in other types of classrooms (all-English, structured English immersion, Canadian French immersion, pull-out ESL). Baker and de Kanter concluded that the results were ambiguous because students in bilingual education did not outperform students who were not in bilingual

education. Crawford reports that Baker later stated that one in three studies favored bilingual education, while one in four favored all-English. This evaluation was criticized because Baker and de Kanter did not control for a number of teaching and student variables; considered the Canadian French Immersion studies to be similar to structured English immersion; and in their narrative tally did not take into account the different numbers of students who participated in the individual program evaluations (e.g., an evaluation with 50 students was considered equal to an evaluation with 200 students).

In 1996, Chrisine Rossell and Keith Baker published another narrative comparison of bilingual education programs and non-bilingual education programs, which again included the Canadian French Immersion programs along with other types of Canadian programs. This time they included 72 out of 300 evaluation studies. On English reading measures, they reported that 45 percent of the findings were inconclusive, while 22 percent of the transitional bilingual education programs outperformed structured immersion, and 33 percent of the structured immersion programs (primarily the Canadian French Immersion programs) outperformed transitional bilingual education programs. According to Crawford, Canadian researchers warned that many of the Canadian programs were not equivalent to the program types in the United States. In some program evaluations, students received native language instruction in both the control and experimental groups, invalidating the comparison. Other researchers complained that they could not find all the studies in the Rossell and Baker evaluation.

Three meta-analyses of bilingual education programs conducted between 1985 and 2008 have reported favorable findings for bilingual education. In 1985, Ann Willig used meta-analysis to reanalyze 23 of the 28 studies originally included in the Baker and de Kanter evaluation, excluding the Canadian French Immersion studies and secondary studies. On English measures of language, mathematics, overall achievement, and reading (and on similar measures in Spanish, plus listening comprehension, writing, social studies, attitudes about school and self), she found small-to-moderate differences in favor of bilingual education. When random assignment had been used in the evaluations, the effect size was even greater for bilingual education. Crawford explains that in 1999, Jay Greene also used meta-analysis to re-analyze the methodologically sound studies that could be located from the Rossell and Baker evaluation, purposefully excluding the Canadian studies. He found 11 studies. To avoid the confounding of program type, he ignored the program labels and based his comparison on the use or non-use of the native-language for the instruction of English language learners. His results were similar to Willig's meta-analysis:

He found small to moderate differences favoring bilingual education on the same types of measures.

Diane August and her colleagues (2008) chose to conduct a meta-analysis that only focused on studies with experimental designs and in which students had been taught for at least six months. They limited their comparison to the English reading test performance of students in bilingual programs and students in programs that only used English. Sixteen programs from the United States and four from Canada were included in the meta-analysis. August and her colleagues concluded that "bilingual education has a positive effect on English reading outcomes that is small to moderate in size" (p. 139). Further, they reported: "children in the bilingual programs . . . also developed literacy skills in their native language. Thus, they achieved the advantage of being bilingual and biliterate" (p. 140).

RELATIONS AMONG LANGUAGE STATUS, AFFECTIVE FACTORS, AND LEARNING

According to Walter Lambert, subtractive bilingualism occurs when students lose proficiency in one language as they develop proficiency in the other language. Several experts have warned that participation in all-English classrooms, structured English immersion, or transitional bilingual education may contribute to subtractive bilingualism. When language-minority students are not fully accepted by native speakers of the societal language because of their accented speech or racial/ethnic appearance the loss of proficiency or lack of further development in their native language can result in low self-esteem and negative self-image. Lilly Wong Fillmore described the psychological problems that occurred when young English-language learners, enrolled in all-English classrooms, lost their ability to communicate with family members in their native language.

Additive bilingualism is viewed as contributing to students' self-esteem. According to Lambert, additive bilingualism occurs when students add proficiency and competency in a second language to the native language without loss or retardation of the native language. The latter is likely to occur for language majority students who are acquiring a minority language, such as in Canada. Participation in maintenance, developmental, or late-exit bilingual education and dual language or two-way immersion programs also can promote additive bilingualism. The length and design of these programs usually provide English-language learners with the opportunity to acquire academic language proficiency in English as students continue to use and further their native-language development. Participation in these programs also may aid students in making effective use of

cross-linguistic transfer when instruction across the two languages is coordinated, so that students learn new and difficult concepts in the language they know best, while being taught the vocabulary and discourse to access this knowledge in English. In a comparison of the performance of Spanish-speakers in transitional bilingual education, structured English immersion, and late-exit bilingual education, David Ramirez found that students in the latter programs had the highest growth curve in English learning as measured on standardized tests, indicating that with additional time in school they would be at a grade level.

SEE ALSO *Learning and Teaching Foreign Languages; Multicultural Education.*

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Georgia Earnest Garcia

BIOLOGICAL THEORIES OF COGNITIVE DEVELOPMENT

SEE *Cognitive Development: Biological Theories.*

BLOOM'S TAXONOMY

The Taxonomy of Educational Objectives: Handbook I, The Cognitive Domain (Bloom, 1956) is a framework intended to classify any curriculum objective in terms of its explicit or implicit intellectual skills and abilities. Curriculum objectives describe the intended outcomes of instruction its goals. Despite their age, the taxonomies have provided a basis for test and curriculum development in the United States as well as throughout the world (Chung, 1994, Lewy and Bathory, 1994, Postlethwaite, 1994). *The Taxonomy* was cited as one of the significant writings influencing curriculum in the twentieth century (Shane, 1981, Kridel, 2000). A Yahoo search showed "Bloom's Taxonomy" appeared in more than 455,000 entries.

Its six categories Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation were tested with sets of actual objectives to assure inclusiveness. The distinctions between categories were intended to reflect those that teachers make in curriculum development and teaching. Although each category was also broken into subcategories, most applications of the framework involved mainly the major categories.

Intended to be logically internally consistent, the underlying ordering dimensions were those of simple to complex and concrete to abstract. Because each category assumed mastery of the previous ones, the framework formed a cumulative hierarchy. For example, comprehension of a rule is assumed necessary to the rule's proper application to a problem. Therefore, one must assume certain background knowledge and skills in order to properly classify objectives for particular students.

Developed by faculty involved in building achievement tests for university courses, *The Taxonomy* was intended to ease communication among test makers so

they could trade items designed to test the same objectives. Thus, the handbook included a large number of sample items for each major category as models. But the framework has found considerable use beyond this. By providing a panorama of the breadth of objectives, it became a standard against which sets of objectives could be compared. Therefore, a major application was the analysis of course objectives to determine the balance of goals across the categories. Repeatedly finding an overbalance of knowledge objectives compared to few, if any, skills and abilities objectives (comprehension through evaluation) led to increased emphasis on higher level behaviors.

The cognitive domain was the first of three taxonomies developed to cover the objectives spectrum. The second, the affective domain (Krathwohl, Bloom, and Masia, 1964), covered interest, attitude, appreciation, value and adjustment objectives. Objectives dealing with motor coordination and physical movement were the subject of the psychomotor taxonomies of Simpson (1966) and Harrow (1972).

All these authors assumed that each field would create subdivisions to make the framework fit its own emphases, language, and characteristics. Indeed, Bloom, Hastings and Madaus (1971) provided examples of how it could be adapted. *The Taxonomy's* wide adoption (including translation into more than twenty languages) showed the usefulness of such frameworks and stirred development of alternatives. Bloom's introduction of taxonomy to the field of education with all the term implied was important. A chapter in *The Taxonomy Revision* describes 19 of numerous competing frameworks, many claiming to be taxonomies.

THE REVISION OF *THE TAXONOMY*

Advances in cognitive psychology suggested a need for revision. In 1995 Krathwohl and Anderson formed a committee composed of P. W. Airasian, K. A. Cruikshank, R. E. Mayer, P. R. Pintrich, J. Raths, and M. C. Wittrock. Their revision was Anderson and Krathwohl (Eds.) (2001). The revision made 12 major changes that fall in three categories, changes in emphasis, terminology, and structure.

Changes in Emphasis. First, the primary audience is elementary and secondary teachers. Second, instead of providing many sample test items, the revision emphasizes the alignment of curriculum, instruction, and assessment. Third, rather than providing models, the sample assessment tasks illustrate and clarify the category's meaning. Finally, subcategories are used to define the major categories.

Changes in Terminology. First, the nouns forming the categories on the cognitive process dimension were rewritten as verbs. Second, the term *Knowledge* became

Remember, but remained the least complex cognitive process. Third, *Comprehension* and *Synthesis* were renamed *Understand* and *Create*. Finally, the subcategories were completely renamed, reorganized, and were written as verbs.

Changes in Structure. The grammatical structure of educational objectives is subject-verb-object. In numerous elementary classrooms one sees the letters TLW, standing for "The Learner Will," written as a lead-in to objectives written on chalkboards or whiteboards. The subject of educational objectives is the student or the learner. The first structural change was to classify each objective in two dimensions according to the verb and object. Second, the verb what is to be done with or to knowledge became the cognitive process dimension with Remember, Understand, Apply, Analyze, Evaluate and Create categories. The object what content is dealt with became the Knowledge Dimension with Factual, Conceptual, Procedural, and Metacognitive categories. Third, the two dimensions became the basis for the Taxonomy Table described below. Fourth, the claim that the cognitive process dimension was a cumulative hierarchy was eliminated.

THE TAXONOMY TABLE

The taxonomy table provides a useful way of analyzing the objectives and instructional activities of a curriculum in terms of *The Taxonomy Revision* framework to show how well objectives and objectives are aligned and how they contribute to the larger course of study of which it is a part.

The Taxonomy Table's Cognitive Process Dimension. Verbs in this dimension usually name the columns of the Taxonomy Table (see Table 1). The learner will remember. The learner will classify. The learner will apply. The learner will organize.

Its Knowledge Dimension. The objects of objectives are derived most frequently from the curriculum content: The learner will remember the major exports of countries; be able to classify poems as ballads, sonnets, etc.; apply algorithms to mathematical operations; organize tree leaves based on botanical principles. Knowledge's four classifications of this content transcend subject matter and grade level and form the rows of the Table (see Table 1). 1) Factual knowledge includes knowledge of terms and facts. "Major exports of countries" is an example of factual knowledge. 2) Conceptual knowledge includes knowledge of categories, principles, theories, and models. "Ballads, sonnets, odes, and epics" are all categories of poems. 3) Procedural knowledge includes knowledge of techniques and methods. Addition, subtraction, multiplication, and division algorithms are

A taxonomy table example

The columns of the table are the Cognitive Process categories and the rows are the Knowledge categories. The sample objective is classified at the intersection of Understand and Conceptual Knowledge.

	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		The learner will compare democracies and autocracies				
Procedural						
Metacognitive						

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

mathematical procedures. 4) Metacognitive knowledge includes knowledge of general strategies, school tasks, and oneself. Knowing how to write an essay that meets the approval of the teacher is an aspect of metacognitive knowledge.

APPLICATIONS OF *THE REVISED TAXONOMY*

Because the format of the Taxonomy Table mirrors the grammatical structure of objectives, it can be used (1) to increase understanding of educational objectives, (2) to design assessments that are aligned with specified educational objectives, and (3) to develop instruction that is aligned with both the objectives and the assessments. Each of these applications is described briefly in the sections that follow.

Increased Understanding of Objectives. The Taxonomy Table provides a framework for showing the underlying similarities across subjects and grades. Consider the following objective: "The learner will compare democracies and autocracies." In this objective, "compare" means the student will understand the similarities and differences of two forms of government. Because "compare" is a cognitive process associated with "Understand" in the Taxonomy Table and because "democracies" and "autocracies" are forms (classifications) of government, this objective would be classified as "Understand Conceptual Knowledge" (see Table 1).

Now, consider an objective dealing with important science concepts: "The learner will compare weather and climate." This objective, like the first, would be classified as "Understand Conceptual Knowledge." The Taxonomy Table, thus, allows educators to move beyond rather superficial subject matter differences (social studies versus science) to a deeper understanding of the objectives in terms of intended student learning.

Designing Valid Assessments. Far too often, educators focus on the objects of the objectives with only a secondary concern for the verbs included in them. Numerous test items can be written about democracies and autocracies or weather and climate. To conform to the objective's real meaning, however, the items cannot ask students to provide or identify memorized concept definitions (which would be less complex, cognitively speaking), nor can the items ask students to evaluate the relative merits of each concept (which would be much more complex, cognitively speaking). If they are to be valid, the items need to determine whether students can compare two forms of government or two meteorological categories in terms of their similarities and differences. One method of improving the alignment between objectives and test items, which is consistent with the Taxonomy Table, is to build items using item formats designed to test these complex objectives (Haladyna, 1999; Roid and Haladyna, 1982).

Planning Effective Instruction. One of the insights many educators gain from using the Taxonomy Table to plan instruction is that objectives that are classified into the same cells of the Table are taught in much the same way. For example, both of the objectives used as examples in the previous sections would be classified as "Understand Conceptual Knowledge." Based on a great deal of research, much is known about teaching students to understand conceptual knowledge (Klausmeier, 1980; Tennyson and Cocchiarella, 1986). Teaching concepts in context, teaching defining features, and using examples and non-examples are all empirically verified ways of teaching concepts.

CRITICISM OF THE TAXONOMIES

Much of the written criticism has been directed toward *The Taxonomy*. Furst (1994) questioned the assumption that *The Taxonomy* was a "purely descriptive scheme in which every kind of goal could be represented in a

relatively neutral way.” (p. 28). He also questioned whether *The Taxonomy* was sufficiently comprehensive, suggesting that omitting the term understanding was an error. Bereiter and Scardamalia (1998) criticized the placement of knowledge on the same continuum as intellectual skills and abilities, particularly its placement at the lowest end of the continuum. Still others resist the objectives-based-movement as overly simplistic or as slicing and dicing the curriculum so as to destroy holistic processes (Marsh, 1992). The taxonomy revision attended to many of these criticisms, including a separate knowledge dimension as well as understanding as a primary cognitive process category. The focus on curriculum standards by both state and federal governments has reminded educators of the importance of objectives.

Shulman (2002) had the right idea when he wrote: “what is important about these taxonomies is that they are . . . heuristics. They help us think more clearly about what we’re doing, and they afford us a language through which we can exchange ideas and dilemmas” (p. 42).

SEE ALSO *Questioning*.

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BRAIN AND LEARNING

This entry discusses “Reading, Writing, and Math Brains” and the relevance of brain research to teaching and learning.

Knowledge of the structure and function of the normal brain in living human beings expanded exponentially during the last decade of the 20th century. Fueled by financial support from the United States government and advancements in brain imaging technology, neuroscientists scanned brains of mostly adults and sometimes children while they performed tasks. Likewise, neuroscientists in other countries contributed to the rapidly growing knowledge of brain-behavior relationships. Prior to this period in neuroscience history, most knowledge of brain-behavior relationships was based on autopsies of individuals who died of brain-related disease or injury.

Educational professionals expressed various reactions to this knowledge explosion, ranging from fascination and enthusiasm to skepticism. Is it really possible to go from brain scan to lesson plan? Many did not see the relevance of this basic research knowledge to their day-to-day practices as teachers in real-world classrooms. In part,

the reluctance to embrace this new knowledge may be related to feeling intimidated by the complexity and terminology of neuroscience, which was not easily accessible by non-neuroscientists.

Typically, few pre-service or graduate students in teacher education are required to take courses on the brain as are students in medical, speech, hearing, and language sciences, occupational therapy, and physical therapy. Considering that the brain is the organ of learning, this oversight seemed shortsighted to some professionals. Virginia Berninger and Todd Richards, the authors of this entry, wrote *Brain Literacy for Educators and Psychologists* to introduce to educators the terminology and concepts needed to read the emerging research literature relevant to the brain and instruction and learning. Other books written for an educational audience for the same purpose are listed below under Suggestions for Further Reading. A Web site included under Electronic Resources by Eric H. Chudler is specifically directed to teachers and includes lesson plans for teaching students about their brains.

This entry provides an overview of some of what is known about reading, writing, and math brains. It also seeks to make the case that the brain and knowledge of it are relevant to teaching. Included is a brief overview of important general principals regarding the brain's role in learning and discussion of how brain research increased understanding of how reading brains, writing brains, and math brains develop as the brain interacts with the educational environment.

BRAIN'S BIDIRECTIONAL, MEDIATING RELATIONSHIPS WITH ENVIRONMENTAL INTERACTIONS

All learning is mediated by the brain's response to either instruction or other educational experience. Whether that instruction or experience is teacher-directed, teacher-guided (through scaffolding or questioning rather than knowledge dissemination), or self-generated and self-directed, the brain receives input from the environment. However, neither teaching nor other environmental input directly programs the brain as the software engineer directly creates programs or the computer-user enters data into the system. Rather, the environmental input indirectly exerts its effects on subsequent learning processes via the brain's attentional system, which selects a subset of the incoming stimuli for focus of attention, and the memory system, which codes the incoming information for temporary or permanent storage. Selection of stimuli for attentional focus may occur at the unconscious level in implicit memory or the conscious level in explicit memory.

The human brain codes incoming information in multiple formats depending on the physical properties of the incoming signal (e.g. visual or auditory) and existing coding formats higher in the system that are uniquely designed for

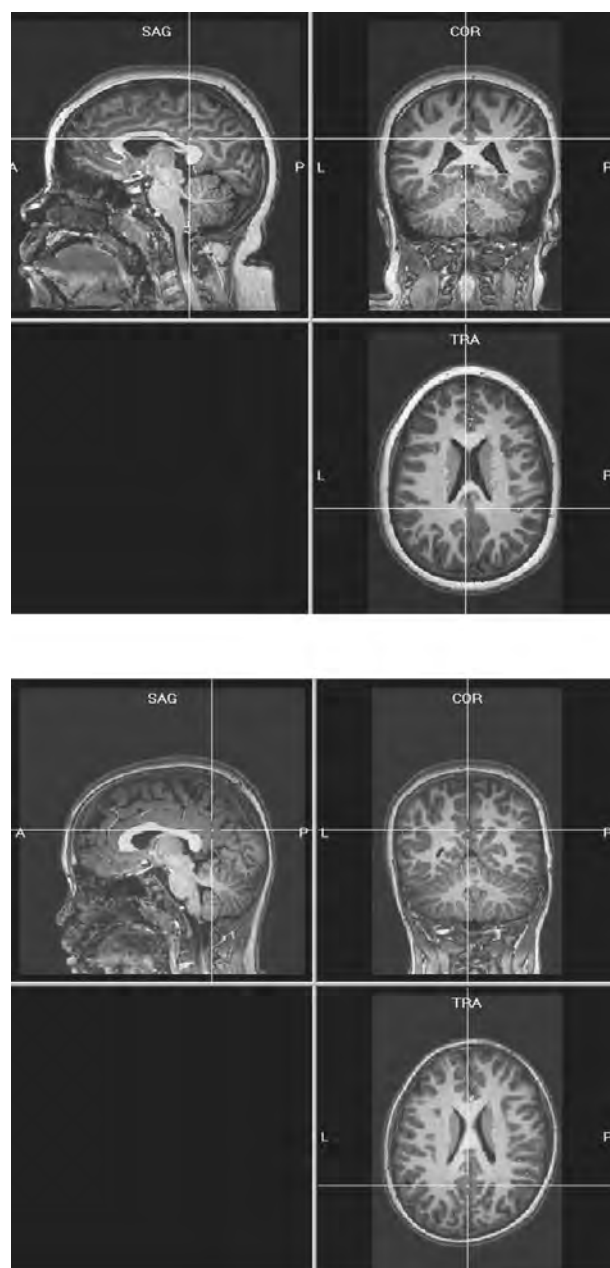


Figure 1 View from 3 Imaging Perspectives of Two Typically Developing Brains. SAG = sagittal side view of the brain section; COR = coronal frontal view of the brain section; TRA = transverse which means a top view of the brain section.

COURTESY OF DR. TODD RICHARDS AND THE UNIVERSITY OF WASHINGTON LEARNING DISABILITY CENTER.

special kinds of sensory input (e.g. orthographic for visual or phonological for auditory). Working memory is a specialized brain system in explicit memory for consciously selecting, storing, maintaining, and processing incoming information and existing information in the brain for goal-directed purposes or tasks. Some of these processes may be automatic and

executed in implicit memory thus freeing up limited conscious awareness in explicit working memory.

Once it is coded into working memory, further processing of the new input is influenced more by the learner's existing knowledge than the teacher's instructional input, guidance, or learning activities to foster self-guided learning. Whether the student has learned to learn, that is, created mental sets or strategies for regulating the learning process, is invisible to an observer but will determine what happens next in the learning process. However, some kinds of instruction or learning activities require that the student act on the environment, that is, produce observable behavior. The brain's motor systems are involved in such behavior generation: gross motor systems for arms, legs, body trunk or fine motor system for mouth and articulation and hand for finger movements.

How the brain mediates the teacher's instructional input or other relevant input is not directly observable, but the brain's behavioral response to that instruction is. Brain differences between students with and without developmental and behavioral problems show pretreatment differences and individual differences in response to the same instruction (e.g., Berninger & Richards, 2002). Likewise, typically developing readers in first grade instructional groups showed normal variation in response to the same reading instruction (Berninger & Abbott, 1992), as did individual at-risk readers and writers (Abbott, Reed, Abbott, & Berninger, 1997).

Children probably exhibit such normal variation in response to instruction because of normal variation in the neuroanatomical structures and functions of individual brains. No two brains are exactly alike. See Figures 1 and 2. Each of these brains shown in a magnetic resonance imaging scan (MRI) has the same parts but they vary markedly in the way the gray and white matter are organized in the convolutions (folds) of cortex on top of the brain, corpus callosum (band of white fibers connecting right and left cortex), and four ventricles filled with cerebrospinal fluid. These MRI scans are not photographs of the exquisite detail of a child's neuroanatomy but rather images that are reconstructed by computer program based on water molecules in the human brain to provide spatial information about brain structures. These scans are not invasive; that is, no radiation is used and that makes them ideal for research purposes with children and youth.

Furthermore, the brain is not only an independent variable that influences response to instruction but also a dependent variable that may change as a result of learning. In some cases the changes involve what is represented—factual or procedural knowledge. In other cases changes involve how the brain functions—amount of activation in specific brain regions that vary in the physical properties of their neurons and presumable their computational capabilities.

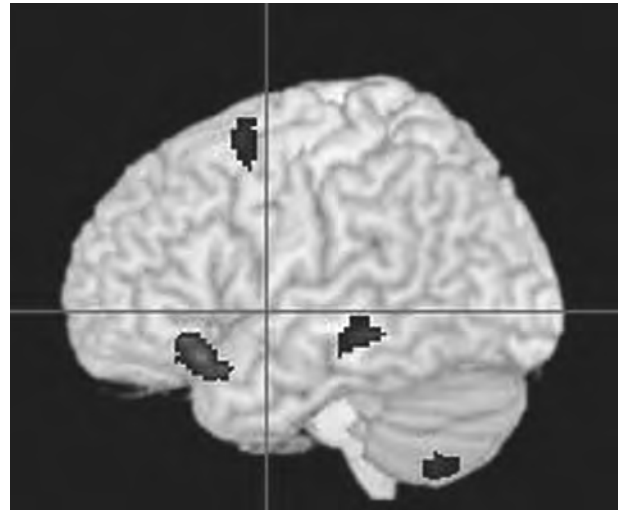


Figure 2 fMRI Functional imaging of brain of a fifth grader deciding if words are correctly spelled real words. Significant Blood Oxygen Level Dependent (BOLD) activation occurred in left cerebellum, left temporal pole, left inferior frontal gyrus, and bilateral supplementary motor area. COURTESY OF DR. TODD RICHARDS AND THE UNIVERSITY OF WASHINGTON LEARNING DISABILITY CENTER.

To summarize, the brain may influence the learner's response to instruction or learning activities, and the learner's behavior in response to instruction may in turn influence the brain's representations or functions. Teaching and learning are not synonymous—the learner may not attend to and encode into memory some or all of the environmental input from teaching or learning activities. Learning depends as much on what the brain imposes on input from the environment and operating on the environment as on the input itself. At some point in time the learner's internal learning mechanism may override the external input from teaching. As shown in the MRI images in Figure 1, the mediating brain is not a black box but rather a gray and white complex structure housed within three thin membranes inside a bony skull. General principles of organizing structure and function of this remarkable, dynamic organ are considered below.

GENERAL PRINCIPLES OF BRAIN AND LEARNING

Two general principles underlie the role of brain in learning. The first is that many different levels of analysis can be applied to the brain's structures and functions. The second is that a system approach is needed to understand how the various component functions might be organized when a brain performs a reading, writing, or math task.

Levels of Structure and Function. Brain structures and functions contribute to learning at the macro-level and micro-level. Examples of structures at the macro-level are shown in Figure 1 and are visible to the human eye. What is not visible is the labeling schemes that evolved over the 20th century to describe specific regions of interest within these structures. Some schemes use names for regions such as inferior frontal gyrus or intraparietal sulcus to indicate location of region in the four lobes of cerebral cortex: occipital, temporal, parietal, or frontal. The adjective indicates where the gyrus (ascending up like a mountain) or sulcus (ascending below like a valley) is in reference to convolutions (grey folds in cortex) surrounding the cerebrum, which contains many visible white fiber tracts (see Figure 1). Other schemes use the numbers a neurosurgeon named Brodmann assigned to specific regions, for example, Brodmann's Area (BA) 8, which is Exner's Area, one of the writing centers in the brain (for more information on the names of brain regions and structures, see Bear, Connors, & Paradiso, 2007; Berninger & Richards, 2002; Chudler Web site; and the *Digital Anatomist Collection Manager* Web site).

Under the microscope the micro-level of brain structure becomes visible. The basic building block of the central nervous system (brain and spinal cord) is the neuron, which consists of a cell body, dendrites that receive electrochemical signals from other neurons, and axons that send electrochemical signals to the dendrites of other neurons. The space that separates the axon of one neuron from the dendrites of the other neuron is a synapse. The individual, microscopic neurons communicate only when an electrical impulse travels over the synapse causing the spatially separate neurons to become functionally connected for the moment until the electrical impulse subsides. Complex neurochemical events are involved in this electrical transmission (see Bear, Connors, & Paradiso, 2007, for research regarding the protein chemistry that regulates electrical transmission across synapses). The gray matter of cerebral cortex is collections of millions of neuronal cell bodies where computation occurs and the white matter of the cerebrum below is a collection of millions of axons bundled together for electrochemical transmission.

The unique computational properties of the human brain are related to this two-layer micro-level and macro-level organization. At the micro-level, spatially separated neurons communicate individually in linear time via dendrites, which look like tree branches and receive analogue signals graded in degree that are summated according to different computational mechanisms in the cell body until reaching a threshold that causes the axon to fire in a digital all-or-none manner. At the macro-level neurons containing the same parts but with somewhat different physical and functional capabilities are arranged in spatially separated cortical or subcortical regions. Large numbers of individual neurons in regional groupings with specialized computa-

tion properties communicate collectively across spatially distributed networks in the brain in multi-dimensional, non-linear, momentary time at any moment in time the constellation of which regional groups of neurons are communicating with other regional groups of neurons varies, but their momentary spatial-temporal communication gets synthesized in real time (linear). (See Minsky, 1986, for discussion of the distinction between momentary and real time.) Thus, the human brain is an electrochemical, cross-talking network of multiple computers that communicate sequentially in time at the micro-level and in parallel at the macro-level in multidimensional space-time constellations.

The lower branches of the dendrites are under genetic control and thus influenced by inheritance and maturation, whereas the upper branches are under environmental control and influenced by education and experience (Diamond & Hobson, 1998; Jacobs et al., 1993). Consequently, the human brain develops through nature-nurture interactions to construct inner mental worlds (the mind) and overt interactions with the external world (behavior). This construction process is thought to occur through hierarchically ordered sensation (perception)-action (production) cycles with feedback and feedforward mechanisms. Without teaching and other kinds of environmental input, brains would not learn and develop, but without their internal computational mechanisms at the micro-level and macro-level, they would not learn.

System Approach to Brain Functions. Like brain structure, brain function is also complex. Alexander Luria (1902-1977), the pioneering Russian neuropsychologist, based on astute clinical observations, proposed four basic principles of organization of the working human brain for managing this complexity and creating multiple functional systems (1962, 1973):

- Many different component processing units are involved in each functional system.
- Regions distributed throughout the brain participate in any one functional system.
- Different functional systems draw on common and unique processing units (i.e. brain regions).
- Any one brain region may participate in multiple functional systems.

Having the same brain region participate in multiple functional systems and using the same common component brain regions across functional systems organized to achieve different goals lends efficiency to the fuel and energy requirements for supporting brain functions.

Brain imaging research results mesh with Luria's observations in a pre-imaging era. A consensus has developed that although certain kinds of functions tend to be associated with

certain local brain regions the brain's operating system is more complex than one brain region having one corresponding function (e.g., Just & Varma, 2007). A particular brain region may be involved in more than one function and usually within the context of a neural network distributed spatially across more than one brain region. The sensory and motor processes have direct contact with the external world and code incoming information in local, primary regions, but subsequent processes draw on multiple codes, integrate them, and create more abstract representations, involving distributed space-time networks in association areas throughout the brain. Multiple, but not all, brain regions co-activate at the same time in a spatially distributed network of brain regions that are not communicating with each other constantly but rather at certain moments in time to achieve specific task-related goals. Brain functions may depend on sequences of these momentary spatial-temporal constellations being coordinated in real time, much as an orchestra conductor creates music by keeping the individual musical instruments, which do not all play at the same time, playing in temporal synchrony across time (Posner, Petersen, Fox, & Raichle, 1988).

Temporal Coordination of Components in Functional Systems. Fuster (1997) devoted his career to studying the frontal lobe, which is larger in humans than other species, especially in dorsal lateral prefrontal cortex (DLPFC), and houses executive functions, including but not restricted to temporal coordination. Based on a life-time of empirical studies, many with white rats, he proposed a model of cross-temporal contingencies for orchestrating the component processes of functional systems in time. The model has three networks:

1. A bottom-up pathway that originates in the sensory areas in the back of the brain that have direct contact with the external world and project incoming information to the association areas that do not have direct contact with the external world;
2. A top-down pathway that originates in the abstract association areas of DLPFC in frontal lobe and projects to midlevel premotor and supplementary motor cortex and then on to primary motor cortex (all in frontal lobe) and finally to spinal cord that generates the elements of movement that act on the world;
3. A cortical-subcortical pathway (including the cerebellum below the cortex and behind the cerebrum that has about half the neurons in the brain) for temporal coordination of the sequential and simultaneous communication of the other pathways.

Working Memory Component in Functional Systems for Reading, Writing, and Math. A common subsystem in the functional systems for reading, writing, and math

functions is the working memory system that supports conscious, goal-directed behavior. Working memory is thought to consist of storage and processing units coordinated through a central executive (e.g., Baddeley, Gathercole, & Papagno, 1998; Swanson, in press). Although the phonological loop was first proposed as a mechanism for maintaining information over time in working memory, it has also been investigated for its role in regulating language learning involving overt or covert naming (e.g., vocabulary words that involve cross-code mapping of visual codes, name codes, and concept codes) (Baddeley et al., 1998). In addition, recent evidence for an orthographic loop for integrating orthographic codes and grapho-motor codes for output by hand was mounting (e.g., Beringer, Raskind et al., in press).

Fuster (1997) proposed implications of his model for working memory. The bottom-up sensory pathways may play an important role in coding and storing incoming information in working memory. The top-down pathway emanating in the dorsolateral prefrontal cortex (DLPFC) may play an important role in the central executive processes of working memory, including supervisory attention and self-regulation of acts upon the world during task completion. The cortical-subcortical pathway may contribute the temporal coordination of the executive functions coordinating codes and/or processes. The cortical path involves DLPFC, including middle frontal gyrus, and the subcortical path includes the cerebellum.

Because working memory is a critical component of all reading, writing, and math brains, this entry focuses on its possible brain basis in creating reading, writing, and math brains through nurture-nature interactions as the learning brain interacts with the external, learning environment. A word of caution is in order. In the initial studies of academic learning during the Decade of the Brain, the focus was on identifying regions of interest that were associated with particular cognitive functions (and presumably computations). Although much progress was made on this front, it is increasingly clear in the early 2000s that academic skills such as reading, writing, and math draw on neural networks distributed in space-time constellations throughout the brain and increasingly brain imaging researchers are studying the temporal connectivity of distributed networks or the temporal unfolding of neural events in complex functional systems rather than focusing on a single region of interest (e.g., Richards & Berninger, 2007; Shaywitz et al., 2003; Stanberry et al., 2006). Moreover, localizing a function to one brain region does not explain a learning process; it merely pinpoints where some of the action is.

How the brain works is not yet fully understood. For one thing, language processing, which is needed for learning to read, write, and do math, activates both right and left cortical regions. Is the side of the brain activated

related to the nature of code for the stimulus storage or processing or to one hemisphere (side of cortex and cerebrum) taking the lead and the other inhibiting networks in the same structure on the other side? When some neurons fire, the electrical signal travels across the synapse causing the receiving neuron to fire in turn or not to fire. The first kind of neuron is excitatory, and the second kind of neuron is inhibitory. Up to two-thirds of the neurons in the human brain may be inhibitory. Children who fail to learn or behave appropriately may not choose not to learn or behave appropriately; rather, they may have neurons that have not yet myelinated, that is, formed a white sheath of myelin that improves the speed and efficiency of neural conduction in networks supporting inhibition and/or excitation.

Thus, the next section of this entry will not, for the most part, identify a single brain region of interest for each function, but rather will offer a conceptual model for a system of component processes that involve local brain regions in distributed spacetime networks, which when coordinated in working memory achieve reading, writing, or math goals. Teachers may find this conceptual model useful in thinking about individual differences in learners who vary in where they have their strengths and weaknesses in working memory components and the related instructional implications. For each content domain, codes represent and store incoming domain-specific information, loops integrate codes with end organs for input and output, and executive functions manage working memory components supporting conscious, task-oriented functions; these working memory components are in boldface in Tables 1, 2, and 3. This working memory architecture is necessary but not sufficient. Issues also considered are (a) other processes supported by working memory to reach goals, (b) the previously discussed three cross-temporal contingencies, and (c) the distinction between internal cognition in invisible/inaudible working memory and external cognition, a kind of extramemory in the visible/audible external world. Coupling internal working memory and external cognition may facilitate learning (Winn, Li, & Schill, 1991).

THE DEVELOPING READING BRAIN

This section illustrates how each of the working memory components contributes to development of a functional system for a reading brain.

Codes and Storage. To learn to read, children must code written words and letters into working memory; this code is called orthographic word-form. The goal is to translate that orthographic word-form into a spoken word (phonological word-form). Once children hear what is pronounced, that spoken word is then coded as an audible

Constructing the reading brain through interactions with learning environment

Word form storage (Initiated with bottom-up coding process)

Orthographic Word-Form Codes
Phonological Word-Form Codes
Morphological Word-Form Codes

Word mapping—Phonological loop for cross-code integration through naming or sound production

Fast mapping
Orthotactics
Phonotactics
Slow mapping
Alphabetic principle grapheme-phoneme direction
Word families
Syllable types

Executive functions

Supervisory attention: inhibition, switching attention, maintain attention
Verbal fluency: word retrieval
Metacognitive reflection (on word forms as objects) to develop linguistic awareness of coded word forms and their parts
Other processing: Levels of language processing (semantic, syntactic, discourse/text) and temporal coordination (orchestration of reading brain)
Other codes: somatosensory, nonverbal cues (vocal and body), ocular-motor (eye movements)

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

phonological word-form that provides sensory feedback about the sounds in the word. When children master the decoding process of translating written to spoken words, they no longer need to read aloud for this phonological feedback which is now accessible through inner speech (covert sound code that is not audible but codes the phonemes that correspond to alphabet letters, that is, alphabetic principle). Both the orthographic and phonological word-form may also have morphological structure (base word plus prefix and/or suffix/es), which the reader may also code. See Table 1.

Processing. Written words are accessible for processing once they are coded as orthographic word forms. Two kinds of cross-word form processing fast and slow may convert orthographic word-forms into phonological word-form (and morphological word-forms). Both are regulated by the phonological loop for cross-word form integration via the act of naming the whole written word or part of it, thereby, making a close-connection in time between an orthographic and phonological code. The codes are probably stored and processed in word-form regions in the back of the brain (e.g., fusiform gyrus, lingual gyrus, inferior temporal gyrus) and may be integrated in Brodmann's Area (BA) 37. Wernicke's Wortshatz (treasure house for words) (see Berninger &

Creating a writing brain through interactions with learning environment

Executive function: idea generation and goal setting (Initiated by top-down process)

Executive function: translating ideas into different levels of written language:

Letters (handwriting) Orthographic letter code

Words (spelling, vocabulary)

Word form coding

Phonological Word Form

Orthographic Word Form

Morphological Word Form (bases and affixes)

Word-form mapping—Orthographic loop for cross-code integration through letter or word writing

Fast mapping for whole words

Phonotactics

Orthotactics

Slow mapping of subword units

Alphabetic principle grapheme-phoneme direction

Onset rimes (Onset phonemes 1 rime word families)

Syllable types

Discourse/text production

Semantics construction

Syntax construction

Discourse schema construction

Executive function: reviewing/revising

Other processing: Temporal coordination of all processes (orchestration of writing brain)

Other codes: Grapho-motor: (fine motor planning of sequential and non-sequential finger movements, fine motor execution of these movements)

Othographic-motor integration: (integrating internally represented letter forms with the fine motor codes for producing letter forms)

Visual-motor integration: (integrating non-letter visual drawings with the motor codes)

Spatial: (placement of letter forms on lines, relative size of strokes, absolute size of letter form)

Table 2 ILLUSTRATION BY GGS INFORMATION SERVICES.
CENGAGE LEARNING, GALE.

Richards, 2002) outside the primary visual areas; but larger temporal-parietal (and visual association areas of occipital) regions are likely to be involved too (Pugh et al., 1996). The phonological loop may involve a right cerebellar-left inferior frontal gyrus network (Eckert et al., 2003; Richards et al. 2006b). Developing reading brains need instructional activities for both fast mapping and slow mapping (see Table 1).

Fast mapping occurs from one or a few exposures (McGregor, 2004), in this case to a seen written word and a heard spoken word close in time, forming a connection between them through association. Once the cross-word-form map is completed, the child automatically recognizes the word, that is, can pronounce it or recognize it through inner speech. Teachers often refer to words learned through fast mapping as sight word vocabulary, but orthographic and phonological codes are involved not just primary visual

regions of brain. Orthotactics (permissible letter sequences and letter positions in words) and phonotactics (permissible sound sequences and sound positions in words) may underlie ease of learning to read as well as spell (see Apel, Oster, & Masterson, 2006) through fast mapping. Some children may struggle with automatic word recognition because of undiagnosed and untreated phonotactic and/or orthotactic problems.

Slow mapping requires a longer learning period and involves more refined units of correspondence between two codes (McGregor, 2004). This slow mapping, which typically requires explicit instruction to bring the corresponding codes to the child's conscious attention, benefits from teaching multiple connections between graphemes (one- or two-letter units) and phonemes (the sounds in spoken words that correspond to alphabet letters); written rimes (part of the syllable remaining when onset phoneme or blend is deleted) and spoken rimes; syllable types (closed, open, silent *e*, vowel teams, *r*-controlled, and the *-le* syllable; and morphological structures for transforming base words by adding prefixes or suffixes. The first kind of slow mapping is the alphabetic principle that is fundamental to phonological decoding of written words. The second kind of slow mapping is word families, which also benefit phonological decoding, especially when the orthographic-phonological correspondence is more predictable for multi-letter units that may exceed two letters (e.g., *-ight* in *right* or *light*). Mapping syllables by classifying them has been found to be more helpful than teaching children to merely mark where one syllable ends and another begins because in English syllable boundaries can be altered by the speed at which a word is said. The morphological mapping is critical for developing vocabulary meaning and a bridge from cross-code word maps to the text-level comprehension processes (e.g., Nagy, Berninger, & Abbott, 2006; Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003). Although many children acquire these maps during the first three grades, others require a longer period of explicit instruction in slow mapping well into middle school and even high school years, possibly because of individual differences in the rate of myelination already defined.

Executive Functions. Frontal and subcortical cerebellar regions and the many neural pathways among them and the anterior cingulate (a region involved in conflict management) play important roles in regulating the process of learning to read and then reading to learn: Lower-level executive functions, especially inhibition and switching attention (Altemeier, Abbott, & Berninger, 2007) but also maintaining attention over time (Amtmann, Abbott, & Berninger, 2006). Inhibition is the ability to focus on what is relevant and suppress or ignore what is irrelevant. Switching attention is the ability to release from focus of attention what was relevant and switch to what is now relevant.

Maintaining attention is the ability to stay focused over time for goal-directed activity, especially when orthographic-phonological code integration is involved. Children who struggle with reading may have difficulty with any of these (Altemeier et al., 2007; Amtmann et al., 2006). Executive functions involving supervisory attention influence orthographic word-form processing (Thomson et al., 2005). Teachers can incorporate in lesson plans, for those children who struggle with attention regulation for written words, strategies for focusing on the relevant, switching attention focus, and maintaining attention over time.

Higher-order executive functions are also involved in reading such as verbal fluency (word finding) and linguistic awareness (see Table 1). Readers need to find in long-term memory associated names (phonological word-form) and meanings for written words. Long-term memory stores complex cognitive representations in associational networks or webs, hierarchical, categorical classification systems, and nonverbal visual images (see Stahl & Nagy, 2005). They also need to reflect upon the word-forms and their parts to develop orthographic awareness, phonological awareness, and morphological awareness (see Berninger & Richards, 2002, Chapter 8).

Other Processing Jobs. If the task is to comprehend the written text, accurate identification of single written words is necessary but not sufficient. Syntax emerges during the preschool years for storing accumulating words in working memory for the purpose of comprehending the incoming oral language message; the sum is greater than the parts in the syntactic constructions based on single words. Children who have problems with ordering accumulating words in working memory according to the syntax structures of the language may have problems in comprehending both oral and written language and persistent reading comprehension problems during the school years (Berninger, in press). However, reading comprehension depends on many levels of language, ranging from vocabulary meaning for single words or idioms of the language to sentence syntax structures to discourse schema (see Table 1). Many parts of the brain are involved in reading comprehension both in the back of the brain (e.g. Wernicke's Area) and front of the brain (e.g. DLFFC and superior frontal gyrus) (see Berninger & Richards, 2002, Chapter 5).

Top-down, Bottom-up, and Cortical-Subcortical Temporal Coordination. Both learning to read and reading to learn require engagement of the bottom-up system (incoming visual information from the written text that proceeds upwards in the system to be coded for orthographic, phonological, and morphological word-forms, syntax, and semantics—the links between language and cognition), the top-down system (existing factual and conceptual knowledge in long-term memory from life experience and

prior reading as well as cognitive procedures for abstracting the gist and details from incoming text and summarizing what is read), and cortical-subcortical temporal coordination (the grand orchestra conductor of mind for coordinating all the processes in momentary and real time).

Even if purpose-setting questions and discussion of background knowledge (top-down processing) precede the actual act of reading written text, the initial process in the actual reading begins with bottom-up brain processing initially in visual cortex but subsequently in temporal-parietal-frontal networks. At some point in this process, top-down and cortical-subcortical temporal coordination processes activate and can influence reading outcomes.

Internal and External Cognition. Input codes that are not exclusively visual and several output codes may externalize cognition in ways that support internal working memory during reading. The first are ocular motor codes that regulate eye movements as the eyes move forward, then backward, and then pause to fixate on external word information while it is being processed; see Berninger and Richards, 2002 for the multiple central (brain and spinal cord) and peripheral (outside brain and spinal cord) regions of the nervous system involved in eye movements. The second is the mouth's oral-motor system that turns written language, which is originally only visible, into audible language, that is, one's first language. That is why oral reading provides important external feedback in learning to read written language. The third is nonverbal cues, including vocal cues (the intonation or musical melodies of spoken language) and bodily expression that may facilitate the translation of written into oral language. For example, some students who struggle to read textbook text orally become fluent when reading play scripts allowing them to act out concepts underlying language and drawing on the intonation of oral language. The fourth is grapho-motor codes that support writing words by hand. Spelling words in writing transferred to improved word reading; and written composition instruction may benefit reading comprehension (e.g., Berninger, 2008). The postcentral gyrus (primary somatosensory area in parietal lobe) receives information from the environment through touch and kinesthetic movement via hands engaged in writing-related reading activities. This somatosensory stimulation may be transmitted to nearby supramarginal gyrus (a phonological processing center) through explicit phonological activities involving hands (e.g. counting syllables or phonemes and writing letters that go with phonemes or hands-on, science problem-solving activities with virtual reality) (Richards et al., 2007).

THE DEVELOPING WRITING BRAIN

Writing has many component processes (see Table 2), but most brain imaging has been done on transcription skills

(handwriting and spelling). Acquired writing disorders in adults are associated with three brain regions: (a) left posterior middle frontal gyrus (Exner's Area BA8) (Exner, 1881) thought to support coactivation of movement sequences during letter generation (Anderson, Damasio, & Damasio, 1990); (b) left superior parietal lobule where internal letter codes are thought to form for production (Basso, Taborelli, & Vignolo, 1978); and (c) left premotor (BA6) thought to store the grapho-motor codes for writing letters (Brain, 1967). A close relationship exists between letter production and letter perception both motor and visual regions are involved in handwriting (James & Gauthier, 2006; Longcamp et al., 2003).

At the end of fifth grade good and poor writers, who differed significantly on behavioral measures of handwriting and spelling, also differed significantly in blood-oxygen-level-dependent (BOLD) activation in each of these regions identified for acquired writing disorders during a functional magnetic brain imaging (fMRI) Finger Succession task controlled for non-successive finger tapping (Richards et al., submitted 2008). In that same study, the good and poor writers differed significantly in left fusiform gyrus in lower non-motor temporal regions on a Handwriting Contrast between a novel configuration and a familiar letter equated for motor movements in formation; fusiform codes letter forms, showing that handwriting is not just a motor skill. Prior findings from two studies with adult writers (Matsuo, Kato, Ozawa et al., 2001; Matsuo, Kato, Tanaka et al., 2001b) replicated for children. Both the good and poor writers activated fewer brain regions when a letter form could be phonologically coded (associated with a phoneme) than when it could not. Alphabetic principle for mapping graphemes onto phonemes may have a brain advantage for more efficient letter writing.

Brain imaging of normal adults during spelling tasks showed that orthographic word-form activated inferior temporal (e.g., fusiform) more robustly than primary visual (occipital) regions in response to linear arrays of visual elements that can be linguistically coded (e.g., Cohen et al., 2002; Dehaene et al., 2002). Phonological-orthographic mapping activated left fusiform gyrus (Booth et al., 2002), posterior parietal cortex (Bitan et al. 2007), and left inferior frontal gyrus (Booth et al., 2007). The time course proceeded from occipital visual association areas to Wernicke's Area (cross-code integration), to left inferior frontal gyrus (Dhond et al., 2001). For the good spellers in grades 4 to 6, significant BOLD activation during an fMRI spelling task occurred in medial superior frontal gyrus, bilateral middle frontal and inferior frontal gyri, middle temporal, fusiform and lingual gyri, right orbital and posterior parietal regions, left superior temporal and inferior temporal gyri, and anterior cingulate and anterior insula, (Richards et al., 2006a). Two conclusions can be drawn spelling like reading is not a purely visual

process and the temporal and parietal regions involved in orthographic and phonological word-forms and their integration appear to activate word-form regions during spelling as well as reading in children. Also, the inferior frontal gyrus involved in the highest level of executive function for coordinating the language systems is activated in brain during spelling as well as reading in children.

Prior to treatment, good and impaired spellers differed significantly in BOLD activation in right inferior frontal gyrus and right posterior parietal BOLD activation, but after orthographic (not morphological control) treatment, the poor spellers normalized in both regions compared to good spellers (Richards et al., 2006a). Based on common core and unique BOLD activation across phonological, orthographic, and morphological word-form tasks (e.g., Richards et al., 2006b), Richards et al. (2005) compared two of these at a time to identify common core and unique brain activation underlying phonological-orthographic, orthographic-morphological, and phonological-morphological mapping in children aged 9 to 13. Results showed a common core of many brain regions and a sizable number of uniquely activated brain regions more associated with one word-form than the other. Clearly, large distributed networks involving many language areas are involved in cross-word form mapping of phonological, orthographic, and morphological word-forms in spelling in children. This cross-word mapping may begin in the posterior word-form centers in temporal-parietal regions and culminate in the left inferior frontal gyrus for phonological mapping and the right inferior frontal gyrus for orthographic mapping (Richards et al., 2005).

Figure 2 shows an individual fifth grader's brain while deciding whether each of two words (always pronounced the same) were real, correctly spelled words. All components of a working memory architecture showed significant BOLD activation: a left temporal region for orthographic word-form and phonological word-form storage and processing, left cerebellum that may be involved in orthographic for cross-code integration in spelling, and two frontal regions (one on left associated with executive functions for language and the supplementary motor area involved in motor planning on both sides).

Top-down, Bottom-up, and Cortical-Subcortical Temporal Coordination. Writing is not the inverse or mirror image of reading (Read, 1981). Note that different component processes are at the top of Table 1 and top of Table 2 for reading and writing, respectively. Also see Chapters 8 and 9 of Berninger and Richards (2002) for further discussion of the differences between the developing reading brain and the developing writing brain. Instead of beginning like reading with a bottom-up pathway, writing begins with a top-down pathway during idea generation and goal-setting of the planning/proposing processes (Hayes &

Creating the math brain through interactions with the learning environment
<p>Concepts initiated by quantitative, visual-spatial, or scientific (mathematics, physics, psychological, behavioral) concept or problem solving</p> <p>Examples of cardinal concepts in early math development</p> <ul style="list-style-type: none"> Counting <ul style="list-style-type: none"> One-to-one correspondence Internal mental line Place value Part-whole relationships <p>Codes for storage and/or production of math concepts and symbols</p> <ul style="list-style-type: none"> Visual numeric symbols for single digits Visual numeric representation of multiplace numbers Auditory number names Auditory numeric representations of multiplace number names Quantitative concept Grapho-motor codes for producing written numeric symbols <p>Quantitative processing</p> <ul style="list-style-type: none"> Number fact acquisition and retrieval Arithmetic algorithms Written calculations Mental calculation Math problem solving (exact and/or estimated) <p>Executive functions for self-monitoring and repairing errors</p>

Table 3 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Flower, 1980; Hayes, in press); Good writers and poor writers at the end of fifth grade differed in BOLD activation in the superior and middle frontal gyri (including DLPFC) while their brain was scanned during fMRI Idea Generation; when they left the scanner, they wrote compositions on what they learned during the summer that they had not learned in school (Berninger et al., 2008). Where they differed suggested that good writers engaged working memory more than poor writers as early as idea generation that initiates the writing process.

Processing. Cognitive processes such as planning, translating (ideas into language), transcribing, and reviewing and revising are important throughout the writing process of skilled adults (e.g., Chenoweth & Hayes, 2001, 2003; Hayes, 2004, in press; Hayes & Flower, 1980), and some progress has been made in how to teach these cognitive processes effectively to young children and middle school students (for review, see Berninger, 1998). Translating occurs at many different levels of language ranging from letters to words to sentences and discourse structures (see Table 1). Additional research is needed to determine whether all these translation processes occur simultaneously or sequentially or both or depend on expertise level and writing purpose.

Codes for Storage and Mapping. In contrast to reading that maps orthographic word-forms onto phonological word-forms, writing maps phonological word-forms (spoken or analyzed with inside voice) onto orthographic word-forms. Like reading, the mapping may be fast or slow and fast mapping may be influenced by phonotactic and orthotactic knowledge, as defined in reading section. English spelling is hard because slow mapping has more alternations or possible spellings for a given phoneme than possible sounds for a given one- or two-letter grapheme (Venezky, 1970, 1999). Both the phonological and orthographic word forms may also have morphological structure. In the case of writing, these morphological structures for transforming base words by adding affixes (Carlisle, 2000) may facilitate word choice during the text generation process, which like reading, occurs at multiple levels of analysis ranging from word to sentence to discourse schema (see Table 2).

Executive Functions. Writing is more complex than reading because it places more demands on executive functions (e.g., Hooper et al., 2002). In addition to low-level executive functions in frontal and cingulate regions, high-level executive functions are required such as (a) planning that involves both idea generation and goal setting for tasks requiring space-, time-, and resource-limited conscious working memory, (b) translating cognitive representations into linguistic representations at multiple levels of written language and translating those levels of language via transcription into written symbols, and (c) reviewing (self-monitoring) text produced and revising it as needed (not only surface feature edits but also repairing deep structures through substantial rewriting).

Internal and External Cognition. The executive juggling act of writing may place greater demands on internal working memory than reading does, but writing has the advantage that it externalizes cognition making it visible via written language to become an object for reflection and repair. Moreover, learners often do not have access to what they are thinking in implicit memory until it becomes consciously available through writing in explicit memory and externalized cognition (see Hayes & Flower, 1980).

THE DEVELOPING MATH BRAIN

Brain imaging studies with adults produced mixed results when localized regions for coding operations during math were investigated, but they clearly support a major role for the parietal cortex and the representation of an internal number line that codes quantity; exact and estimated math appear to be represented in different neural networks. The math brain draws on many of the regions that reading and writing do because math involves verbal as well as quantitative and visual spatial representations and procedures. However, one brain region uniquely

involved in the math brain but not the reading or writing brains is the lenticular nucleus (for review of imaging studies in math and instructional implications, see Berninger and Richards [2002, Chapters 7 and 10]). Math, which has many branches and subspecializations, begins with the concepts underlying this knowledge domain.

Concepts. Counting is the fundamental cornerstone of math in early math development and the work of mathematicians engaged in discovery of mathematical truth (see Hoffman, 1998, for account of Erdős the mathematician who loved only numbers). Numbers can extend in either direction infinitely and be real or imaginary. Some mathematicians devote their careers to detecting complex patterns in the number line that are then used to solve important problems about the physical universe. Multiple number lines (one for each continuous dimension) can be used to describe quantitatively how changes in one distribution affect changes in another distribution and to solve problems involving multiple number lines, each on different scales (e.g., seconds, minutes, hours, half days for telling time). Another key concept is place value, which is the syntax for numbers and allows the math brain to represent an infinite number of numbers with just ten symbols if one of them is zero to indicate nothingness. The part-whole concept is another cornerstone of math underlying fractions, mixed numbers, telling time, measurement, and algebraic reasoning. Children first learn that objects have permanence in the mind even if not in the external world and then they must learn that quantity for objects is not absolute—the magnitude depends on how many parts the object has. One-fourth is less than one-half no matter what the absolute size of an object even though four is a larger quantity than two (see Table 3).

Codes and storage. A number is an internal representation of quantity, that is, a quantitative code, abstracted from counting many objects, but a numeral or digit is an external symbol written by hand for that number by the grapho-motor system and is visible to primary visual area of brain. Numbers also have names that stimulate the primary auditory area and are audible to the brain. Letters and numerals may be represented in different locations in brain (Anderson et al., 1990) even though grapho-motor codes for writing them may be the same (see Table 3).

Processing. Arithmetic is often confused with mathematics, which is higher-order problem solving, including proving theorems and applying science to the physical universe and human behavior. Arithmetic involves number facts (learning them and retrieving them are separable processes), and arithmetic algorithms for calculation (steps of basic addition, subtraction, multiplication, and division operations). Math fact learning and retrieval and

calculation operations may be executed in internal working memory (mental math) or coupled with the external environment through written calculation (see Table 3).

Executive Functions. All low-level supervisory attention functions influencing reading and writing brains may also influence the math brain. In addition, math calculation and problem solving require planning, thinking, translating metaknowledge about math, and self-monitoring and correction.

Top-down, Bottom-up, and Cortical-Subcortical Temporal Coordination. Math problem-solving typically initiates with top-down pathways, but math fact retrieval and calculation may begin with bottom-up pathways. As with the reading and writing brain, the math brain requires orchestration in time of all the relevant processes to the task at hand (see Table 3).

Internal and External Cognition. Hand-held calculators and other technology tools provide external cognition support for overcoming weaknesses in internal working memory that support math problem solving. However, unless math is taught in a way that includes mental math as part of the coupling of working memory and external cognition supports, learners will never become skilled in math. Ultimately mathematical thinking and applications occur in the math mind—the math brain at work.

FROM BRAIN SCAN TO COMPASSION AND INDIVIDUALLY TAILORED LEARNING ENVIRONMENTS

Knowledge of the developing brain and its influences on learning to read, write, and do math is not absolutely necessary for individuals to be effective teachers for many students. Such knowledge may matter for designing and implementing specialized instruction for students with biologically based developmental and learning disorders and for optimizing academic achievement of all students. Working memory components and other processes in Tables 1, 2, and 3, may break down or be a talent in individual students. Whether such knowledge translates directly to daily lesson plans may depend on teachers' grasp of the whole system of processes involved in learning and not just teaching reading, writing, and math and individual differences among learners that affect response to instruction. At a time in the history of education when educators are becoming aware of diversity due to multicultural backgrounds of learners, it is equally important to understand that biodiversity is also relevant to academic achievement.

Students may differ in meaningful ways in the kinds of learning environments in which they learn most appropriately. Educators and students need a no-fault approach to

education. Academic underachievement cannot be attributed only to teachers or only to students. Not all students learn the same way and learning is harder for some than it is for others because of brain differences. Improving teachers' knowledge of the brain may lead to greater compassion for learners who do not learn easily and may stimulate teachers to discover creative alternative instructional approaches for improving the match between how individual students learn and the environmental conditions under which they may realize their biologically influenced talents and overcome their weaknesses. Increasing pre-service teachers' knowledge of brain and biodiversity along with multicultural diversity may contribute to this next step in educational evolution that leaves no teacher or student behind (see Berninger & Richards, 2002, Chapter 12).

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BRANSFORD, JOHN D.

John D. Bransford helped start the cognitive revolution and used cognitive theory to create ground-breaking instructional designs. Bransford received his PhD in cognitive psychology at the University of Minnesota in 1970. His early experimental research demonstrated the constructive nature of understanding and learning. In a classic study, Bransford, Barclay, and Franks (1972) asked people to read sentence pairs such as "The turtle was sitting on the log," and "The fish swam under the log." Afterwards, participants completed a verification task in which they decided whether they had seen a given sentence verbatim. People demonstrated systematic errors that indicated they had constructed a mental model of the situation. For instance, they incorrectly verified that they had read, "The turtle swam under the frog," when, in fact, the sentences never stated that explicitly. Prevailing theories of behaviorism could not explain why people made this mistake because behaviorism could only refer to the stimulus and not what might or might not be going on in the mind.

A central tenet of Bransford's constructivism is that learning builds on prior knowledge. Prior knowledge was not in the lexicon of the prevailing theory of behaviorism, which explained human behavior through reinforcement not knowledge. Bransford and Johnson (1972) demonstrated the significance of prior knowledge by showing participants passages that were largely unintelligible. For example, "The procedure is actually quite simple. First you arrange things into groups. Of course, one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities, that is the next step." Bransford showed that a simple phrase that elicits the correct prior knowledge can make the unintelligible become meaningful. In this example, the phrase would be "washing clothes."

These early demonstrations presaged a career of high creativity and theoretical edge. Initially, journal editors were incredulous of his findings and he had difficulty publishing. However, he demonstrated the effects on the editors themselves, and they realized that they had been blinded by their theories.

As of 2007, Bransford had published roughly 90 journal articles, 90 book chapters, 6 authored books, and 4 edited volumes. His work has been translated into various languages, including French and Japanese. One explanation for Bransford's high level of productivity and reach is his combination of curiosity and collaborative abilities. Only four of his publications are sole-authored. His collaborative efforts enabled him to expand his scholarship into publications that appear in psychology, reading, medicine, engineering, technology, business, science, math, and special education outlets; the work is further cited in fields as diverse as animal neuroscience and economics.

One of his most broadly collaborative periods involved the development of the Cognition and Technology Group at Vanderbilt (CTGV). Bransford gathered a diverse collection of scholars who dedicated themselves to designing effective, technology-driven educational lessons and assessments in multiple content areas. Much of the work stemmed from his theory of transfer appropriate processing, which attempted to explain why people sometimes fail to apply their prior knowledge. Of the many original creations of the CTGV (1997), one of the most notable is the “Adventures of Jasper Woodbury.” The Jasper series helped students engage in sustained mathematical problem solving, so they could learn to solve problems that might arise in everyday life and not just word problems. Bransford recognized that students could not learn complex problem solving at school unless they had a strong body of prior knowledge to help anchor their reasoning. To solve this problem, Bransford created anchored instruction: Each Jasper adventure was presented as a twenty-minute video narrative. In one adventure, for example, students had to create a plan to rescue an eagle that had been injured. The video developed the context, constraints, quantities, and the goal of the problem. The anchor created the prior knowledge that enabled students to experience complex problem solving with mathematics, and students developed the type of knowledge that was likely to transfer to everyday settings.

In the late 1990s, Bransford led a team of federally commissioned scholars to author the volume, *How People Learn* (2000). This book brought learning back into the spotlight and has had a tremendous impact on the research agenda in the United States and internationally.

SEE ALSO *Anchored Instruction; Metacognition.*

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Daniel L. Schwartz

BRONFENBRENNER, URIE 1917–2005

Urie Bronfenbrenner was born in Russia in 1917 and came to the United States at the age of 6. He went to high school in Haverstraw, New York, and completed a double major in psychology and music at Cornell University in 1938. He received a master’s degree in education from Harvard University in 1940 and a doctorate in developmental psychology from the University of Michigan in 1942. After completing his doctoral work he was inducted into the U.S. Army, where he served as a psychologist in the Army Air Corps and the Office of Strategic Services. After his military service he worked briefly as a research psychologist for the VA Clinical Psychology Training Program, before returning to the University of Michigan as an assistant professor of psychology. Two years later, in 1948, he accepted a faculty position in Human Development, Family



Urie Bronfenbrenner COURTESY OF LIESA BRONFENBRENNER.

Studies, and Psychology at Cornell University, where he remained for the rest of his professional life. He continued his research and writing as a professor emeritus of Human Development and Psychology in Cornell's College of Human Ecology until he died on September 25, 2005.

It is fitting that Bronfenbrenner spent most of his professional career in a department with a name that encompasses three separate fields and ended it in a college named Human Ecology a field that he did much to inspire. He was dissatisfied with what he saw as fragmented approaches to the study of human development, each with its own level of analysis (child, family, society, economics, culture, etc.), and was fond of saying that "Much of contemporary developmental psychology is the science of the strange behavior of children in strange situations with strange adults for the briefest possible periods of time" (Bronfenbrenner, 1977, p. 513).

In response Bronfenbrenner developed an ecological systems theory, detailed in his 1979 book *The Ecology of Human Development*. In this theory the child is at the center of many levels of contexts (or systems) that interact to influence development over time. He described five systems, each of which is progressively distant from the child but which nevertheless impact development. The microsystem includes those relationships and interactions that are closest to the child, such as family, peers, and school. The meso-system comprises the connections between the influences closest to the child, such as the relationships between parents or between parents and schools. The exosystem includes the larger social context, such as the surrounding community, that impacts children indirectly through their parents. The fourth level, the macrosystem, is the most distant from the child and includes cultural values, economic conditions, political systems, and laws, all of which flow back through the inner levels to influence the child. Finally the chronosystem incorporates the unique influence of a child's personal history. Later formulations of his theory included the child's biological system as an important but not decisive factor in development (Bronfenbrenner & Ceci, 1994; Bronfenbrenner, 2001).

Bronfenbrenner's theory, with its emphasis on the powerful influence of multiple contexts on the child, both directly and indirectly through his/her parents, has had a profound effect on how others view a child who has difficulties in school. It is no longer sufficient to simply blame the parents or conclude that the child has a low aptitude for learning. In fact, Bronfenbrenner explicitly argued that it is the cumulative effect of the specific, enduring, supportive interactions children have with all of the individuals in their lives that allows them to live up to their biological potential. He called these interactions "proximal processes" and asserted that others share responsibility for both directly providing such interactions to children and creating social conditions that allow their parents to do so.

Bronfenbrenner, a tireless advocate for more humane and supportive contexts for children and their families, helped to establish the Head Start program and taught an entire generation of social science researchers to take a broader more inclusive look at the forces acting on children. Perhaps his most enduring legacy will be his insistence that people must not only strive for a more accurate picture of human development, but also act on this knowledge to improve the lives of children.

In the forward to one of Bronfenbrenner's last books, Richard Lerner wrote: "For more than 60 years, Urie Bronfenbrenner has been both the standard of excellence and the professional conscience of the field of human development, a field that because of the scope and synthetic power of his vision has become productively multidisciplinary and multiprofessional" (2005, p. ix).

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Fred Danner

BROPHY, JERE E(DWARD) 1940-

Jere Edward Brophy was born in Chicago in 1940. He received his BA from Loyola in 1962 and his PhD from the University of Chicago in 1967 in Human Development and Clinical Psychology. He took his first position at the University of Texas at Austin in 1968 in the Department of Educational Psychology. From there he moved in 1976 to Michigan State University where in 1990 he was named University Distinguished Professor of Teacher Education and Educational Psychology. His earlier training in clinical psychology and human development helped him to become a pioneer in understanding how teachers think about their students and the ways in which their beliefs

affect their behavior. Steadily, and throughout his career, in his capacity to translate theory and research into concrete applications for the practitioner, Jere Brophy contributed to the way in which teachers are educated. His two main contributions are teacher expectation effects and student motivation in learning.

TEACHER EXPECTATION EFFECTS

In the field of educational psychology, Brophy collaborated with Tom Good on teacher expectation effects and self-fulfilling prophecies (e.g., Brophy, 1983; Brophy & Good, 1970). At that time, data suggested that teachers' beliefs about students' academic potential could impact students' achievement in positive or negative ways. Brophy and Good provided some of the first studies to examine how these beliefs transformed teacher practice and ultimately student outcomes. From this body of research, Brophy and Good developed models to explain teacher expectation effects as well as specific strategies to help teachers become more aware of their achievement expectations and how they are communicated to students (Brophy & Good, 1986). These initial sets of studies spawned a generation of researchers interested in understanding how teacher expectations are formed, communicated, and received by students (see Brophy, 1998).

Brophy's classroom research on teacher expectation effects led to questions about what made teachers effective. In collaborations with Evertson and McCaslin and others, Brophy studied experienced teachers to understand the nature and impact of their instructional and classroom management practices (Brophy, 1996; Brophy & McCaslin, 1992; Brophy & Evertson, 1981). Studies looking at how expert teachers think about student behavioral and achievement problems and subsequently address them generated numerous publications offering teachers practical strategies for how to think about classroom management in general and problem behaviors specifically (e.g., Brophy, 1992, 2004).

MOTIVATION TO LEARN

The impact of Brophy's work on the field of educational psychology rests with his enduring concern for helping teachers with their daily practice. Nowhere is this more evident than in his work on student motivation. In his 2004 book *Motivating Students to Learn*, Brophy synthesizes the motivational literature while drawing upon his research and clinical background to provide one of the most practical resources for teachers in helping them think about how to motivate their students. Brophy's opus provides a fresh and practical perspective on learning and motivation that is critical of theorists who argue that learning should be made enjoyable. Instead, he

argues that the field should reconstruct motivation to focus on what Brophy calls "motivation to learn" which he defines as, "a student tendency to find academic activities meaningful and worthwhile and to seek to get the intended learning benefits from them, whether or not they find the content interesting or the processes enjoyable" (Gaedke & Shaughnessy, 2003, p. 207).

Brophy's view of motivation stems from criticisms that traditional motivational researchers do not adequately account for the learning context (the real constraints and affordances in day-to-day classroom life) or the student perspective (e.g., Brophy, 2005). Brophy filled this void by providing an unparalleled body of work that is organized by the common goal of understanding where theory and research intersects with daily practice. The result was over 300 articles, chapters, and technical reports, and numerous authored, co-authored, and edited books that provide teachers with valuable resources for helping them to improve their instructional practice.

Brophy's work in the early 2000s focused on issues related to social studies curricula and assessment. In this vein, Brophy brought his concern for students and teachers in practical settings to analyses of curricular content and instructional method issues involved in teaching social studies for understanding, appreciation, and life application (e.g., Brophy & Alleman, 2007).

IMPACT AND LEGACY

Brophy's impact on the field is extensive. His editorial efforts brought scholars together to comment on enduring issues related to teachers, teaching, and classroom life (e.g., Brophy 1992, 1998). His empirical work generated a rich literature for understanding the underlying processes of teaching and teacher-student relationships. And his texts have provided valuable tools for helping teachers to think about how to manage classrooms and cope with students presenting all sorts of motivational and achievement-related dispositions. One of his most enduring legacies is the single text that was used for 30 years in the field and as of 2008 was in its tenth edition. Co-authored with Tom Good of the University of Arizona, *Looking in Classrooms* is widely regarded as one of the most authoritative texts to synthesize research on classroom life.

Jere Brophy was the 2007 recipient of the Thorndike Award for career achievement in educational psychology, by Division 15 of the American Psychological Association. This honor underscores Jere Brophy's legacy as having made an indelible impact on the field of teaching and teacher education.

SEE ALSO *Praise*.

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Sharon L. Nichols

BROWN, ANN LESLIE

1943-1999

Ann Leslie Brown, a leading educational psychologist, was the first in her family to go to college. In spite of having difficulty learning to read as a child, only becoming fluent at 13, she was to become one of the leading scholars on memory, metacognition, how people learn, and classroom-based learning research. Brown pioneered the term *metacognition*, which referred to individuals' understanding and control of their own mental processes. Using this approach, she and Annemarie Palincsar designed an interventional reading program, reciprocal teaching, which was designed to help students improve their ability to understand what

they were reading by using metacognitive strategies such as clarifying, questioning, predicting, and summarizing during collaborative reading of content-rich text.

Brown emphasized "design experiments" (1992) in which "first principles guide the engineering and investigation of educational innovation" (Palincsar, 1999, p. 33). Using "first principles" Brown and her chief collaborator and husband, Joe Campione, built the Fostering a Community of Learners (FCL) project in West Oakland, California. The FCL research project demonstrated that underperforming schools could effectively create learning communities characterized by an ethos of trust and respect, in which students learned a great deal of complex science while developing literacy and technology skills (Brown & Campione, 1994, 1996).

Brown was known for her ability to comfortably travel between theory and practice. Her theories about how children learn and classroom design have spread across the world of teaching as well as to numerous branches of educational research. Brown took laboratory-informed theories and tested them, using rigorous research methods, in real classrooms. Her research trajectory from laboratory to classroom and back has set a high standard for those involved in classroom research.

Brown's PhD degree in psychology was completed at the University of London in 1967; her dissertation was titled "Anxiety and Complex Learning Performance in Children." She held faculty positions at the University of Sussex, England; University of Illinois, Champagne Urbana; Harvard University; and the University of California, Berkeley. Brown co-edited *How People Learn: Brain, Mind, Experience and School* (1999), served as president of The American Educational Research Association and the National Academy of Education and won major career awards from national associations in psychology and education.

Brown was described by her collaborator and friend Annemarie Palincsar in this way:

Ann's work can be characterized as a journey—a journey toward a theoretical model of learning and instruction—a journey in which she integrated and applied her vast knowledge of teaching, learning, curriculum, assessment, and the social contexts of classrooms and schools—a journey always focused on the goal of expanding learners' capabilities. (Palincsar, 1999, p. 33)

At her American Educational Research Association president's talk in 1993 Brown explained that "her talk would be a 'kind of odyssey of her life,'" examining how her own professional journey paralleled changes and developments in education and research on education. Brown argued that educational researchers "throw the baby out with the bath water" when they should strive to build cumulatively (Brown,

1994; Rutherford & Ash, in press). Brown argued for a synthetic approach, which included designing strong learning communities through a process she described as “design experiments” (Brown, 1992). Brown explained:

A major part of my personal effort in the design experiment of creating community is to contribute to a theory of learning that can capture and convey the core essential features. The development of theory has always been necessary as a guide to research, a lens through which one interprets, that sets things apart and pulls things together. But theory development is essential for practical implementation as well. (Brown, 1994)

The practical outcome of this goal, the Fostering Communities of Learners project, occupied much of Brown’s time at the University of California, Berkeley. Working with teachers, principles, and other educators in urban schools, Brown viewed “classrooms as contexts in which diversity was not only tolerated but was, in fact, integral to success” (Palincsar, 1999, p. 34). Such learning environments, based on “first principles” carefully conceived and grounded in the particulars of the context, guided the development of communities that foster intellectual curiosity and engagement so that all students may learn how to learn (Rutherford & Ash, in press).

Brown loved being in the classroom, often talking comfortably with her students as they were actively involved in learning how to learn. The students also loved Brown. One FCL student, Florencia Tuumu, remarked in 2004 about her 1992–1993 FCL classroom, “It was almost like a homecoming of sorts . . . it was something we had always been able to do but never actually had the chance . . . and now, the possibilities were seemingly endless” (Rutherford & Ash, in press, p. 2). Florencia’s remarks convey “the essence of a silver thread that ran through all of Ann Brown’s work—a deep passion and commitment to create the ways and means for young people to learn to use their minds well” (Rutherford & Ash, p. 2).

SEE ALSO *Analogy; Communities of Learners; Metacognition; Reciprocal Teaching.*

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Doris Ash

BRUNER, JEROME S(EYMOUR)

1915–

Jerome Seymour Bruner is a psychologist whose contributions to cognitivist and constructivist views of human learning and child development spanned several decades.

Bruner first encountered the field of psychology in the 1930s as an undergraduate and (for a short time) graduate student at Duke University, where his early research in collaboration with behaviorists convinced him that even laboratory rats were thinking creatures whose behavior could not be reduced to simple stimulus-response connections. He followed up with graduate study at Harvard University, earning his Ph.D. in 1941.

After a four-year stint working for the federal government during World War II, Bruner returned to Harvard as a faculty member. There he soon felt at odds with current mainstream views in American psychology, and especially with the behaviorist idea that thought processes



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could not be observed and so could not be studied scientifically. Furthermore, Bruner's research on perception in the late 1940s and early 1950s (much of it conducted with collaborator Leo Postman) consistently pointed to the same conclusion: People's perceived realities were often quite different and different in predictable ways from the information their various senses actually detected in the environment. In the 1950s, Bruner also ventured into new territory by looking at how people form categories. In 1956 he published *A Study of Thinking* with coauthors Jacqueline Goodnow and George Austin. Although the book was justifiably criticized for its study of people's behaviors in an artificial concept-learning exercise, central to its discussion was an important insight: Rather than being merely the unwitting victims of environmental circumstances, human beings are rational, strategic learners who work hard to make sense of the world around them.

Convinced that human cognition both could and should be a focus of study, Bruner and his colleague George Miller established and co-directed Harvard's Center for Cognitive Studies in 1960. Bringing together scholars from diverse disciplines (e.g., psychology, anthropology, linguistics, philosophy, mathematics), the

center was a fertile cross-breeding ground for new ideas (including those of developmentalists Jean Piaget [1896–1980] and Lev Vygotsky [1896–1934]) and was a key player in turning the tide in American psychology from behaviorism to a more cognitively oriented perspective.

By 1972 cognitive theories, especially information processing theory, had become the mainstream point of view in American psychology. That year Bruner moved to England to join the faculty at Oxford University, where much of his research addressed cognition and cognitive development in infants. Upon his return to the United States in 1980, he spent another year at Harvard and then in 1981 joined the faculty at New York University. At NYU he continued his work in cognition into the early years of the twenty-first century, with a particular focus on the ways in which human beings impose meanings on the world around them.

Despite his many contributions to psychology, Bruner is probably best known for his work in education. In his 1960 book *The Process of Education*, Bruner argued against the prevailing notion that lack of readiness prevents young children from understanding difficult subject matter. He advocated a spiral curriculum in which children tackle challenging topics in age-appropriate ways even in the primary grades, revisiting these topics year after year and each time building and expanding on previous acquisitions. In a later book, *Toward a Theory of Instruction* (1966), Bruner suggested that children mentally represent events in three ways—first as physical actions (enactively), then as mental images (iconically), and eventually as language (symbolically). Through concrete manipulatives and carefully designed activities, children can discover important ideas and principles on their own, first representing them enactively, then iconically, and finally symbolically. Thus, Bruner was an early advocate of discovery learning. Furthermore, he contended, children are intrinsically motivated to master new skills, particularly when those skills are sequenced to enable frequent success.

In the 1990s and early 2000s, Bruner increasingly emphasized the many ways that culture shapes the mind, both in school and in the world beyond it. In his *The Culture of Education* (1996), Bruner emphasized a point that many contemporary sociocultural psychologists share: Culture provides general frames of reference that permeate the meanings people impose on daily events and classroom lessons. Rather than assume that students will absorb classroom subject matter exactly as it is presented, educators must engage students in ongoing dialogues, assessing existing beliefs and understandings and modifying instruction in light of them. Education, then, must always involve two-way communication, continually informing both student and teacher alike.

SEE ALSO *Cognitive Development; Constructivism; Information Processing Theory; Sociocultural Theories of Motivation.*

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Jeanne Ellis Ormrod

BULLIES AND VICTIMS

Bullying perpetration and victimization was brought to the attention of U.S. researchers by Dan Olweus, who spearheaded a nationwide Scandinavian campaign against bullying. Referring to bullies as “whipping boys” in the 1970s, Olweus set forth the following definition of bullying that continued to be consistently used into the early 2000s: “A student is being bullied or victimized when he or she is exposed, repeatedly and over time, to negative actions on the part of one or more students” (Olweus, 1993, p. 318). It often involves an imbalance of strength and power between the bully and the target and is repetitive in nature. Children and adolescents may experience isolated acts of aggression, but children who have been bullied live with the ongoing fear of the recurring abuse from the bully, which is usually more damaging than an isolated and unpredicted aggressive event. In the late 1990s and early 2000s, scholars have recognized that bullying can be verbal, physical, and social in nature. Smith and Sharp noted: “A student is being bullied or picked on when another student says nasty and unpleasant things to him or her. It is also bullying when a student is hit, kicked, threatened, locked inside a room, sent nasty notes, and when no one ever talks to him” (Sharp & Smith, 1991, p.1).

PREVALENCE

Bullying is thought to be one of the most prevalent types of school violence. Students assume roles, including bully, victim, bully/victim, and bystander. Estimates in the early 2000s suggest that nearly 30% of American students are involved in bullying in one of these capacities (Nansel et al., 2001). Specifically, findings from this nationally representative sample indicated that among sixth through tenth graders, 13% had bullied others (bullies), 11% had been bullied (victims), and 6% had both bullied others and been bullied (bully-victims). Worldwide incidence rates for bullying victimization in school-aged youth range from 10% of secondary students through 27% of middle school students who report being bullied often (Whitney & Smith, 1993). When peer, teacher, and self-reports were used to classify a sample of sixth graders (N = 1,985), the authors found 7% of the sample were bullies, 9% were victims, and 6% were bully-victims (Juvonen, Graham, & Schuster, 2003).

The delineation of these bully and bully-victim groups has direct implications for prevention and intervention efforts because these subgroups not only display different patterns of aggression, but they also have different emotional and psychological profiles. First, bullies exhibit a more goal-oriented aggression, entailing more control and planning. In contrast, bully-victims tend to display a more impulsive aggression with concurrent poor emotional and behavioral regulation, which is perceived as particularly aversive by their peers and contributes to their own victimization (Schwartz, Proctor, & Chien, 2001). Second, bully-victims are at-risk for greater social maladjustment than bullies and have been found to experience victimization in other domains, including childhood sexual abuse and sexual harassment (Holt & Espelage, 2005).

RISKS FOR BECOMING A BULLY, VICTIM, OR BULLY VICTIM

Aggression, like other forms of behavior, is often conceptualized as emerging, being maintained, and modified as a result of a child’s personality characteristics and the interactions between these characteristics and social contexts (e.g., peers, family, schools). This perspective has been called a social-ecological theory (Bronfenbrenner, 1979) and includes microsystems, which contains structures with which the child or adolescent has direct contact, including parents, siblings, peers, and schools. The mesosystem comprises the interrelations among microsystems, such as an adolescent’s family and peers. For example, attachment to one’s parents might contribute to a willingness to connect with a teacher at school. The social-ecological framework has been extended to predictive models of bullying victimization and perpetration, which are discussed briefly next.



Bullying can be verbal, physical, and social in nature. ©GIDEON MENDEL/CORBIS.

Individual Risk Factors. Certain individual characteristics heighten one's risk for being victimized or perpetrators. In demographic terms, boys are more often victimized and perpetrators than girls (Espelage & Holt, 2001), although this depends somewhat on the form of victimization; whereas boys are more likely to experience physical bullying victimization (e.g., being hit), girls are more likely to be targets of indirect victimization (e.g., social exclusion). In one of the few studies addressing the influence of race on bullying, Black students reported less victimization than White or Hispanic youth (Nansel et al., 2001). Juvonen and colleagues (2003) found that Black middle-school youth were more likely to be categorized as bullies and bully-victims than White students. Another study found that Hispanic students reported somewhat more bullying than Black and White youth (Nansel et al., 2001).

A wide range of personality characteristics has been associated with either pro-social behaviors or bullying victimization/perpetration. First, empathy is consistently negatively associated with aggression and positively associated

with prosocial skills (Miller & Eisenberg, 1988). The inverse correlation between aggression and empathy was stronger in studies that focused on the emotional component of empathy rather than the cognitive aspects of empathy. This might be especially relevant in the case of bullying in which the aggressors might be able to understand others' emotional states without sharing the victims' feelings. Bullies' careful selection of victims who are vulnerable and disliked by their peers reflects good perspective-taking. However, the fact that they use violence to achieve their goals, disregarding the pain that they inflict on their victims suggests that perspective-taking (e.g., cognitive empathy) does little to inhibit aggression.

Second, a positive attitude toward bullying is often a strong predictor of bullying perpetration. Espelage and colleagues found that a positive attitude toward bullying partially mediated the relation between empathic concern and bullying for males, and the relation between perspective-taking and bullying for both males and females (Espelage, Mebane, & Adams, 2003). From a slightly different angle, Boulton and colleagues (2002) investigated children's

general attitudes toward bullying and their impact on bullying. Investigators found significant positive correlations between pro-attitudes and self-reported involvement in bullying (Boulton, Trueman, & Flemington, 2002).

Contextual Influences. Family, peer, and school contexts can exert positive or negative influences on bullying involvement. With respect to the family context, bullies often report that their parents are authoritarian, condone fighting back, use physical punishment, lack warmth, and display indifference to their children (Baldry & Farrington, 2000). In addition, children who have insecure, anxious-avoidant, or anxious-resistant attachments when 18 months old were more likely than children with secure attachments to become involved in bullying at ages 4 and 5 (Troy & Sroufe, 1987). Similarly, middle school students classified as bullies and bully-victims indicated receiving substantially less social support from parents than students in the uninvolved group (Holt & Espelage, 2005). McFadyen-Ketchum and colleagues (1996) found aggressive children who experienced affectionate mother-child relationships showed significant decreases in aggressive-disruptive behaviors over time.

The peer context is another salient contributor to bullying behaviors. Several theories dominate the literature, including the homophily hypothesis, attraction theory, and dominance theory (for review, see Espelage, Wasserman, & Fleisher, 2007). According to the homophily hypothesis, adolescent peer group members tend to have similar levels of aggression. In addition, peer group bullying is predictive of individual youths' bullying behaviors over time, even after controlling for baseline levels of bullying, a finding that holds true for both males and females (Espelage, Holt, & Henkel, 2003). This might in part be due to deviancy training, a process by which values supportive of aggression are fostered. Peer groups can also have a positive influence on youth. Further, peers can promote positive social functioning among youth; adolescents with low levels of prosocial behaviors in sixth grade relative to their friends demonstrated improved prosocial behaviors at the end of eighth grade (Wentzel & Caldwell, 1997).

CLASSROOM AND SCHOOL FACTORS

One of the most salient and influential environments for children is the school (Eccles et al., 1993). A tremendous amount of research has tied schooling to both academic and personal outcomes. School contextual factors have been linked to children's mental health, achievement, self-concept, and ability to form social relationships. Understanding the school environment is an essential part of understanding a child's behavior. In addition, educators have long seen the classroom as having an

important impact on children's well being. If a classroom does not meet the needs of a child, negative outcomes can occur and the child can be put at-risk for academic and social difficulties (Eccles et al., 1993).

Students involved in bullying reported more negative views of their school environment and positive school climate has been found to be vital to reducing bullying behaviors. Classroom practices and teachers' attitudes are also salient components of school climate that contribute to bullying prevalence. Aggression varies from classroom to classroom, and in some classrooms aggression appears to be supported. Bullying tends to be less prevalent in classrooms in which most children are included in activities, teachers display warmth and responsiveness to children, teachers respond quickly and effectively to bullying incidents (Newman, Murray, & Lussier, 2001), and parents are aware of their children's peers relationships (Olweus, 1993). It is well accepted that when school personnel tolerate, ignore, or dismiss bullying behaviors, they implicitly convey messages that students internalize. Conversely, if staff members hold anti-bullying attitudes and translate these attitudes into behaviors, the school culture becomes less tolerant of bullying.

Kasen and colleagues' 1994 study is perhaps the most comprehensive examination of the impact of school climate on changes in verbal and physical aggression, anger, and school problem indices. In this study, 500 children (and their mothers) across 250 schools were surveyed at the age of 13.5 and 16 years across a two-and-a-half year interval. A 45-item school climate survey included multiple scales assessing social and emotional features of the school environment, including a conflict scale (classroom control, teacher-student conflict), learning focus scale, social facilitation scale, and student authority scale (student has a say in politics and planning) as predictors. Outcome measures included a wide range of scales, including school problems, deviance, rebelliousness, anger, physical and verbal aggression, and bullying. School context can influence engagement in bullying and more positive social interactions. Results found that students in high-conflict schools had an increase in verbal and physical aggression, after controlling for baseline aggression. In contrast, attendance at schools that emphasized learning resulted in a decrease in aggression and other school-related problems. Of particular interest was the finding that schools high in informal relations had increases in bullying perpetration over the two-and-a-half year interval, and schools with high conflict and high informality combined had the highest increase in bullying over time.

RENEE'S STORY

As a high school mathematics teacher I have regretfully witnessed many bullying situations. It is of particular concern to me, because it can have such a profound impact on classroom performance. I am reminded of a student, Renee (pseudonym), that I recently had in one of my classes. Renee's story reflects many of the points raised in Espelage's entry on bullying.

As Espelage defined bullying in this chapter, two ideas emerged that are reflected in Renee's story. One was the idea that bullying is repeated over time, and often is not just a one time occurrence. The second idea is that bullying is not always a physical act; it also occurs via social interactions and dialogs between students. Both of these were apparent in the case of Renee. Renee was a student of mine in a freshman algebra class. She was in a unique situation because she was a sophomore. She had transferred from a different school and she was lacking her required algebra credit, so she was the only sophomore in the algebra class. Initially this did not seem to be a problem for Renee. She was a very happy and sociable student. She was friendly and would talk with everyone and she would laugh often. After several weeks it appeared she was developing some friendships. She was also an academically strong student; during class she was focused on the task at hand and she worked well with her classmates.

As the year progressed, there was a group of four boys that would commonly joke around with Renee. They would tease her by pretending that one of their group was dating her. They would say things like, "where are the two of you going tonight?" or "is your old boyfriend mad you left him for me?" These conversations usually occurred in the transition between classes and when I heard these comments, I quickly redirected the students to the tasks of the day. Renee would usually laugh at the group of boys and always seemed to have a quick witted response. From my vantage point it genuinely seemed like a group of friends having fun and enjoying each others' company.

My feelings about the situation changed when I noticed Renee missing several class sessions. She did not turn in her homework, and when she did attend class she did not perform as well as she had previously. I investigated her poor performance and why she had been missing class, and I found that the boys were the reason. Renee told me she had

not been coming to class because she did not want deal with the groups of boys teasing her. Sometimes bullying is difficult for an outsider to detect. It is difficult to determine if kids are having good natured fun, or if someone is being victimized. As a teacher the best way I have seen to deal with these hard to distinguish situations is to build strong relationships with the students. The better you know the student the easier it will be to determine if they are actually being victimized. In Renee's case I did not see her as a victim of bullying initially, but her missing class and turning in poor work were immediate red flags.

After I realized that Renee was a victim of bullying by a peer group, I immediately confronted the four boys, called their parents, and notified the assistant principal of the situation. Renee began coming back to class and the boys seem more respectful toward her, but, on occasion, they would make the same type of comments to her, usually in the hallway before class so I was not aware. It was difficult to change the nature of the boys' interactions with Renee. On one occasion, I was working with a group of students and one of the boys made some remarks to Renee. I was unaware of the initial exchange, but I quickly noticed Renee aggressively react to their comments. She became extremely agitated and began yelling explicatives at the boys. As Espelage mentioned in this chapter, victims of bullying are often impulsive and lack behavior regulation, which can be seen in Renee's reactions.

The bullying between Renee and the boys was not immediately corrected but after time, consistent monitoring of interactions, parent conferences, and consultation with the assistant principal, the students developed a respectful relationship. Renee's performance returned to the level I had come to expect from her and the boys developed a more mature relationship with their classmate.

The bullying situation with Renee helped remind me, as a classroom teacher, that bullying is not always obvious, and that teachers have to know their students well to understand if bullying is occurring. As a teacher, it also is important to realize that bullying can profoundly influence a student's performance and achievement.

Anthony Durr

BULLIES AND VICTIMS ACROSS THE LIFESPAN

Victims, bullies, and bully-victims often report adverse psychological effects and poor school adjustment as a result of their involvement in bullying. For example, targets of bullying reveal more loneliness and depression, greater school avoidance, more suicidal ideation, and less self-esteem than their non-bullied peers (Hawker & Boulton, 2000).

Findings have been mixed about the stability of bullying behavior over time. In one study, bullying perpetration and victimization at age 8 were related to bullying perpetration and victimization at age 16, with particularly strong associations emerging for victimization patterns and for the experiences of boys (Sourander, Helstela, Helenius, & Piha, 2000). Similarly, in a later study, girls and boys classified as victims in Grade 4 were significantly more likely than their peers to be identified as victims in Grade 7 (Paul & Cillessen, 2003).

It does appear though that the psychological costs associated with involvement are not transient. Adults at the age of 23, who had been chronically victimized in their youth, had lower self-esteem and were more depressed than non-victimized members of their cohort who had not been bullied (Olweus, 1993). Whereas victims tend to report more internalizing behaviors, bullies are more likely than their peers to engage in externalizing behaviors, to experience conduct problems, and to be delinquent (Nansel et al., 2001). Furthermore, long-term outcomes for bullies can be serious; compared to their peers, bullies are more likely to be convicted of crimes in adulthood (Olweus, 1993). One study revealed that youth identified as bullies in school had a one in four chance of having a criminal record by age 30 (Eron, Huesmann, Dubow, Romanoff, & Yarnel, 1987). Finally, considerable research has documented that the most at-risk group of youth is bully-victims. Bully-victims demonstrate more externalizing behaviors, are more hyperactive, and have a greater probability of being referred for psychiatric consultation than their peers (Nansel et al., 2001).

CREATING BULLY FREE ACADEMIC ENVIRONMENTS AND PROTECTING VICTIMS

Many school-based bullying prevention and intervention programs include training teachers to create bully-free environments. For example, bullying prevention programs generally encourage teachers to generate rules about bullying collaboratively with their students. These rules typically include variants of the following: (a) Bully is not allowed in the classroom; (b) If a child is being bullied, then students and teachers will help him or her; and (c) Students and teachers work to include students who are left out. These rules are often posted in the classroom. Students and teachers are also encouraged to generate potential sanctions for

violating the rules, including an individual talk with the bully, taking away a privilege, etc. Teachers are encouraged to hold class meetings to review the rules and sanctions in weekly class meetings in which students and teachers sit in a circle and discuss incidents of bullying. Teachers should also use praise when students engage in pro-social or caring acts.

Teachers are often encouraged then to incorporate a prevention program that more specifically teaches about bullying and helps children develop skills to minimize the risk of involvement with bullying. One program that is relatively inexpensive and easily adopted by elementary and middle school classroom teachers is *Bully Busters* (Newman, Horne, & Bartolomucci, 2000). Unlike many bullying prevention programs, *Bully Busters* has strong empirical support for its efficacy. For example, teachers who were trained to implement the program reported significantly higher levels of self-efficacy for managing bullying behavior, demonstrated greater knowledge of classroom behavior management, and had fewer classroom behavior problems and office referrals than comparison teachers (Newman-Carlson & Horne, 2004).

In this program, teachers are encouraged to do the following:

- Develop a definition of bullying collaboratively with students. Exercises are used to facilitate a conversation among students about who is a bully, what is bullying, and where it happens.
- Facilitate activities with students to recognize how their words/actions can be hurtful, and then role-play more constructive ways of interacting.
- Discuss with students how bullying develops and the variety of forms it can take. Activities could include viewing movies or reading books in which characters are victims or bullies.
- Engage in conversations with students about the effects of victimization and challenge myths about victims.
- Encourage bystander intervention and encourage students to break the code of silence and create a safer climate for all students.
- Teach empathy skills training, social skills training, and anger management skills.
- Assist victims in becoming aware of their strengths, viewing themselves in a positive manner, and building skills and confidence in joining groups.
- Identify how their attitudes and behaviors influence student behavior and how school-level factors relate to bullying.

School-based bullying perpetration and victimization develops and is maintained as a result of various factors, including a child's personality, home environment, peers,

and experiences at school. Children and adolescents are at-risk for developing aggression or are at-risk for being involved in bullying because they have multiple risk factors and few protective experiences. However, research suggests that involvement in bullying can be prevented. For example, social support, teacher attachment, supportive friends, a positive school climate, involvement in extracurricular activities, all serve to protect or buffer children from both experiencing and expressing bullying, and these factors also serve to minimize the psychological impact over time.

SEE ALSO *Aggression*.

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Dorothy L. Espelage

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CALFEE, ROBERT C. 1933–

As of 2008 Robert C. Calfee was distinguished professor of education and professor emeritus at the University of California at Riverside, where he also served as dean of the College of Education from 1998 to 2003. The majority of his career (1969–1998) was spent as an associate professor and professor in the School of Education at Stanford University, where he worked following his first faculty position in the Psychology Department at the University of Wisconsin at Madison (1964–1969). Educational research was enriched immeasurably when Calfee joined Stanford's School of Education.

Calfee earned his BA, MA, and PhD (1963) in experimental psychology at the University of California at Los Angeles, working mostly on learning tasks, often with the psychologist Richard C. Atkinson. Early work on the reading process, much with the reading researcher Richard Venezky, brought Calfee into closer proximity with educational settings. When he turned full attention to the field of education he brought with him considerable knowledge about the psychology of reading, using the (then new) lens for the study of how individuals learn that was provided by cognitive psychology and information processing models of human learning. But he brought as well important methodological skills from his work in experimental psychology, and those interests subsequently influenced research design and assessment in educational research.

Education, in turn, gave Calfee a deeper understanding of school context and the organizational life of teachers, so that he gained deep knowledge of reading processes in the real world and respect for the difficulties of both teaching

reading and learning to read in public school classrooms. Perhaps most important was his immersion in the Stanford environment, where both extraordinary faculty colleagues and a remarkable cadre of graduate students stretched his knowledge and were stretched by him as well.

From the 1980s on Calfee's career was more focused on applying cognitive psychology to reading and writing instruction and assessment; broad issues in educational policy but particularly reading policies; and school reform issues in California and across the United States. Much of this work was collaborative, with many of his students and co-authors going on to distinguished careers in reading research or related research areas. Calfee served the faculty at Stanford with turns as associate dean of research and director of the Stanford Center for Research and Development on Teaching. Subsequently he became director of Stanford's Teacher Education program and served as associate director of the Study of Stanford and the Schools, work that eventually transformed the nature of scholarship at Stanford. During this same period (the mid-1980s) Calfee also served as a member of the board of trustees of the Palo Alto Unified School District, marking him as an involved citizen/educator.

Calfee served as editor of the flagship journal in the field of educational psychology, the *Journal of Educational Psychology* (1985–1990), published by the American Psychological Association (APA). He also edited the journal *Educational Assessment* (1992–1998), and was co-editor of the first *Handbook of Educational Psychology*, published in 1996, by the Division of Educational Psychology of the APA. He served twice as a member of the board of directors of the National Society for the Study of Education (NSSE), and during these terms (1995–1998; 2000–2004) he chaired the board twice. Calfee

was named to the California Reading Association Hall of Fame (1992) and the International Reading Association Hall of Fame (1993). In 2003 the National Reading Conference awarded him the Oscar Causey Award for Outstanding Contributions to Reading Research. His advisory work and consulting has been at the national, state, and local levels of education, and he served as chairperson of the educational advisory board for Leap-Frog Enterprises, an award-winning developer of educational products. As of 2008, Calfee was a Fellow of two divisions of APA, Experimental Psychology and Educational Psychology, and a Fellow of the Center for Advanced Studies in the Behavioral Sciences.

Calfee's interests evolved over three decades from a focus on the psychology of verbal learning to concerns about the assessment of beginning literacy skills and eventually to a concern with the broader reach of the school as a literate environment. His theoretical efforts were directed toward the nature of human thought processes and the influence of language and literacy in the development of problem-solving and communication. At home in theory and in practice, in running true experiments or design experiments, in the board-room or the classroom, and in working with policymakers or teachers, Calfee proves himself to be a unique scholar. As of 2008, he continued to have a productive and engaged career.

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David C. Berliner

CARING TEACHERS

Literature over the last 30 years has increasingly documented the importance of supportive student-teacher relationships to improving student motivation, learning,

and achievement (Davis, 2003). Research suggests caring, or supportive, teachers create qualitatively different classroom environments that feel warm, encourage student to behave in social responsible ways, and emphasize learning over performing. Students who perceive their teachers as caring tend to engage more with the content, take intellectual risks, and persist in the face of failure. Children who had caring, supportive teachers early in their schooling tend to evidence more adaptive academic and behavioral outcomes up through junior high school. Moreover, junior and senior high school students who perceive their teachers as caring are more likely to connect with classroom content and less likely to dropout of high school. Emerging from this literature are three different ways to think about what it means to be a caring teacher.

CARING GUIDES TEACHER ENGAGEMENT

Aaron Ben-Ze'ev thinks about care as reflecting an emotion state that motivates teachers to engage in different caring behaviors. From this perspective, the emotion of care arises as a function of teachers' making four distinct judgments about their students. These judgments, in turn, can result in them engaging in caring versus uncaring behaviors.

First, in order to care about a student, a teacher must judge the relationship to be important. However, judging importance is merely the first step in moving teachers from feeling care toward engaging in caring behavior. To engage in caring behavior, teachers must believe that without action their goals (either personal or instructional) might be undermined. They must believe they are in control, or responsible and they must judge themselves to be capable of managing the relationship. Within this framework for care, teachers can think about how they create boundaries, either implicitly or explicitly, around what they will care about. Teachers may consider which relationships they care the most about, whether they care equally for all students, and when they struggle to interact with a child do they care about the failure to try to understand what happened and to modify their approach (Muller, Katz, & Dance, 1994).

CARING AS A PROFESSIONAL DISPOSITION

Other scholars such as Nel Noddings (1988) and Lisa Goldstein conceptualize caring as a process; that is, something teachers do rather than something they feel. They argue caring is an ethic, or a moral value, that teachers communicate to students through their selection of curriculum, their planning of a lesson, their establishment of classroom norms, and their interactions with students. What teachers choose to teach communicates something to students about the content they care about. The norms

Students' perceptions of caring teachers		
	Feeling understood	Feeling misunderstood
Locus/sense of responsibility	Teachers press students to develop relationships with them and with peers. Teachers want to 'know' each student and want students to 'know' them. Teachers create room for students to have voice in classroom.	Teachers distance themselves emotionally. Teachers develop differential relationships; Play favorites with some students in the class.
Orientation towards classroom climate, culture, and management	Teachers monitor their levels of unpleasant emotions. Teachers endorse humanistic orientations; Are supportive of students' autonomy. Teachers emphasize social negotiation; Emphasize natural consequences for disruptive behavior.	Teachers have high levels of unpleasant emotions. Teachers endorse custodial orientations; Are more controlling of student behavior Teachers emphasize law & order and may have severe consequences for mis-behavior.
Cultural synchronization	Teachers strive to be 'in sync' with interpreting and responding to student behavior.	Teachers and students are 'out of sync' and little attempt is made to understand student behavior.
	My understanding is important	My understanding is trivial
Academic content	Teachers create meaningful intellectual boundaries. Teachers press students to understand academic material. Teachers create space in the classroom for learning from mistakes/failure.	Intellectual boundaries seem arbitrary to students. Teachers press students to perform regardless of whether they understand. Students experience failure as an endpoint, something to be feared and avoided.
Role of student interest	Teachers cultivate student interest and strive to connect content to students' lives. Teachers identify authentic tasks or emphasize future value of tasks.	Students perceive their interest is subordinate to teachers' prescribed curriculum. Students perceive academic tasks as 'work'.
Expectations of success	Teachers hold attainable, high expectations for all students. Warm demander.	Teachers hold unreasonably high, low, or differential expectations for students. Demanding

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

they establish communicate to their students the values they care about and their frequency and quality of interactions with individual students communicates whom they care about. From this perspective, caring is not an entity that exists or does not exist in a classroom. Rather, educators can think of caring as a vector having a direction as well as a force, with teachers exhibiting caring about content, values, and relationships in different ways.

Identifying teacher candidates and socializing the value of caring has become a central task of most teacher preparation programs. Across the literature, several qualities have been identified as epitomizing a caring disposition. Beyond teaching content, caring teachers view schooling as serving either a liberating or marginalizing function. Caring teachers identify the ways in which society, in general, and schools, in particular, maintain existing social structures and incorporate in their lesson plans ways for students to identify these inequities, engage in social critique, and work for change. Caring teachers are oriented towards advocacy for all of their students, regardless of their cultural and economic background. Moreover, they are committed to being systematically and outwardly reflective about their

work as caring teachers (E. Davis, 2006). They are so because of the strong connection identified between self-reflection and change. Teachers who are willing to question their own practice in the face of failure, question the usefulness of their beliefs, and view change as a necessary component of growth are viewed as teachers who care about their teaching.

CARING AS A QUALITY STUDENTS PERCEIVE IN A RELATIONSHIP

Much literature on caring teachers, however, has less to do with actual teacher caring and more to do with students' perceptions of teacher caring. Table 1 organizes students' perceptions into two dimensions of caring: feeling understood and feeling that understanding is important.

Feeling Understood. First and foremost, students perceive teachers as caring when they make attempts to understand and connect with their students as individuals. Teachers who assume responsibility for developing individual relationships with students and who press them to develop relationships tend to be perceived as

NURTURE YOURSELF

Successful teachers not only need to care for their students, they need to care for themselves also.

Set aside relaxation time. Include rest and relaxation in your daily schedule. Don't allow other obligations to encroach. This is your time to take a break from all responsibilities and recharge your batteries.

Connect with others. Spend time with positive people who enhance your life. A strong support system will buffer you from the negative effects of stress.

Do something you enjoy every day. Make time for leisure activities that bring you joy, whether it be stargazing, playing the piano, or working on your bike.

Keep your sense of humor. This includes the ability to laugh at yourself. The act of laughing helps your body fight stress in a number of ways.

caring by their students. Caring teachers may employ strategies such as personal disclosure, where they share information about themselves as a way to create space for relationships in the classroom. They cultivate a climate in their classroom where students have an "authentic" voice (Oldfather & McLaughlin, 1993). In contrast, teachers who distance themselves emotionally or develop differential relationships (Babad, 1993), where they favor some students over others, are less likely to be viewed as caring teachers.

Teachers perceived as caring tend to endorse different orientations towards classroom management and establish distinctive types of classroom climates and cultures. Julianne Turner and colleagues (1998) suggest teachers perceived as caring tend to monitor the emotional climate of the classroom particularly with regard to the experience of unpleasant emotions (i.e. anger, frustration) in themselves and their students. Teachers perceived as uncaring tend to express higher levels of unpleasant emotions and may, in fact, use the expression of unpleasant emotions (i.e. yelling, showing disappointment) as a way to regulate their students' behavior. In contrast, students tend to characterize caring teachers' classrooms as "warm" places. Again, it is not that caring teachers avoid expressing unpleasant emotions in their classroom, but they tend to be judicious about their expression of anger, frustration, and disappointment.

Teachers perceived as caring tend to endorse more humanistic orientations towards classroom management (Willower, Eidell, & Hoy, 1976). Caring teachers view students as able to learn responsibility for self-regulating their

own behavior and view themselves as participating in the process of socializing necessary skills and values. The classroom becomes a place in which students learn about the value of rules and rule making and the teacher is a conduit for understanding social order. These classrooms tend to be more supportive of students' autonomy and emphasize the value of social negotiation (DeVries & Zan, 1996; see also Reeve, 2006). In contrast, teachers endorsing more custodial orientations tend to view undisciplined behavior as an indicator of irresponsibility and respond by increasing control and enforcing punitive sanctions. Sadly, a strong emphasis on law or order, without explicit rationales, may leave students feeling manipulated. Teachers perceived as caring do have some custodial elements in their classroom; not everything is negotiable and there are consequences for poor choices. However, caring teachers are willing to negotiate some elements of classroom life, they express clear expectations for students' self-management of behavior, and they are willing to endure somewhat more interpersonal conflict in the classroom.

CARING FOR ALL STUDENTS

This task of trying to understand students becomes challenging when students and teachers come from different cultural backgrounds. Jacqueline Irvine introduced the concept of cultural synchronization to describe the ways in which conflict is generated in relationships between students of minority backgrounds and their teachers when values, patterns of interaction, and ways of being are not aligned. In two seminal studies, Monroe and Obidah (2004) and Blackburn (2005) identified the ways in which majority teachers and minority students become out of sync with each other by misinterpreting each other's intentions and actions. From this perspective, caring teachers are those who seek to develop cultural competence when interacting with students from different backgrounds (Ladson-Billings, 2001) and strive to understand the perspectives of each student in their classroom.

STUDENTS FEEL THEIR UNDERSTANDING MATTERS

The perception of caring by students also has a strong instructional component. Teachers perceived as caring delineate intellectual boundaries, including what will be learned and the standards for mastery. Caring teachers are focused on cultivating student interest in the content they are teaching and employ a variety of strategies that connect content to their students' lives. Caring teachers set high expectations for all students in their classes and press their students to understand the material, not merely for the sake of performing on a test but to understand the world around them. Among teachers who push their students to excel, what distinguishes teachers perceived as caring is the quality of their interpersonal interactions with students. Across the

literature, caring teachers have been defined as warm demanders, an idea conceived by Judith Kleinfeld (1975). Warm demanders exert influence on their students' learning through their relationship. They are not willing to let a child turn in lesser quality work or fail; instead, with compassion, they express their belief that their students can do better and are willing to work with students to improve their work.

IMPLICATIONS FOR TEACHERS

To be caring means to be willing to critically evaluate what and for whom one actively cares. Doing so entails being reflective of whether there is a match or mismatch between the things one cares about and the needs of one's students. To be caring means to be thoughtful about the scope of one's caring—including the extent to which one cares about maintaining or challenging the status quo, representing an authoritative view or allowing student conceptions to be at the forefront, and to create potential for what is personal to mingle with what is academic. To end here, however, would fail to acknowledge a tension in the caring teacher literature in that teachers who care more may be more prone to feeling emotional exhaustion, to becoming burnt out and to leaving the field (Sutton & Wheatley, 2003). Finally, to be a caring teacher inherently means to identify ways to care for oneself (Ben-Ze'ev, 2006); to create healthy intellectual and interpersonal boundaries and to identify sources of support for when the task of caring for a student, or a group of students, is beyond one's resources.

SEE ALSO *Classroom Environment; School Belonging.*

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Heather A. Davis

CASE-BASED LEARNING

SEE *Constructivism: Case-Based Learning.*

CHEATING

Academic cheating appears in a variety of forms and at the heart of each is an attempt to convince others that one has higher academic skills, abilities, or potential, or



Cheating appears to be fairly prevalent at every educational level. PHOTOS ALYSON/TAXI/GETTY IMAGES.

that one exerts more academic effort than is actually the case. Amid multitude of definitions for cheating, Garavalia, Olson, Russell, and Christensen noted that common components are the use or provision of unauthorized means of information in a setting in which there are assessment consequences for the performance. Cizek classified forms of cheating into four categories: the unapproved transfer of information between individuals, the use of unapproved materials, exploiting weaknesses in others, and plagiarism. Many cheating behaviors consist of elements from multiple categories. Cheating may be engaged in for one's own interest and also in the interest of others such as one's peers, students, or children.

PREVALENCE OF ACADEMIC CHEATING

The prevalence of cheating is difficult to estimate because few reliable sources for cheating information exist. Students have strong incentives to underreport their cheating and may have difficulty estimating the cheating that

occurs in their schools. Cheating that is not discovered obviously goes unrecognized by teachers and thus is not reported. Additionally, individuals may hold different definitions of cheating staying home from school on the day of a test may be viewed differently from bringing a cheat sheet into a test. As Whitley concluded, in part due to these issues, reports of the percentage of students who cheat vary from 5 to 95%. However, some trends have been identified.

Cheating appears to be fairly prevalent at every educational level. According to Cizek, one-third of elementary students report having cheated and, according to Evans and Craig, just over 60% of middle school students report that they know when cheating occurs in their classes but rarely complain about cheating to peers or teachers. A nationally representative survey of youth conducted by the Josephson Institute of Ethics revealed that 38% of middle school students and 60% of high school students cheated on a test during the prior school year and approximately 24% of middle schools students

and 33% of those in high school used unauthorized information from the Internet to complete out-of-class assignments. Both test cheating and plagiarism increase fairly steadily from grades 6 through 12.

Although widespread cheating also occurs in college, most of the available data suggest there is less academic dishonesty in higher education than in high school but in the 1990s and early 2000s rates appeared to increase. Self-reports of college cheating increased from 63% in 1963 to 70% in 1993 according to McCabe and Bowers. Investigations conducted by Newstead, Franklyn-Stokes, and Armstead, and separately by Schab revealed that college students report higher levels of cheating in science, technology, and math courses than in other domains. Compared to liberal arts majors and education majors, Baird found that business majors were more likely to report cheating on unit tests and to conceal professor errors and were less likely to disapprove of cheating. Similarly, McCabe, Butterfield, and Trevino found that graduate students in business reported cheating at a higher rate (56%) than graduate students in other fields (47%).

TYPICAL CHEATING METHODS

As reflected in a review of the research on cheating methods conducted by Garavalia and colleagues, the most comprehensive studies of the relative frequency of cheating methods have used samples of college students. When these authors asked college students how students cheat on graded work, more students listed at least one non-technological method than at least one technological method (84% versus 34%). Fifty-two percent of these students reported at least one method that did not require collaboration with others while 40% reported at least one method that did require collaboration.

Newstead and colleagues reported on the frequency of various specific behaviors at the college level. These data reveal multiple forms of plagiarism are common. Many students report having copied text from a source without a citation (42%), paraphrasing from a source without a citation (54%), inventing data (48%), allowing one's coursework to be copied by others (46%), and padding bibliographies (44%).

Students admitted to a number of coursework shortcuts. Many students reported copying other students' work with their knowledge (36%) or taking individual credit for collaborative work (18%). Students also cooperated by agreeing to mark peer-graded work too generously (29%) or doing others' work for them (16%). Frequently reported deceitful behaviors also included falsifying data (37%), hiding books or articles so peers cannot access them (32%), and lying about personal circumstances in order to get extensions or exemptions (11%). In testing situations, 13% of students copied exam answers from others without their knowledge. Relatively fewer students reported taking unauthorized

material into tests (8%), plotting in advance to get information on the exam (5%), or lying about circumstances to get special privileges by the examiner (4%).

Technological advances have increased the methods and opportunities for cheating. Students store and retrieve information in programmable calculators, MP3 players and cell phones during exams. They text message one another during exams and use portable electronic devices to illegally access the Internet. The World Wide Web has simplified plagiarism on take-home essay exams and papers, with numerous Web sites that will provide any sort of assignment for a price, and large volumes of easily accessible information that can be plagiarized.

PERCEPTIONS OF CHEATING SEVERITY

Evans and Craig found at the middle and high school levels, perceptions of cheating severity differ between students and teachers. According to Kohn, these perceptions also vary among teachers within a given school. For example, one teacher's assignments require collaboration in order to be completed, whereas another teacher will classify collaborative behavior as cheating. In a study of undergraduate students and instructors, Whitley and Keith-Spiegel (2002) found that other behaviors that are viewed as cheating by some and as honest by others include collaboration without specific permission, submitting a single paper for more than one class, and copying homework. However, there is general agreement that copying or using a cheat sheet during an exam and purchasing papers to submit as one's own work both qualify as cheating.

PREDICTORS OF CHEATING

In 1928, Hartshorne and May conducted the most well known study of dishonesty. Although the initial goal of the study was to determine the characteristics associated with people who made more or fewer moral decisions, their data revealed that people's behavior has little cross-situational consistency. Although many of the thousands of students they studied cheated on their schoolwork some of the time, few students cheated in every assessment situation and making the decision to be honest in the classroom was not always consistent with their behavior in other domains. Murdock and Stephens found that efforts to identify the profile of the moral student typically account for a small amount of the variance in students' actual behavior. As such, the view of as students' dishonesty as a resulting from the interaction between their personal choice and the specific environment permeates most theoretical models that have attempted to provide a framework for understanding cheating. Examples of such perspectives are Whitley's model of cheating as reasoned action, and Murdock and Anderman's motivational model of cheating.

INDIVIDUAL DIFFERENCE PREDICTORS OF ACADEMIC DISHONESTY

Findings from self-report suggest that students who engage in academic dishonesty differ in several ways from those who do not, including attitudes about cheating, views about themselves, and demographic characteristics. Whitley found that compared to those who do not cheat, cheaters in college hold more positive attitudes toward cheating and do not feel as strong a moral obligation to avoid cheating. They also view themselves as less generally honest, as lacking study skills, and as under pressure to achieve success. However, there are not strong achievement differences between cheaters and non-cheaters.

Miller, Murdock, Anderman, and Poindexter reported that college students are more likely to engage in academic dishonesty when they are younger or unmarried. In contrast, children in K-12 schools are more likely to cheat when they are older or in higher grade levels. Although researchers find no documented gender differences in cheating rates when actual cheating behavior is observed, men admit to more dishonesty when the information is self-reported. There are no such gender differences, however, when asked specifically about their cheating in the service of others.

CONTEXTUAL PREDICTORS OF ACADEMIC DISHONESTY

As described above, those who cheat also justify cheating more than those who do not. Several environmental factors influence perceived justifiability of cheating and whether cheating actually occurs, including peer norms, classroom factors, and facets of students' lives outside of school. Students may look to their peers for signs regarding whether cheating is justified. Whitley found students who cheat report that more of their peers cheat. Also, teachers' practices and interpersonal behaviors can influence cheating. Murdock, Miller, and Goetzinger found that students justify cheating based on poor pedagogy, testing practices, and student-teacher relationships.

The goals that teachers create for their classrooms can influence cheating. Interest or improvement objectives are more attainable than performance-related objectives. Anderman found that through assignments, assessments, and feedback, teachers who demonstrate that they are less concerned with learning or improvement and instead have set a predetermined standard for students to meet will increase the likelihood that their students will cheat. Similarly, Schraw and colleagues found that in contexts in which students work in order to earn a grade instead of to pursue an interest, students are more likely to cheat.

Clear instructional objectives in combination with active facilitation of students' progress towards those objec-

tives improve the attainability of success and, according to Whitley and Keith-Spiegel (2002), reduce the likelihood of cheating. Through these and similar behaviors, teachers can convey respect and fairness toward students. Cheating is also reduced when these methods are reflected in tests that are aligned with the content being taught and that are not unreasonably difficult or long. Additionally, according to Anderman, cheating is less prevalent when scoring is criterion-referenced rather than norm-referenced (scored on a curve).

Finally, students' environments outside the classroom can influence the cheating that occurs inside the classroom. When students experience undue pressure to attain certain grades or when they have insufficient time to prepare for their courses, success becomes less attainable and cheating becomes more likely, according to Whitley.

PREVENTION OF CHEATING IN THE CLASSROOM

Cheating prevention research has been focused on college classrooms; however, the information gained from this work is likely applicable to other educational settings. While some schools implement formal honor codes, institutions' actual commitment to integrity is more important for reducing cheating than the existence of a code, according to McCabe and Trevino. Further, Whitley and Keith-Spiegel (2001) found that institutions must model this commitment in order to minimize academic dishonesty. McCabe, Trevino, and Butterfield advocated communicating clear expectations for honest behavior, including explicit definitions of honesty; communicating clear consequences for dishonest behavior; and enforcing those consequences.

Clarity is also important in terms of educational objectives. Teachers must set and communicate clear objectives in order to reduce the likelihood of cheating. These objectives should drive instruction and assessment so that students can predict and prepare for tests instead of being surprised by test content. Also, students' progress towards these objectives should be supported through scaffolding and frequent assessments. Frequent assessments help ensure that students are progressing toward objectives at the expected pace, limiting the need for cramming before a major exam, and also result in more evaluations that contribute relatively less to the final grade, as opposed to one or two high-stakes exams.

As described above, students are less likely to cheat when they are interested in the content and are working to learn rather than to earn a grade. This can be accomplished through several means. First, teachers should seek student input into content or allow students to choose specific topics for projects or papers. Second, tasks and assignments should be constructed so that they are at

levels of challenge appropriate for students. Finally, teachers should strive to create an atmosphere that is safe for and encouraging of student curiosity, risk-taking, and improvement.

In addition to pedagogical and interpersonal choices, teachers can take steps to reduce cheating through the way they format and administer exams. Multiple versions of the same test can be useful, but these versions must be carefully designed and implemented as students taking tests with scattered questions are able to cheat equally as well as students taking a single-version test, according to Houston. For multiple-choice tests, it is important to randomize question stems as well as answer options across versions. For open response tests, question order can be randomized and certain details of the questions, such as numbers, should be changed, if possible. Also for open response tests, teachers should distribute a blank piece of paper so students can cover their answers. Most exams that are delivered in online formats have features to reduce the likelihood of cheating such as set time limits and delivery of a random set of items and responses from a larger database. Without photographic or fingerprint identification, however, it is impossible to know who actually takes an online exam.

Teachers can take several steps to make cheating from multiple versions more difficult. When using multiple versions, it is important that the versions are not easily distinguishable. Also, depending on the space available, and thus how far apart students can be seated, two to four test versions may be necessary. Houston noted that assigning seating has the added benefit of preventing students from choosing cheating partners. Even with multiple test versions teachers must prevent students from accessing tests ahead of time. Cizek suggested that teachers create different sets of test versions for different administration days and times, keep paper copies locked or only keep electronic files of tests, and create new tests for every year.

Teachers can communicate respect to students to help reduce rates of cheating. While teachers may think that their own lax behavior during test sessions signifies respect, Cizek noted that it actually increases cheating and frustrates students who expect teachers to monitor the testing environment and are bothered if teachers are ignoring classmates' obvious cheating. Teachers can show students that they expect honest academic behavior by appearing aware of the class, noticing and acting on questionable behavior, and moving through the classroom during the test.

In addition to cheating on exams, plagiarism is another form of academic dishonesty that teachers can work to reduce. Just as multiple versions of a test can block attempts to cheat, creating new essay assignments can thwart plagiarism. Teachers can make widely available Internet essays useless by assigning less typical essays

and requiring students to tailor their essays to a particular context or to develop their own opinion. There are also commercially available tools, such as turnitin.com that check students' work against large-scale databases of other work and provide the instructor and student with a redundancy index.

As noted earlier, frequent assessments help eliminate cheating and requiring students to submit their work at several stages of progress can minimize plagiarism. For students who procrastinate or who are overscheduled, more frequent deadlines can reduce the need to anxiously complete an assignment during the days before the due date, possibly leading to drastic and dishonest measures. Also, feedback on students' progress supports their efforts to learn and helps clarify the objectives or requirements of the assignment, perhaps minimizing the perceived need to cheat.

SEE ALSO *Moral Development; Moral Education.*

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CHILDHOOD

SEE *Early Childhood Development*.

CLARK, KENNETH BANCROFT 1914–2005

Kenneth Bancroft Clark was born in 1914 in the Republic of Panama. Jones and Pettigrew note that he earned both a bachelor's and a master's degree from Howard University. In 1940 Clark became the first African American to obtain a Ph.D. in psychology from Columbia University. Through-



Kenneth B. Clark in his office, May 29, 1975. HULTON ARCHIVE/GETTY IMAGES.

out his career, Clark received honorary degrees from several colleges and universities, including Oberlin, Amherst, Haverford, Tuskegee, Columbia, and Princeton. Clark was the first African American president of the American Psychological Association (APA), a position he held from 1970 to 1971. According to Pickren and Tomes, Clark was instrumental in the establishment of the APA's Board of Social and Ethical Responsibility of Psychology, which was charged with a number of tasks, including monitoring discrimination by APA vendors, researching social problems, and developing ethical guidelines for research and assessment. He was the president of the Society for the Psychological Study of Social Issues from 1959 to 1960. Clark was also the director of Metropolitan Applied Research, Inc., and president of the Society for the Psychological Study of Social Issues from 1959 to 1960. In 1978 Clark received the first annual Distinguished Contribution to Psychology in the Public Interest Award from APA.

Clark taught psychology at Howard University from 1937 to 1938 and Hampton University from 1940 to 1941. Clark joined the faculty of City College of New York in 1942, becoming an assistant professor seven years later and, by 1960, a full professor—the first African American academic to be so honored in the history of New York's city colleges. He remained at City College until his retirement in 1975. Clark also served as a visiting professor at Columbia University, Harvard University, and the University of California at Berkeley. In 1962 Clark helped establish Harlem Youth Opportunities Unlimited, designed to help reduce unemployment, school dropout rates, and to prevent juvenile delinquency in the city. The *American Psychologist* notes that Clark was the president from its establishment in 1975 until 1986 of Clark, Phipps, Clark, and Harris, Inc., a consulting firm with a focus on affirmative action, human relations, and race relations.

Clark's most notable research collaborator was his wife, Mamie Phipps Clark (1917-1983). Together, Kenneth and Mamie Clark are best known for their focus on race relations and civil rights in education. Much of their work in this area concerned several experimental studies that explored racial identity and racial preferences in African American children. Among these studies are the line drawing tests and the more widely known "doll studies".

In 1939, for example, Kenneth and Mamie Clark designed a study to investigate the development of self and racial consciousness in African American preschool children. One hundred fifty African American children, ages three to five, were shown different combinations of line drawings of African American boys, Caucasian boys, and irrelevant objects, for example, a lion, a dog, a clown, and a hen. The young male participants were asked, "Show me which one is you. Which one is (name of subject)?" The young female participants were asked to identify a brother, cousin, or African American male playmate. As a whole, the African American participants chose the African American male line drawing more often than the Caucasian male line drawing. As age increased, the African American participants chose the African American male line drawing significantly more often than the Caucasian male line drawing. Also, the majority of participants chose a human line drawing significantly more than the irrelevant objects.

In that same year, Clark and his wife began examining racial preferences in African American children using African American and Caucasian dolls. A total of over 300 African American children between the ages of 3 and 9 were shown an African American and Caucasian doll. The dolls were identical except for skin color. The Clarks served as the primary investigators; they asked the participants a series of questions designed to probe the participants' racial and skin color preferences and, thus, provide insight into their racial identities. In particular, the participants were asked which doll they would like to play with, which doll was good, bad, nice, and which doll looked the most like them.

Over 90% of the children identified the African American doll as resembling themselves. However, over half of the children tested designated the Caucasian doll as the nice doll and the doll they wanted to play with. These same participants regarded the African American doll as the bad doll. Clark concluded that the children had suffered damage to their self-esteem and self-image due to segregation and the pervasive negative perception of African Americans. For the Clarks, the participants' choices were reactions to the pressures associated with being African American in the racially segregated South.

Clark's doll study results were integral to school desegregation during the 1950s. His testimony during the Supreme Court case, *Brown v. Board of Education, Topeka,*

Kansas, outlined the detrimental psychological effects of segregation on both African American and Caucasian children. While heralded for his significant contribution to the study of racial identity among African Americans, Phillips notes that Clark later was criticized for his advocacy for mainstream integration and for criticizing the Black Power movement. Kenneth Clark died May 1, 2005, at the age of 90.

SEE ALSO *Ethnic Identity and Academic Achievement.*

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Kenneth M. Tyler

CLASS SIZE

The consensus among many in education that smaller classes allow a better quality of teaching and learning has led to a policy of class size reductions (CSR) by a number of U.S. states, by the United Kingdom (UK) and Netherlands, and Asia Pacific countries as diverse as New Zealand and China. This policy is contentious, though: Some argue that the effects of CSR are modest and that there are other more cost-effective strategies for improving educational

standards (Slavin, 1989; Rivkin, Hanushek, & Kain, 2000; Hattie, 2005).

Despite the important policy and practice implications of the topic, the research literature on the educational effects of class-size differences has not been clear. However, more recent research and reviews provide some answers, and this entry addresses whether class-size differences affect children's educational attainment and learning and classroom processes such as teaching and pupil behavior.

CLASS SIZE AND ACADEMIC ACHIEVEMENT

Overall, much previous research has not had designs strong enough to draw reliable conclusions (Blatchford, Goldstein, & Mortimore, 1998). It has long been recognized, for example, that simple correlational designs, which examine associations between a measure of class size or pupil-teacher ratios, on the one hand, and measures of pupil attainment on the other are misleading because researchers often do not know whether the results can be explained by another factor, for example, that poorer performing pupils are placed in smaller classes. To arrive at more valid evidence two kinds of research design have been used.

Experimental Studies. The frequent assumption that the problems of correlational research are best overcome by the use of experimental research or randomized controlled trials, offers one reason for the great attention paid to the Tennessee STAR project. A cohort of pupils and teachers at kindergarten through third grade were assigned at random to three types of class within the same school: a small class (around 17 pupils), a regular (typical) class (around 23 students), and a regular class with a teacher-aide. In brief, the researchers found that in both reading and mathematics pupils in small classes performed significantly better than pupils in regular classes, and children from minority ethnic group backgrounds benefited most from small classes (Finn & Achilles, 1999; Nye, Hedges, & Konstantopoulos, 2000). In fourth grade the pupils returned to regular classes and the experiment ended, but gains were still evident after the following three years, that is, grades 4-6 (Word, Johnston, Bain, & Fulton, 1990).

Longitudinal Studies. There are some difficulties (e.g., concerning validity) with experimental studies (Goldstein & Blatchford, 1998), and an alternative approach is to set up longitudinal studies that measure the full range of class sizes and account statistically for other possibly confounding factors, including pupil differences at an earlier point. This approach was adopted in a large-scale UK study (Class Size and Pupil Adult Ratio, CSPAR) project (Blatchford, 2003; Blatchford, Bassett, Goldstein, & Martin, 2003; Blatchford, Moriarty, Edmonds, &

Martin, 2002). This project tracked over 10,000 pupils in over 300 schools from school entry (at 4-5 years) to the end of the primary school stage (11 years). It used a multi-method approach and sophisticated multi-level regression statistical analyses.

The study found a clear effect of class size differences on children's academic attainment over the first year (4-5 years) in both literacy and mathematics. The effect size was comparable to that reported by the STAR project, and this trend is therefore supported by both experimental and non-experimental research designs. Small classes (fewer than 25) worked best in literacy for children with the lowest school entry scores who had most ground to make up. Effects of class size in the first year were still evident on literacy progress at the end of the second year of school, though by the end of the third year the effects were not clear. There were no clear longer-term effects of class size differences on mathematics achievement. Though this result indicates that the early benefits disappear after two years in school, there were no restrictions in terms of which size of class they moved to from year to year (in contrast with the STAR project).

The CSPAR's naturalistic design captured changes in class sizes from year to year. An important disruption effect on children's educational progress was found, that is, moving to a class of a different size, especially a larger class, had a negative effect on progress.

POSSIBLE EFFECTS OF CLASS SIZE ON TEACHERS AND PUPILS

Despite the widely held view that small classes will lead to a better quality of teaching and learning, the research evidence has not been clear. One reason is the often-anecdotal nature of much research. Finn, Pannozzo, and Achilles (2003) point out the need for systematic, preferably observational, research in this field. Overall, reviews of research suggest that class size effects are likely to be not singular but multiple, and that it is difficult in one study to capture all the complexities involved.

Effects on Teachers. Perhaps the most consistent finding is that class size affects individualization of teaching. The smaller the class, the greater the likelihood is that a teacher will spend more time with individual pupils. In smaller classes there also tends to be more teaching overall. Large classes present more challenges for classroom management, pupil control, and marking, planning, and assessment. Teachers are put under more strain when faced with large classes. Qualitative studies suggest that in smaller classes it can be easier for teachers to spot problems and give feedback, identify specific needs and gear teaching to meet them, and set individual targets for

pupils. Teachers also experience better relationships with, and have more knowledge of, individual pupils.

Effects on Pupils. Finn, Pannozzo, and Achilles (2003) conclude that students in small classes in the elementary grades are more engaged in learning behaviors, and they display less disruptive behavior than do students in larger classes. The CSPAR study found in the case of four to five year old pupils more disengagement in large classes but no effects in 10 to 11 year old pupils, possibly because of assessment and curriculum pressures at that age. In large classes pupils were more likely to simply listen to the teacher while in smaller classes pupils interacted in an active way with teachers, by initiating, responding, and sustaining contact (Blatchford, Bassett, & Brown, 2005).

Curriculum Effects. Research shows a moderating role of school subject on relationships between class size and classroom processes. Rice (1999) found that in mathematics, but not science, as class size increased, less time was spent on small groups and individuals, innovative instructional practices, and whole group discussions. In the CSPAR study, the overall effects of class size on individualized attention were found in all subjects but English. One direction for future research is to identify more precisely ways in which class size effects vary in relation to particular school subjects and student age.

IMPLICATIONS FOR POLICY AND PRACTICE

Overall, results suggest that while small classes will not make a bad teacher a good one, they can allow teachers to be more effective; conversely, large classes inevitably present all teachers with difficulties and the need for compromises. Small classes can offer opportunities for teachers to teach better (Anderson, 2000) or, to use a different term, they can create facilitating conditions for teachers to teach and students to learn (Wang & Finn, 2000).

Age of Pupil. Research shows that the age of the child needs to be taken into account when class size effects are considered. There is a clear case for small class sizes in the first years of school. Results show where resources could be further targeted, that is, classes smaller than about 20 to 25 for those with most ground to make up in literacy skills. Another policy implication is to maintain smaller classes across years where possible.

Age versus Start Up Effect. Research also suggests that class-size reduction initiatives are best seen as a policy of prevention but not remediation, in the sense that the evidence supports the use of small classes immediately after entry to school, but there is little evidence that small classes introduced later in children's school lives are as

effective. However, there is still the possibility that smaller classes may be advantageous at later strategic points of transition in students' school lives, for example, in the first year of secondary education. Research evidence on this possibility is needed.

Implications for Practice. It has often been pointed out that teachers do not necessarily change the way they teach when faced with smaller classes, and this fact might well account for the relatively modest effects of class size on achievement. Blatchford, Russell, Bassett, Brown, and Martin (2007) have suggested several ways in which CSR can be accompanied by pedagogical changes to enhance beneficial effects for students, for example, taking advantage of the possibilities of increased individualization; adopting more adventurous and flexible teaching; and implementing more effective collaborative learning between pupils. Some have argued that teacher professional development is a better investment than CSR, but it is preferable not to see them in opposition. Rather, professional development should be used to help teachers see pedagogical opportunities in small classes and develop strategies for realizing educational objectives in small (and large) classes.

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Classical Conditioning

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Peter Blatchford

CLASSICAL CONDITIONING

Associative learning occurs when an organism links two or more items of information. The simplest forms of associative learning are classical conditioning and instrumental conditioning. Classical conditioning is also known as Pavlovian conditioning in honor of Ivan Pavlov

(1849–1936) who was the first person to conduct extensive research of this nature. In a typical experiment with dogs, Pavlov would present a neutral auditory stimulus such as a metronome immediately before applying sand or food powder to the dog's tongue, which produced salivation. After a number of these pairings, Pavlov presented the metronome alone, and the dog now salivated. Pavlov developed terminology for these components of classical conditioning: The dog experienced a relatively neutral stimulus or conditioned stimulus (CS, the metronome) in conjunction with a biologically significant stimulus or unconditioned stimulus (US, the food powder), which always produces an unconditioned response (UCR, salivation). After multiple CS-US pairings (i.e., acquisition), presentation of the CS alone elicited a response, the conditioned response (CR, also salivation), which is appropriate for its corresponding US. Following acquisition of the CR to the metronome CS, Pavlov also reported that presenting the CS alone a number of times would eventually eliminate the salivation CR, a procedure termed extinction.

Although most classical conditioning experiments have used nonhumans, classical conditioning readily occurs in humans (e.g., Hermans, Craske, Mineka, & Lovibond, 2006). With nonhumans, many model systems have been developed to explore classical conditioning, including conditioned eyeblink, conditioned taste aversion, and conditioned approach/avoidance (Domjan, 2003). Clearly, these have little classroom application, but the most common classical conditioning paradigm, conditioned emotional response, is applicable. Conditioned emotional reactions can be either positive or negative. A positive conditioned emotional response is produced by pairing a relatively neutral stimulus with a US that elicits a positive emotion such as happiness. For example, a parent may use the preferred taste of cheese to cover the flavor of broccoli. After a few meals of cheesy broccoli, a child will be more willing to eat broccoli by itself (for a review of food preference learning, see Capaldi, 1996). Although it is possible to produce positive emotional reactions, broad application of this methodology has not been implemented (other than in advertising when an attractive model is paired with a product). In practicality, it may be difficult for a teacher to spend substantial time during the earliest portions of class to pair their presence with a positively affective US. One can imagine only the youngest of children would not see through an instructor plying them with candy or treats on the first day of class.

Instead, the more commonly studied phenomenon, and the more likely classroom occurrence, is the negative conditioned emotional response. A classic example of conditioned fear in humans is the Little Albert Study conducted by Watson and Rayner (1920). Watson and Rayner examined if a phobia could be induced in a human, so they

borrowed nine-month-old Albert from the nursery at Johns Hopkins University. After recording Albert's baseline responses to a range of stimuli such as animals and neutral objects, conditioning began two months later. During acquisition, a white rat was paired with a loud noise US (Watson clanged a steel bar with a hammer) seven times. Five days later, Albert was tested with a range of stimuli, including the white rat. Albert cringed and cried in response to the rat, behaviors that were quite different from his curiosity about the rat during the baseline phase. They tested long-term retention of fear 30 days later, and Albert was still scared of the white rat and other white objects such as a rabbit, white fur coat, and Santa Claus mask. In addition to demonstrating conditioned fear in humans, Watson and Rayner planned to examine the conditions necessary to extinguish Albert's fear. Unfortunately, on the day prior to the implementation of the extinction phase, Albert was released from the hospital with his fear intact.

CLASSROOM PHOBIAS AND TEST ANXIETY

Just as Albert learned to fear the white rat, the potential for students to learn a phobia to a neutral classroom or instructor is always present. Few instructors aim to produce a threatening or fearful situation, but a wrong answer or embarrassing situation may induce a negative emotion in the student and confer learning to the cues present at this time. As a result, the student may choose to miss class or decrease participation during class. A specific example comes from an advanced course in tests and measurements. Here, students are often given a short, timed, math ability test. Students frequently report experiencing anxiety during this exam. Some report their heart beating faster and harder, shortness of breath, and inability to concentrate because they cannot ignore the stopwatch used for timing. They often state "I hate math," or "I can't do math." Occasionally the anxiety is so strong, they stop in the middle of a problem and say, "I can't go on." When asked about their anxiety many trace its beginning to One Minute Arithmetic Tests in elementary school. In these tests, they had a sheet of arithmetic problems to complete correctly in one minute, or repeat the test until they did so. From a classical conditioning perspective, the CS is the arithmetic problems and the US is the time pressured testing situation that produces pressure and anxiety (the UCR) to both finish in a rapid time (one minute) and calculate problems correctly. After the CS-US pairing the CS (the math problems) alone produces anxiety (CR).

EXTINCTION AS NEW LEARNING

Because the student overcomes the anxiety enough to pass these tests, an instructor who has learned about conditioned fear might expect an extinction treatment has effectively eliminated the fear. A common miscon-

ception of extinction is that it is the equivalent of unlearning: Once a CS-US association has been learned, this association could be unlearned if the CS is frequently presented alone, like erasing a word from a blackboard so no trace remains. Yet, numerous studies have shown that extinction is not unlearning, but is actually new learning. Two extinction-related phenomena, spontaneous recovery and renewal, illustrate this interpretation. In spontaneous recovery, an organism experiences acquisition of the CS-US association, followed by CS-alone presentations (i.e., extinction). If the student is tested within a few days of the extinction trials, a weaker CR is observed. However, if CS testing is delayed for a few weeks (e.g., 21 days), a significantly stronger CR (anxiety reaction) is recorded. The fact that the CR returns without any additional training suggests that the original CS-US association is still intact (Rescorla, 2004). Indeed, some neuroscience studies suggest that the locus of the acquisition memory (CS-US association) is a different anatomical region from the locus of the extinction memory (CS-no US association) (e.g., Sotres-Bayon, Cain, & LeDoux, 2006). Thus it would not be unusual for a strong math anxiety reaction to recur spontaneously in students who had not experienced panic in quite some time.

THE RENEWAL EFFECT

Further support for this view comes from a second extinction-related phenomenon, the renewal effect (e.g., Bouton 2002; Bouton & King, 1983). The renewal effect is produced by alterations in the contexts of learning and extinction. For example, a control group will learn the CS-US association in an aqua room (A), experience CS alone experiences (i.e., extinction) in this aqua room (A), and then be tested with the CS in the same aqua room (A). Not surprisingly, following this order of experiences, members of Group AAA will show weak responding to the CS in the aqua room during testing. In contrast, the experimental group will receive learning in the aqua room (A), extinction in a blue room (B), and testing of the CS in the aqua room (A). Group ABA will show a significantly stronger response to the CS during testing than Group AAA. This outcome provides convergent evidence that the original CS-US association learned in the first (A) phase is still intact and can be retrieved if the contextual cues during testing are the same as during learning.

One might ask why some students develop test anxiety while others did not. In 2001, Bouton, Mineka, and Barlow proposed a modern learning theory approach to panic disorder that can be extrapolated to this anxiety. According to their model, during an experienced panic episode, various external or internal cues (CSs) can become associated with the negative emotion US. As individuals re-encounter these

CSs, they experience conditioned anxiety, and this may lead to a panic attack. Bouton and colleagues also argue that a major contributing factor to panic and conditioned anxiety is catastrophic misinterpretation of somatic symptoms. In the math test anxiety situation, the students experience panic during a testing situation, perhaps as an increasing heart rate or impaired recall or attention. These cues can lead to catastrophic thoughts, such as “I can’t do math.” There are a number of other cues that can serve as the CS in this situation. The contextual cues of the classroom are encountered in academic settings, the quiet shuffling of feet and the sound of pens scribbled on paper, the visual features of other individuals quietly hunched over their desks could be another cue. Importantly, a host of internal cues may be most salient, such as the heart rate and racing thoughts. If the students engage in catastrophic thinking at this stage, then they may increase their anxiety worrying that their performance on this test is the first step to career success or failure. Overall, this combination of events can then be generalized to a host of other testing situations because most tests will have common visual, auditory, or contextual conditions, these will be coupled with internal somatic sensations that seem unique to the situation, and even though the students have passed the previous exam, the current exam holds the same potential for life-long failure.

SEE ALSO *Applied Behavior Analysis; Connectionism; Operant Conditioning.*

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CLASSICAL TEST THEORY

Classical test theory (CTT) is both a philosophical argument in psychological science and a set of operations in mathematical statistics that focus on measuring mental attributes in humans. This broad description of CTT contains all the elements one needs to understand and appreciate it, both as a theory and in its operation in testing programs, but it does require an extended explanation. In the description, the phrases “philosophical argument in psychological science,” “operations in mathematical statistics,” and “measuring mental attributes” deserve particular attention because understanding them is the key to learning CTT. In this entry each term is explained in nontechnical language. Then CTT is discussed regarding its mathematical underpinnings, again presented nontechnically. In this second part, four formulas are explained that illustrate two essential aspects of CTT: reliability and standard error of measurement.

CTT is a scientific endeavor. In fact, realizing that CTT is science is an important step in learning about it. CTT meets all the criteria of any true science: It has a philosophical underpinning, a coherent methodology, and its methods are replicable by other scientists. Its place in science is so well established that it may be claimed that measuring mental attributes—the purpose of CTT—is psychology’s greatest contribution to the world of science.

Even before exploring the terms listed in its description, however, it is useful to note the words that compose CTT: classical, test, and theory. *Classical* suggests something old as well as tried-and-true. CTT is classical in the sense that it is fundamental to measurement science, but it is not ancient. In fact, many persons are surprised to learn that the field of measurement science formed only in the mid-to-late 19th century with much of its development not until the 20th century, stemming from the groundbreaking work of Spearman, Binet, Thurstone, and later Thorndike, all persons with unusually high IQ. (For a history of the field, see the 1997 special issue of *Educational Measurement: Issues and Practices* or Sternberg’s delightfully readable *Metaphors of Mind: Conceptions of the Nature of Intelligence* [1990].) The noun *test* is widely known, of course, meaning an instrument used to appraise, examine, or analyze. The last word in CTT, *theory*, is also descriptive and accurate. Theories are, by definition, ontologically unprovable; however, like most robust theories, CTT has provided over the

years ample evidence that applying it appropriately yields meaningful and useful information.

The descriptive terms of CTT, “philosophical argument in psychological science,” “operations in mathematical statistics,” and “measuring mental attributes” need to be explained next. Regarding the philosophical argument supporting CTT, the ontological contention is made that there are certain malleable aspects to the fundamental being of humans such as ability, proficiency, beliefs, attitudes, opinions, and probably, desire and intent, too. In psychological science these mental attributes are conceived of as cognitive processes and get hypothesized as *constructs*. Constructs are often more fully called *latent constructs* to emphasize that they are deeply embedded in human psyche and represent cognitive processes. Cognitive processes are malleable after all, the very purpose of education is to develop them but they are not directly observable. People cannot see *reasoning* even with sophisticated devices, although they can measure brain waves and quantify electrical and chemical actions. Still, despite not *seeing* into the brain, individuals perform myriad behavioral operations based on cognitive processes, such as reading or voting or expressing an opinion.

It follows that while latent constructs are not observable, the behaviors people use to express them are. For instance, people can observe an individual reading a story, reciting historical incidents, solving a mathematical or reasoning problem, or expressing a belief or an opinion. Hence, by observing behaviors they infer stimulation of a cognitive process. It is important to recognize that mental measurements of hypothesized latent constructs are only and at best inferences of more deeply seated cognitive processes.

Furthermore, people can reliably make distinctions between observations. That is, they can suggest that one person consistently comprehends more of a given passage in a text than is comprehended by another person or that a particular individual can reason through a problem more thoughtfully than another person or that one man or woman has an opinion that is more extreme than is the opinion expressed by others. In a 1904 foundational work on CTT, *Introduction to the Theory of Mental and Social Measurements*, Thorndike described the capacity to reliably make distinctions in behavioral observations as a concept called a *just noticeable difference*. In 1966, this just noticeable difference was given a mathematical structure in Fechner’s law.

Putting the facts together that (1) observation of behaviors leads to inferences about cognitive activity, and (2) distinctions can be reliably made between degrees of a hypothesized construct gives us a test. A test simply but significantly standardizes the examinees’ behavioral responses so that others can scale and score them and then make interpretations, usually by comparisons to peers or to

defined standards. In testing contexts, a test item or test exercise is considered to be a carefully prescribed *stimulus*.

However, the testing situation becomes complex when this basic idea is implemented with people. Several obvious reasons contribute to the complexity: (1) latent constructs are difficult to specify with precision, (2) the constructs are malleable, and (3) the stimuli meant to engender the examinee’s behavioral response may be constructed such that an examinee’s response does not completely or accurately engage the targeted construct (for example, in the case of a poorly crafted test item). All this adds up to imprecision in measurement termed *measurement error*. Without measurement error, people would know the *true ability* for any individual on a given cognitive process. And the notion of true ability is a central feature of CTT. Of course, people never measure mental attributes without error.

Mathematically, the notion of measuring true ability in CTT is expressed in this famous formula:

$$X_{ij} = \tau_{ij} + \varepsilon \quad (1)$$

where X is observed score,
 τ is true score,
 ε is error.

Formula 1 states that in CTT an observed score is the sum of a true score plus some error. While this is a logical supposition, expressing it as a mathematical formula allows testers to use it to model an individual’s behavior in a testing context. Examining the CTT formula shows how this works.

Each term in the equation has a special meaning. The left-hand term (X) is a Roman letter indicating that this outcome is observed; namely, it is the test score of a given examinee. The first term on the right-hand side of the equation is the true score (τ *tau*) and denotes the structural part of the equation. That is to say, it represents the latency being measured. The error (ε *epsilon*) is called the stochastic part of the equation, from the Greek word for *aim* or *guess*. It is characterized by randomness in the population, an accurate description since no two individuals’ true score is estimated with the same degree of precision. Greek letters are used for these terms to indicate that they apply globally; that is, everyone in the population has a true score (although it differs from person to person) and measuring always includes error.

The subscripts in the formula have meaning, too. The first subscripts specify that the observation is on a given item (i) and for a particular individual (j). There is no subscript for the error since it is not tied directly to any individual: again, the randomness of all measurement errors.

From the formula, it is easy to see that as the error decreases to a limit of zero (*attenuates*, in statistical language); the observed score grows closer to the value of the true score. In perfect measurement, they are the same: $X = T$. Unfortunately, measurements are never perfect, which explains the existence of the error term in CTT.

CTT often used to estimate the degree of error in a particular testing context. This application of the theory usually centers on two statistics: the standard error of measurement (SEM) and an index of the reliability of scores for a particular testing occurrence. Both concepts are mathematical estimations of measurement error, but they convey different information. In a global sense both measures indicate stability in measurement, or reliability. In fact, CTT is often called a theory of reliability, encompassing both indices.

Reliability means consistency of measurement. A perfectly reliable test is one that would yield the identical score (i.e., the examinee's true score) over many occasions, presuming no learning or other confounding factor intervened between the test administrations. But, of course, perfect reliability is never achieved in real-world scenarios. Were a test administered many times, any given examinee would likely not obtain the same score over and over again. Even with a carefully constructed test some variation in scores would occur. As illustration, in a case in which the raw score on a first testing occasion was 72, while on the second it was 74, and on the third a 68 was obtained, the inconsistency in scores is evidence of measurement error, or less than perfect reliability.

Given the improbable but theoretically interesting scenario in which a tolerant examinee took the test (or equivalent tests) a very large number of times and (also improbably) no learning or other factor such as fatigue influenced any attempt, the examinee would eventually have an entire distribution of scores that ranged from the examinee's lowest obtained score to the highest obtained score. From this theoretical distribution of scores, the mean is considered to be the examinee's true score, and the standard deviation is the SEM.

Thus, reliability and SEM are indicators of consistency in CTT, and there are methods for calculating various statistics that represent them. Of course, calculating indicators of consistency requires multiple occasions; with only one occasion, consistency cannot be determined. This point, while obvious, is important: For reliability estimation, regarding the test, there needs to be more than one item, and for the examinee, there needs to be more than one testing occasion.

To address this constraint it is necessary to introduce another important aspect of CTT, its additive character-

istic. In CTT, tests are considered to be composed of some number of items that work together in an additive fashion. An additive function is one that conserves the addition operation, as shown for a test with n items in Equation 2.

$$f(x_1 + x_2 + \dots + x_n) = f(x_1) + f(x_2) + \dots + f(x_n) \quad (2)$$

Essentially, this equation shows that in CTT the scores of individual items which are often, but not always, dichotomous (meaning right or wrong) can be summed to a cumulative whole, a test score. More technically, the overall test score is a linear combination of the individual test item scores. Working from the additivity rule, reliability is determined by calculating a consistent response among the items.

Traditional reliability strategies use one of two ways to estimate the consistency: either *temporal stability* or *internal consistency*. These are two routes to determine consistency of responses. Temporal stability is a family of techniques that gauge the extent to which a test yields consistent scores from one occasion to the next. It includes such strategies as test-retest and splitting the test in half (i.e., split-half) to produce an index of reliability. Internal consistency looks to the covariance structure of the item responses to produce an index of reliability. One popular measure of internal consistency is called Cronbach's alpha (α). By any of these means, however, reliability is theoretically conceived as the correlation of the observed score with the individual's true score, and it is expressed syntactically in Formula 3. In statistical contexts, a ρ (rho) symbolizes a correlation, and the subscripts denote the variables.

$$\rho_{XT} \quad (3)$$

This formula represents an index of reliability and applying it to any of the calculation strategies yields a coefficient. Coefficients in this context range from 0 to 1: no reliability (i.e., randomness) to perfect reliability.

Finally, as explained above, SEM indicates discrepancies between observed scores and true scores, and it too is a good indicator of reliability. Syntactically, it is the ratio of the standard deviation of the errors (expressed as sigma, σ) to the standard deviation of the observed scores, as shown in Formula 4. When the test's reliability is known, the SEM is easily calculated.

$$\frac{\sigma_e}{\sigma_x} = \sqrt{(1 - \rho_{XT})} \quad (4)$$

In sum, CTT is clearly a powerful theory of measurement with a philosophical base and set of mathematics useful to implement it. From learning about them, people

can readily appreciate why CTT is the most commonly used basis for educational and psychological tests.

SEE ALSO *Item Response Theory*.

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CLASSROOM ASSESSMENT

Classroom assessment is the process, usually conducted by teachers, of designing, collecting, interpreting, and applying information about student learning and attainment to make educational decisions. There are four interrelated steps to the classroom assessment process. The first step is to define the purposes for the information. During this period, the teacher considers how the information will be used and how the assessment fits in the students' educational program. The teacher must consider if the primary purpose of the assessment is diagnostic, formative, or summative. Gathering information to detect student learning impediments, difficulties, or prerequisite skills are examples of diagnostic assessment. Information collected on a frequent basis to provide student feedback and guide either student learning or instruction are formative purposes for assessment, and collecting information to gauge student attainment at some point in time, such as at the end of the school year or grading period, is summative assessment.

The next step in the assessment process is to measure student learning or attainment. Measurement involves using tests, surveys, observation, or interviews to produce either numeric or verbal descriptions of the degree to which a student has achieved academic goals. The third step is to evaluate the measurement data, which entails making judgments about the information. During this stage, the teacher interprets the measurement data to determine if students have certain strengths or limitations or whether the student has sufficiently attained the learning goals. In the last stage, the teacher applies the interpretations to fulfill the aims of assessment that were defined in first stage. The teacher uses

the data to guide instruction, render grades, or help students with any particular learning deficiencies or barriers.

CLASSROOM ASSESSMENT CONCEPTS AND APPLICATIONS

Hundreds of books and articles on classroom assessment have been written, but most, if not all, ascribe to an assessment framework articulated in the 1930s and 1940s by Ralph Tyler (1949), who believed that assessment was an integral component of curriculum and instruction planning. Tyler developed a multistep model of curricular and instructional design that began with consideration of what the educator expected the student to be able to know and do after teaching had occurred. He termed these end results of education, "instructional objectives," which he stated should be crafted by considering both the mental skill, such as "applies" or "creates," and the subject matter content the student will develop. Good planning, according to Tyler, involved developing a table that specifies the body of objectives students will develop during the course of a school year, semester, or lesson.

After the instructional objectives are formulated, educational experiences can be developed that encompass the teaching materials and instructional opportunities that will be provided to students. Also during this planning stage, teachers must consider how they will determine if students have attained the instructional objectives. Indeed, good objectives are those that clearly define the type of activity the students will accomplish to indicate the degree to which the students have attained the objective. After students experience the learning opportunities provided by the teacher and after assessment has occurred, the teacher's task is to examine the assessment results and decide whether students have sufficiently reached the objectives. If they have not, the teacher can revise the educational experiences until attainment has occurred. Thus, Tyler's model of testing emphasized the formative role of classroom assessment.

Tyler did not organize the mental skills that make up objectives in any meaningful way. Benjamin Bloom, who earlier was a graduate student of Tyler at the University of Chicago, orchestrated a committee during the 1950s to develop a Taxonomy of Educational Objectives (Bloom et al., 1956). The committee organized mental, or intellectual, skills in a hierarchical fashion from the most basic levels, knowledge, and comprehension, to the most advanced levels, applications, analysis, synthesis, and evaluation. The Taxonomy has been widely used to organize the types of objectives students of all ages are expected to attain in schools worldwide.

Selected- and Constructed-response Formats. Teachers have an array of item formats upon which to measure

student attainment of objectives (see Linn & Miller, 2005; Oosterhof, 2003). Assessment items can be classified into two categories: selected- and constructed-response formats. It is the student's duty in selected-response items to choose one or a few correct options among multiple alternatives. Examples of selected-response item formats include multiple-choice, ranking of options, interpretive exercises, matching, true-false, alternate-choice, embedded alternate-choice, sequential true-false, and checklists. In constructed-response items, students must supply an answer to a question prompt. Short answer and essay items are common constructed-response items. Essay items can require students to write either extended or restricted responses. Responses can be restricted by limiting the amount of space available to supply the answer, dictating the number of acceptable answers ("state three reasons . . ."), or by qualifying in the prompt the expected response length ("briefly describe . . ."). Restricted-response essays are useful for measuring student attainment of factual knowledge and basic comprehension. Extended-response essays are more appropriate if the goal is to measure students' skills at analyzing, synthesizing, constructing, or evaluating information because they offer students greater latitude in how to organize and present their thoughts.

Performance assessments are another type of constructed-response item. With this format, students are expected to perform an activity or set of activities. They can be asked to perform a process, such as delivering a public speech, or produce a product, such as a science notebook or work of art. Many performance assessments, but not all, attempt to represent real-life contexts or applications and are therefore considered authentic assessments. Because students perform activities during these assessment tasks, performance assessments can be integrated well with regular instructional activities.

Scoring. Constructed-response items must be scored by a judge, using either a norm- or criterion-referenced scoring procedure. In norm referencing, the teacher compares the quality of a student's response to a reference group, which might include the other students currently in the class or to prior students the teacher has taught. The teacher then assigns a score to the student's response based on how the response ranks or where it falls in the distribution of responses in the reference group. Criterion-reference scoring involves basing a student's score on the degree to which the student has demonstrated the attainment of specified knowledge or skills. Academic standards stipulate what students should know and be able to do, and performance standards specify the degree to which they have mastered the academic expectations.

The criteria or expectations often are defined in a scoring rubric, which provide descriptions of responses on a scale. Teachers can use either holistic or analytic scoring

rubrics to render criterion-referenced scores. An analytic rubric allows the teacher to score the constructed response on separate and multiple dimensions, such as organization, accuracy, and voice. For holistic scoring, the teacher produces one overall score. A holistic rubric could be based on multiple dimensions, but the teacher considers all of the dimensions simultaneously to yield the score. Analytic rubrics are more useful if the goal is to provide more extensive and deeper feedback to the student, because the student gets separate scores on multiple dimensions. Holistic scoring takes less time, typically, because only one score per response is made. It works, however, only when there is a high relationship among the dimensions for the responses. For example, if students who are high on organization also tend to be high on accuracy and voice, then holistic scoring can work effectively. If the dimensions are not correlated well (e.g., responses can be high on voice but low on accuracy), analytic scoring is more suitable.

Advantages and Limitations of Test Formats. There are advantages and limitations with each item format, and teachers should choose the format that best suits the purposes for assessment. If teachers have less time to score the assessments, selected-response questions are advantageous because they can be scored faster than constructed-response items. Selected-response items also are superior to constructed-response items if the goal is to measure basic levels of Bloom's Taxonomy, such as knowledge or comprehension. Students can respond more quickly to selected-response items, allowing the teacher to assess a broader range of objectives across a given timeframe. Selected-response items also are considered more objective than constructed-response questions because the latter items require teachers to score the responses, introducing rater error to the scores. Because reliability is increased by having more items with less error, selected-response items tend to yield more consistent scores relative to constructed-response items.

But given that selected-response items present both correct and incorrect options to students, those items are more prone to guessing than constructed-response items. The probability that students can guess correctly depends on the number of distracters for each question, the test-taking skills of the student, and the quality of the distracters. Constructed-response items also take less time to create, so if teachers have little time to construct an exam, they should consider including more of those items on the test. Crafting reasonable and high-quality distracters and selected-response items that are not prone to guessing is an arduous and time-consuming process. Also, because students must supply an answer for constructed-response items, the format is more suited for measuring more advanced levels of Bloom's Taxonomy in a direct manner. For example, if students are to demonstrate their evaluation skills or show

that they can apply their knowledge in a novel situation, teachers must rely on constructed-response questions. Students would only be able to demonstrate that they can identify a proper application or accurate evaluation with selected-response items. Constructed-response items test the recall of information and actual demonstration of advanced skills, whereas selected-response items focus on mental recognition and serve, at best, as indirect indicators of advanced intellectual skills.

Report Card Grades. Teachers typically must assign grades indicating student performance based on assessment information. Often the types of grades to be assigned on report cards are determined by the district office. Many districts rely on letter grades, which require the teacher to report student performance in ordinal categories (e.g., A-E), while other districts use percentage grades (0-100), pass-fail marks, checklists, or narratives. It is not uncommon for report cards to consist of multiple grading methods (Guskey & Bailey, 2000). A relatively new form of grading is standards-based reporting. With this method, teachers report student performance on state or district academic standards using performance levels such as “Falls Below Expectations,” “Approaches Expectations,” “Meets Expectations,” and “Exceeds Expectations.” Many districts have moved to this newer method to encourage teachers to focus on academic standards and to provide students and parents with an alternative report on students’ performance on the standards besides state achievement tests.

Though districts often determine the grading method, teachers usually have considerable freedom in deciding on how they will transform student performance into grades. Teachers can employ either norm-referenced or criterion-referenced scoring procedures. Norm-referenced methods first require teachers to rank students from the highest to lowest performers. Curving is perhaps the most conventional normative method. After ranking students, teachers set thresholds between performance levels based on percentages that roughly follow the normal (i.e., bell-shaped) distribution. For example, the top 10 to 15 percent of students would be assigned A’s, the next 20-30 percent of students would be assigned B’s and so on. Teachers can modify curving by changing the proportions of students who receive various grades. Percentage scores can be administered based on norm referencing, that is, by assigning students percentage scores based on their percentile standing in the class distribution.

Many teachers have moved away from norm-reference grading because it encourages competition for a limited number of desirable grades and because it provides limited information regarding what students actually have learned. Most grading in classrooms in the early 2000s is based on criterion-reference scoring. The

point system probably is the most prevalent grading procedure used by teachers. This method involves assigning maximum possible points for each assignment or exam that comprises the final grade, allocating points for each of the assignments or exams for students based on their performance, and then tallying the total number of earned points for each student. If letter grades are used for reporting, teachers can assign A’s to those students with 90 percent or greater of earned points, B’s to students who earned between 80 and 90 percent of the points, and so on. Percentage grades also can be assigned by reporting the percent of total earned points per student. Other criterion-referenced methods can be used by teachers to produce standards-based grades (Ainsworth & Viegut, 2006).

CLASSROOM ASSESSMENT COMPARED TO EXTERNAL STANDARDIZED TESTING

Teacher classroom assessment commonly is compared to external achievement tests to articulate its strengths and weaknesses. Such comparisons, however, are misguided because the two types of assessment serve quite different purposes. Being standardized assessments, external achievement tests serve to compare the achievement levels of students across many schools, districts, states, or countries at discrete points in time (usually fall and spring) on broad knowledge and skills. Although these tests can serve a formative role, they typically are used for summative purposes. Classroom assessments usually are developed to reflect if students developed the knowledge and skills taught in a given classroom and, thus, are more focused on the specific curriculum and instruction delivered by the teacher. Assessment in the classroom also is an ongoing and continuous process, so its strength is the provision of formative information about student learning and teacher instruction.

Items on external achievement tests are subjected to extensive development and review processes. Items are carefully examined for content accuracy and lack of bias and other test flaws. Often external test items are field tested and statistically analyzed before they can be used operationally on test forms. Developers of external tests also expend considerable effort to systematize the scoring of constructed response items. Often they employ multiple judges who have received extensive training to calibrate their stringency levels and increase their reliability.

Teachers commonly develop their own items or use items provided in teachers’ manuals that accompany textbooks. Items found on most classroom assessments, thus, have not been constructed with the same level of quality control compared to external tests. Further, teachers usually score constructed responses by themselves without applying preliminary procedures to reduce scorer error. Not only are

external achievement tests developed with more deliberation, they typically contain more items than classroom final exams, quizzes, or graded assignments. For these reasons, scores from classroom assessments tend to be much less reliable than scores from external tests.

Besides yielding less reliable scores relative to external tests, scores across teachers often are not comparable. Teachers in the same school and teaching the same grade can administer tests that differ considerably in terms of item difficulty, cognitive demand, and scoring methods. Thus, students with the same levels of achievement can earn different grades in different classrooms. This situation would be unlikely if the students took the same standardized achievement test. Indeed, the lack of comparability across high school grades led to the development of standardized college admissions tests.

There are advantages, however, of assessments that are unique to classroom curriculum, instruction, and teacher expectations. Because most teacher tests are tailored to what students learned in the classroom, they usually provide teachers with richer information about student learning within the context of students' classroom experiences. This more targeted information can be used more effectively by the teacher to modify instruction to actual student needs. Teacher tests, therefore, likely produce more valid scores of the degree to which students attained the instructional objectives generated by the teacher.

Frequency of Testing. Though external tests contain more items than classroom assessments, the teacher has the opportunity to administer more items representing a far greater array of item formats during the school year. External tests typically are administered once or twice at most in a given year, and they usually contain one to three item formats. If teachers assess frequently and use an array of formats, they can collect a body of student information that has four major advantages.

First, frequent assessment allows the teacher to track student growth and to detect areas in need of more or different instruction. Second, assessing often yields learning information that teachers can use to give constructive feedback to students. Timely feedback focused on what students have mastered and where they need to improve has been linked to greater learning gains (Black & William, 1998). Third, if teachers base final grades on frequent small assessments containing items representing various formats, the final grades likely would be as or more reliable than external achievement tests, given teachers' opportunity to gather more information regarding student attainment than a single test administration. Finally, besides increasing reliability, this assessment approach yields more valid scores. As Campbell and Fiske (1959) noted, validity is delimited by relying on a sole item format or test method because scores are

influenced to some degree by those factors. By using various methods, including different item formats and paper-pencil as well as oral testing and observation, teachers can generate information about each student's learning that transcends the method type.

Ultimately, it is the prerogative of the teacher to maximize the strengths and limit the weaknesses of classroom assessments. Teachers must make a concerted effort to integrate testing into their teaching plans and practices. Research indicates that teachers who prioritize assessment and use test results to improve their instruction tend to be more effective instructors (Black & William, 1998). Unfortunately teachers vary greatly in the degree to which they value assessment. Some teachers are opposed to testing, while others assess in a haphazard manner. Still others use the same, favorite item format for all assessments, consequently limiting the validity of students' scores. By contrast, those teachers who systematize assessment and rely on it to guide their practice likely produce the highest quality of information available on student learning.

SEE ALSO *Criterion-Referenced Tests; Reliability; Validity.*

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Jerome V. D'Agostino

CLASSROOM ENVIRONMENT

Classroom environment encompasses a broad range of educational concepts, including the physical setting, the psychological environment created through social contexts, and

numerous instructional components related to teacher characteristics and behaviors. The study classroom environment has been widespread across nearly all subspecializations of educational psychology. Researchers are interested in relationships between environment constructs and multiple outcomes, including learning, engagement, motivation, social relationships, and group dynamics. Early researchers recognized that behavior is a function of people's personal characteristics and their environment.

In the educational setting, Urie Bronfenbrenner's work on ecological contexts secured a place in educational research for studies of classroom environment. Bronfenbrenner's *Ecological Systems Theory* (Bronfenbrenner, 1977) encompasses the layered environmental system of microcosms in which human development takes place and emphasizes the importance of family, teachers, schools, and the larger sociocultural environment on the developmental process. Over the years this research has evolved from examining purely physical elements of the environment to more complex models of psychosocial relationships between students in the classrooms as well as between the teacher and students.

Research beginning in the mid-1990s has focused on one or more of these aspects and has associated classroom environment variables with numerous positive and negative student outcomes. In addition to the wide array of outcomes investigated in relationship to classroom environment, this area of study has also been of interest to methodologists as the data structure poses a unit of analysis dilemma; in terms of examining classroom variables in combination with student outcomes, researchers have had to determine if the data would be analyzed at the classroom level or at the student level. With the arrival in the 1990s of statistical methodologies capable of handling data collected from both levels, studies have been better able to include variables collected at both levels. Various methodologies, including survey, observations, and interviews have been used to capture aspects of the classroom environment from student, teacher, and observer perspectives. The Early Childhood group based at the University of Virginia has an extensive body of work that examines classroom environment as a validated observation system of multiple dimensions of the classroom.

THE PHYSICAL ENVIRONMENT

More frequently a focus in earlier studies of classroom environment, the physical environment has continued to appear in contemporary studies as an influence on behavioral and academic outcomes. Current studies of the physical environment have investigated aspects such as class composition, class size, and classroom management.

Class composition studies examine classroom grouping methods, including ability grouping of students, single-

sex classrooms and cooperative learning groups. Research has found that classrooms with highly cooperative groups appear to have students with more positive perceptions of fairness in grading, stronger class cohesion, and higher degree of social support, as well as higher achievement scores. Female students have been found to prefer collaborating with other students when studying and resolving problems, and they have a stronger preference for teacher support than male students. The primary school environments tend to use collaborative strategies more frequently and have higher levels of teacher involvement and support than is found in secondary schools. Research on single-sex classrooms has been more divided in terms of academic outcome research. Some studies found that girls do better in math and science particularly when separated from male students; other studies found no achievement differences between genders when either in single-sex or mixed-sex classrooms.

Studies about class size have examined how class size influences student and teacher behaviors. In general, smaller classes are associated with students who are less stressed and are more frequently on-task with fewer reported behavior problems than students in larger classes. Although teachers tend to use similar instructional strategies whether teaching large or small classes, there is some evidence to suggest that more class time is spent on administrative tasks for larger classes, leaving less time available for instruction. Some research has suggested that differences in academic outcomes based on class size are due to differences in student behaviors.

Overcrowded facilities, too many students in certain classes, and lack of teachers' assistants are three major issues cited as potentially creating problems due to increased stress levels of students and increased teacher-reported incidences of behavioral problems. These increased stress levels and behavior problems found in larger classrooms are frequently accompanied by lower levels of academic achievement.

Teacher-to-child ratios are also of interest to many researchers because the number of reported behavioral problems seem to increase as class size increases. Many researchers have observed that large classes, with 30 or more students, tend to have a larger number of students off task more often with fewer students engaged with the teacher than children in small classes of 20 students or less. Yet there may be a social cost for students in small classes; other researchers found that smaller classes also had high incidences of children engaging in asocial and exclusionary behavior. Whether students are engaging in on-task or disruptive behavior can also be influenced by effective classroom management instructions and consistency of teacher enforcement.

The timing of classroom management and organization also impacts students' perceptions of the teacher as an

CLASSROOM CLIMATE

Part of the larger focus on school improvement is School Climate or Educational Climate, which defines how teachers interact with each other and with administrators. This is different from Classroom Climate, which identifies relationships among students with each other, the teacher and how this translates into learning.

There are a number of tools available to determine Classroom Climate and then to use the results as part of the comprehensive plan for school improvement. Even the most sophisticated measurement tools rely heavily on opinion and perception. Opinion is generated from information, statistics on student and teacher performance, while perception is based on observation of the behaviors in the classroom and the school.

In determining Classroom Climate, it is important to apply information gathered from both opinion and perception to form a comprehensive picture of student success and to therefore create a meaningful school improvement plan.

Opinion is generated by reviewing student test scores, grades earned, attendance, health and family. Perception is formed by observation and by paper and pencil tools that evaluate Classroom Climate based on organization of the classroom, the attitude toward student achievement, the attitudes toward school, the attitudes toward peers, the degree of democracy experienced in the classroom, the acceptance of diversity, the range of learning experiences, the autonomy of the teacher, the competitiveness among students, the consistency of interpretation of rule infractions and their consequences.

Elizabeth Soby

effective manager. When students have been asked to describe effective classroom managers, researchers report that these are teachers who set clear expectations and consequences early in the year. They also describe teachers who consistently (and predictably) follow through with consequences, as opposed to merely threatening consequences. These characteristics appear essential in establishing good classroom environment in terms of social support and mutual respect. Additionally, the amount of time a teacher

spends in teaching organizational behaviors impacts the classroom environment. Researchers have found that students in classrooms that spent more time early in the school year on organizational instruction substantially increased the amount of time students spent in student-managed activities later in the academic year. Intentionally providing organizational instruction at the start of the academic year is a characteristic of an effective classroom environment manager.

THE PSYCHOLOGICAL ENVIRONMENT

Beyond the physical arrangement of a classroom a psychological environment is also created, based on the interaction of key players in the classroom, namely students and teachers. Research in this area has varied greatly and proliferated during the early twenty-first century. Studies have been particularly concentrated on student class participation rates, teacher support, and communication of learning goals.

Many teachers equate student engagement and on-task behavior with classroom participation, typically a top concern for teachers. Researchers support teachers' intuition of a difference in the participation style of the different genders. Whereas girls are more likely to participate as part of the relational responsibility they feel toward the teacher, boys tend to respond more often if they feel the class is interesting and less often if the class is perceived as boring indicating that for these students, teachers may be equally responsible for the participation level and learning. Most studies have found that boys speak out in class about three times as frequently as girls do; however, both genders typically perceive girls as better class participants. Although responses vary when students are asked what participation consists of, the most common response, and one frequently examined by researchers, is that participation is defined as answering questions when specifically asked. Both boys and girls seem to indicate a need for relational aspects to be present in order for this type of participation to occur; however, whereas girls more frequently participate by responding to teachers' questions, boys are more likely to participate as a means of obtaining attention or being noticed by the teacher. Teachers who want to encourage development of relational aspects for both genders may need to utilize different acknowledgment techniques for male students to enhance their perceptions of feeling supported as a class participant.

The notion of feeling supported as students has also been extensively examined in the classroom environment literature. Helen Patrick and colleagues (Patrick, Ryan, & Kaplan, 2007) found that there is a strong, positive relationship between students' level of motivation and engagement and their perceptions of the classroom environment as being socially supportive. The perception of a climate of mutual respect is required in order for students to increase their use of effective study strategies and

increase feelings of confidence about their ability to successfully complete assignments. Furthermore, when students perceive that they receive emotional support and encouragement from their teachers and academic support from their peers they are more likely to be on-task in the classroom and use self-regulated strategies.

Another large body of educational research has focused on the communication of learning goals to students in combination with the individual goals and expectations of students. Some students and classrooms are more focused on obtaining grades than on mastery of objectives; these students and classrooms are said to be performance oriented rather than mastery oriented. A multitude of studies have examined this social-cognitive aspect of classrooms and found that the classroom-level learning goal can be linked to both behavioral and academic outcomes. Students in classrooms where performance is emphasized are more likely to engage in cheating, avoid help-seeking, and exhibit lower levels of academic engagement. In contrast, students who are in a classroom where the focus is on learning and improvement demonstrate higher levels of self-efficacy and engagement as well as more positive affect. At the personal goal level researchers have found that whereas students who are more focused on grades tend to have higher grades, those students who are more focused on mastering objectives tend to engage in more academically challenging tasks and retain information learned for a longer period of time.

THE ROLE OF THE TEACHER IN THE CLASSROOM ENVIRONMENT

The third focus of many examinations of classroom environment has been on teacher behaviors, specifically teacher development and school culture and how these components affect classroom environment. Some research suggests that due to the complexity of cultivating an effective classroom environment, it may be beyond the developmental scope of the newly graduated teacher. Some researchers recommend that professional development for new teachers should include intense mentoring and teaching partnerships that reduce isolation and form productive and meaningful relationships with other adults in the school community.

Following the research studies on physical and psychological environment many suggestions for teachers have been presented in the literature, including classroom management plans and recommendations for building better relationships with students. Classroom rules and procedures should be introduced early in the school year and consequences should be enforced consistently across students and throughout the school year. Research has shown that routine and fairness have a positive impact on behavior as well as academic quality. It has been found that teachers who run respectful classrooms are in turn more respected by their students, and students believe that these teachers also hold higher learning expectations. Teachers are encouraged to focus more on the learning

task than on the outcome or grade assigned at the end of the task, although this becomes much more difficult if the emphasis in education is placed on accountability and high-stakes testing.

Although most classroom environment studies are by definition limited to classrooms, a few studies have investigated the impact of the school culture on classroom environment. Findings suggest that schools with an authoritative culture (e.g., clear direction, delegation of responsibilities, accountability to and from all) tend to be judged by students and teachers as being successful. Schools that lack leadership or have a culture of multiple micro-conflicts tend to be perceived by students and teachers as undermining educational gains.

MEASURING CLASSROOM ENVIRONMENT

In studies of classroom environment a plethora of measurement tools have been employed, including direct, objective observational measures as well as more subjective perceptions of the classroom environment. The types of items that have been used range from low inference (e.g., frequency counts of behavior) to high inference (e.g., classroom members' perceptions about meaning of behaviors). There has been a heavy reliance on perceptual measures in much of the literature, supported by the argument that observational measures tend to be low-inference based and are of a limited time period, whereas perception measures better capture high-inference constructs, and therefore better represent day to day experience in the environment. Moreover, advances in statistical analyses have allowed for better incorporation of multiple student observations in one classroom to be aggregated as a measure of classroom environment. In contrast, an objective observation tool is limited to a single opinion or an agreement statistics between two or three independent observers.

Some of the most extensive work on measuring classroom environment was completed in the 1970s by Rudolf Moos, resulting in the widely used Classroom Environment Scale (Moos, 1979). Moos's work, which has permeated the literature on classroom environment, is based on three essential areas of classroom environment: (1) Relationship dimension, which focuses on the interpersonal relationships between students and students and the teacher in a classroom; (2) Personal Development dimension, which centers on individual characteristics of the classroom member; and (3) System Maintenance and Change dimension which includes attributes such as classroom control and order as well as responsiveness to change. As delineated above, much of the research on classroom environment has also been attuned to these three dimensions or combinations thereof.

The mid-1990s was marked by a shift to more high-inference measures such as the What Is Happening In this Class (WIHIC) Questionnaire developed by Barry Fraser and colleagues (Fraser, 2002). This scale focuses entirely on student perceptions of a wide range of dimensions of the

classroom, including student cohesiveness, teacher support, involvement, investigation, task orientation, cooperation, and equity. Each of the dimensions in the WIHIC can be mapped to three major dimensions of Moos's schema.

While these two measures continue to appear in the research literature, there are many other ways to measure classroom environment. As theories of learning continue to evolve the need to create and validate more measures of classroom environment continues to grow. Just as it is difficult to provide a concise definition of what classroom environment is, it is also difficult to define a measure of the construct, resulting in a multitude of varieties and variations in the literature.

IMPLICATIONS AND CONSIDERATIONS

Classroom environment is a broad term and the research in this area is far reaching and defined in many different ways according to theory as well as practice. Regardless of the definition, there are many important findings from the research as a whole that can impact students' learning and behavior. This is also an area of continued growth in research as changes in technology and social culture alter the dynamics of what is considered classroom environment.

One of these areas to consider is the environment beyond the classroom. There has been debate on the impact of school-wide environment on classroom environment. With an increased importance placed on school-wide performance in order to demonstrate school success in terms of annual academic progress of students, there is undoubtedly pressure on teachers to produce high scores on standardized state exams. This school-wide demand filters to the classroom and is communicated in various ways to students, directly impacting their experiences in the classroom. There is ongoing research to examine the implications of the high-stakes testing for the psychosocial dimension of the classroom as well as how this approach has influenced instructional strategies used by teachers in classrooms.

Furthermore, the definition of classroom environment continues to evolve with the development of online courses and increased use of technology in learning situations. Classrooms are now networked, expanding the environment beyond physical walls, enabling students to interact via email, video conferencing, and blogs. The addition of technology to the classroom has changed the environment, and research is only beginning to consider these new aspects and their impacts on classroom outcomes.

Information gained from ongoing studies of classroom environment continues to impact teachers' knowledge. Learning about factors that may shape students' perceptions of their learning environment, how teachers' actions appear to students, and how changes made to the

learning environment may stimulate and encourage learning continue to be of the utmost importance to classroom teachers.

SEE ALSO *School Belonging*.

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Kathryn Cunningham*

CLASSROOM MANAGEMENT

This entry contains the following:

- I. OVERVIEW
Valerie A. Evans, Nina C. Wilde, Saul Axelrod
- II. ASSERTIVE DISCIPLINE
Rosetta F. Sandidge
- III. PUNISHMENT
T. Steuart Watson, Tonya S. Watson, Sarah Gebhardt
- IV. RULES AND PROCEDURES
Robert F. Putnam, Marcie W. Handler
- V. TOKEN ECONOMIES
Tonya N. Davis, Mark O'Reilly, Giulio Lancioni, Jeff Sigafos, Wendy Machalicek
- VI. WITHITNESS
Edmund T. Emmer

OVERVIEW

Teacher enthusiasm, organization, and technical skill of instruction are almost all of the characteristics of an effective classroom leader. Almost. It is sophistication regarding classroom management that makes educated and enthusiastic teachers Classroom management encompasses all the components that impact upon the smooth delivery of education to students. These components include teacher behavior, student behavior, and the classroom's physical features. This entry reviews the most common factors that

Examples of simple data collection forms																																			
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Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

may provoke problem behaviors for individual students or for an entire class, describes methods for determining why the problems are occurring, and suggests how to intervene effectively.

CHOOSING AND DEFINING BEHAVIORS TO MODIFY

Assessment and treatment of student behavior is time-consuming. Before a behavior is deemed a target for change, the teacher must first determine whether it is worth the time and effort to collect data, analyze function, and implement a treatment plan. If the behavior is a threat to the safety of the students, it should be addressed promptly. Examples of dangerous behavior are bullying, throwing furniture, running around the classroom, and engaging objects in a dangerous manner.

The impact of the behavior on the learning environment as a whole is another important consideration when deciding if a behavior is worth the time it takes to intervene. If the behavior is disruptive to the entire class (e.g., call-outs) or is incompatible with student participation (e.g., note-passing), then it warrants attention on the basis that the behavior is preventing the classroom from achieving its educational objectives. Once a behavior is chosen as a target for analysis and intervention, it must first be defined in specific and observable terms. The definition must be technical enough so that anyone may walk into the classroom, read the definition, and recognize whether the behavior of concern is occurring. Disruptive behavior, for example, is a broad behavior category in which many behaviors may be included. Out-of-seat behavior is much more specific and is very simple to define and measure. Specific definitions also make it easier for the student to understand, which should prove to be helpful during the intervention stage. Finally, it is important that the teacher prioritize treatment. Rather than feel overwhelmed by the immediate desire to have a classroom of orderly students,

the teacher should focus on one problem at a time and set realistic expectations.

DATA COLLECTION AND ANALYSIS

Teachers have many tasks to attend to each day. So they might wonder about the worth of adding another task, such as collection of data. Whether a teacher has chosen to work on an individual student's behavior or to work on class-wide performance, tracking progress allows the teacher to make informed decisions regarding whether intervention is necessary, and if so, if the intervention is resulting in desired outcomes. When a teacher identifies a target behavior to change, the teacher should begin with an initial assessment of behavior rates. This type of data is referred to as baseline. Before baseline data may be collected, the teacher must first choose which method of data collection is appropriate, given the nature of the behavior. There are measurement techniques that track the frequency, duration, rate, and latency of behavior (see Figure 1). The chosen data collection method should be both appropriate for the nature of the behavior and practical for the teacher to use.

During the baseline phase, another type of data should be gathered to further assess the variables correlated with the target behavior. These variables may be time of day, type of activities, and availability of certain preferred items (see Figure 2). Analysis of these data will provide the teacher with naturally occurring patterns that may indicate consistent precursors of behavior. For example, if students are reliably aggressive mid-morning, it may be due to hunger, the difficult math lesson that is presented at 10:00 each day, or agitation from being seated all morning. The effectiveness of intervention is highly correlated with the teacher's ability to critically analyze behavior trends with the data that were collected.

CONSEQUENCES OF STUDENT BEHAVIOR

In order to effectively treat students' behavior, the teacher must first understand it from the students' perspective. The

Sample of a data form that may be used to assess function

The example shows a pattern of all three episodes of behavior motivated by attention in the form of verbal interactions with the teacher and laughter from peers, as well as a possible concurrent motivation of escape from work tasks.

Antecedent (What was happening before the problem behavior?)	Behavior observed	Consequence (What happened after the problem behavior?)
Silent reading	Steven threw a book on the floor.	I asked him to pick the book up. Two other students laughed.
I asked the class to get out their homework.	Steven stood up and walked out of class.	I followed him into the hall and talked to him until he came back to class.
The class was walking in the hall to the lunchroom.	Steven began singing loudly.	I asked him to be quiet. Many students were laughing.

Figure 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

teacher must always remember that the behavior of concern is adaptive and useful; otherwise, the students would not engage in it. Students engage in a particular behavior because it provides them with some valuable reinforcer. The reinforcer is any consequence that increases the probability or rate of the response in the future (Skinner, 1938). A consequence is anything that follows a behavior.

Consequences may be pleasant, unpleasant, or neutral. When the outcome of a behavior is something desirable, individuals are likely to engage in the behavior again. The pay-off, or reinforcer, for engaging in the behavior may not be readily apparent to others, but that does not mean it does not exist. "He just does it to annoy me" is a popular attitude of exasperated teachers, which is sometimes, but not always true. Concluding that "This is just a rambunctious group of students who cannot be controlled" will make any teacher feel better about not being effective but will do nothing to improve the situation for either teacher or students.

In order to improve the situation, the analysis of antecedents (events that occur before a behavior) and consequences of behavior will reveal the factors maintaining the undesired behavior and lead the educator toward effective intervention strategies. Understanding why students engage in the problem behavior (the function of the behavior) will indicate treatment options. For example, if disruptive students continually interrupt the lesson, it is likely that they are being disruptive to access attention from the teacher and peers. So in this case, the function is attention. An effective treatment will use attention as the reinforcer, as that is what motivates the students' behavior.

Understanding what motivates behavior is also useful in preventing accidental reinforcement of that behavior. For example, if students act up at school because they do not like attending school and the consequence is they are suspended for three days, the acting-out behavior was likely reinforced. It is very likely that these individuals will engage in the same

undesirable behaviors in the future because it was those behaviors that gave them access to the desired consequence. In this case, if the school administrators referred to the suspension as a punisher, they would be mistaken.

Punishment is any consequence of behavior that decreases, rather than increases, the likelihood a behavior will occur again (Skinner, 1938). Both reinforcement and punishment are highly individualized per student and behavior. In the case of a student who acts out for peer and teacher attention, if the teacher were to give this student stage time at the end of the day for appropriate behavior, this would likely be an effective reinforcer. However, if stage time were given to a shy student, it would most likely act as a punishing consequence. These examples highlight why accurate assessment of the variables that maintain behavior are necessary before effective treatment may be designed and implemented.

OTHER CONSIDERATIONS

Some classroom problems may be influenced by physical characteristics of the environment or by the established teaching patterns and class schedule. According to Smith, Neisworth, and Greer (1978), a number of factors should be considered when arranging the instructional environment. These include several elements of physical design and organization, such as lighting, temperature, noise, visual distractions, colors, furniture, displays, and shelving. The seating arrangements, desks, and work and play areas should be designed so that the teacher is able to observe all the students in the room. This organization will allow the teacher to determine which students might need assistance, as well as what types of social interactions are occurring (Stainback, Stainback, & Froyen, 1987). A well-managed classroom also has a schedule and established classroom rules. These rules should be clearly stated and be visually accessible to the students throughout their school day. In addition, teachers should discuss with the students the consequences for both

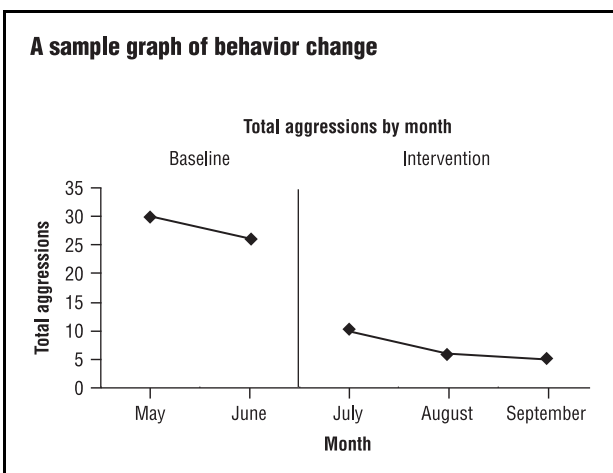


Figure 3 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

rule following and rule breaking. The majority of teacher-student interactions should involve positive reinforcement of appropriate behavior. The teacher should move about the room, rather than remain seated at the desk. Doing so allows the teacher to deliver immediate prompts and reinforcers for appropriate behaviors. When students are actively engaged in instruction, they are less likely to exhibit problematic behaviors.

Classroom schedules are another important consideration. Difficult or repetitive academic tasks should alternate with activities that are naturally reinforcing to the students. Minor classroom management problems might be addressed by making alterations in these areas, although it is important to note that these changes alone may not be sufficient to establish classroom order. Persistent issues with poor instructional control in the classroom will likely require some degree of more direct assessment of student and teacher performance and intervention by the teacher.

PROTOCOL DEVELOPMENT

The most effective protocols directly address the function of the target behavior. Just as the students learned to achieve their goals with an inappropriate behavior, they now learn how to achieve their goals with a socially acceptable behavior. The new socially acceptable way of achieving reinforcement is defined as an equivalent response; it serves the same function as the inappropriate behavior (Carr, McConnachie, Levin, & Kemp, 1993) but is an appropriate behavior. Simultaneously, the way in which teachers respond to the undesirable behavior may also need to change. The treatment plan is, simply, a protocol for changing the behavior patterns of both teacher and stu-

dents. If the plan is a success, the teacher will learn to reinforce appropriate student behavior and withhold reinforcement when undesirable behaviors occur.

The students will, in turn, learn to respond differently, based on the teacher's allocation of reinforcement. For example, if certain students shout out during class to gain the teacher's attention, the teacher will need to identify an equivalent response for gaining teacher attention. Hence, if the teacher instructs the students to raise their hands when they want attention, the teacher will need to provide more immediate and higher quality reinforcement for hand-raises than for call-outs. The students will quickly learn that hand raising is the most efficient way to receive attention from the teacher and will use hand raising in place of the call-outs. When a teacher chooses an appropriate equivalent response for a student, the new behavior must be at least as easy to perform for the student as the undesirable behavior. Hand raising is an appropriate equivalent response for call-outs. Writing a note to the teacher in place of call-outs would not be an appropriate equivalent response since writing notes is much more laborious than calling out. In the beginning of teaching equivalent responses, it is important that the teacher reinforce every appropriate response. As the student learns to raise his hand, the rate of reinforcement may be gradually thinned and the delivery of reinforcement can become less frequent and less immediate. Any effective intervention requires an investment of time and effort in the beginning stages, but soon pays off when the classroom comes under control.

MONITORING CHANGE

The data collection process should continue throughout intervention in order to monitor progress and to make informed decisions regarding intervention efforts. It is important to collect data and to display it in a graph that will allow the teacher to easily see progress or the lack of it. A visual display of data permits the teacher to see changes in behavior that may not have been expected or may not have otherwise been noticed. Graphing of data helps the teacher avoid over or underestimating behavior change. The simplest method of graphing is to draw a line graph by hand. The quantity of behavior(s) should be placed on the y-axis (ordinate), and time, such as days or weeks on the x-axis (abscissa) (Figure 3). It is important to depict baseline and intervention data on the same graph. A vertical line should be inserted between all changes in condition. This arrangement allows the teacher to quickly scan graphs for treatment effects. Once the baseline and intervention data are graphed, the teacher may observe the effects of intervention. If the behaviors fail to respond to teacher interventions, it may be necessary to obtain assistance from a qualified behavior analyst.

Classroom management is an ongoing process that requires continual monitoring and adjustment. Knowledge of reinforcement and keen analytic skills are the most important tools for effectively managing a classroom. Many classroom problems may be prevented with careful attention to physical design and scheduling. When problems arise, analysis of the sequence of events leading up to and immediately following the behavior of concern will indicate strategies for effective treatment. Successful interventions are carefully planned and based upon the function of target behaviors. The time spent improving one's classroom management is an important investment toward a pleasant and productive working and learning environment for teachers and learners.

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ASSERTIVE DISCIPLINE

Assertive discipline is a structured, teacher-centered system designed to help educators manage student behavior in the classroom. Armed with the belief that teachers were

ill prepared to address behavioral problems in their classrooms, Lee and Marlene Canter proposed a new discipline model in their 1976 book, *Assertive Discipline: A Take-Charge Approach for Today's Educators*. A straightforward model that was easy to understand and implement, assertive discipline gained rapid acceptance among teachers throughout the United States. The widespread popularity of the model became more evident with the growth of Canter and Associates, a firm designed to market books and resources on assertive discipline and provide assertive discipline training for school districts and educators across the country. It is estimated that well over 1 million teachers have received training in this packaged behavior management system since its inception in 1976 (Canter & Canter, 2002).

Over the years, the Canthers published additional books that focused on assertive discipline for parents (1982) and assertive discipline strategies for difficult or challenging students (1993). The system was modified slightly over time as the Canthers further developed aspects of the model. Perhaps the most notable change came with the publication of the third edition of *Assertive Discipline: Positive Behavior Management for Today's Classrooms* (2002), which stressed the importance of teachers building a caring and trusting relationship with students in addition to providing the classroom structure that was advocated in earlier works.

The overall premise of assertive discipline is that teachers must act assertively to ensure that their rights as teachers are met. The Canthers believed that, traditionally, teachers had focused on student needs, in keeping with earlier theories espoused by Thomas Gordon (1918-2002), Sigmund Freud (1856-1939), Rudolph Dreikurs (1897-1972), and William Glasser (1925-), and ignored their own needs in the classroom (Canter & Canter, 1976, 1992). According to the Canthers, teachers have the right to establish a classroom environment that facilitates student learning, determine expectations for student behavior in the classroom, expect student compliance with these expectations, and seek the support of parents and school administrators in implementing this system. Similarly, students have the right to have teachers who set boundaries for student conduct, provide support for appropriate behavior, and identify and enforce consequences for inappropriate behavior.

The Canthers posit that teachers respond to student behaviors in an assertive, nonassertive, or hostile manner (Canter & Canter, 1992). To ensure that teacher and student needs are addressed, teachers must learn to respond assertively in the classroom. Assertive teachers clearly communicate their expectations to students and quickly administer positive recognition for appropriate student actions and consequences for inappropriate

behaviors. Nonassertive teachers fail to specify to their students the behaviors they will or will not accept, threaten students with punishment for inappropriate behavior but do not follow through with their threats, and often ignore inappropriate behaviors altogether. Hostile teachers address students in an abusive manner, making sarcastic, demeaning, or mean-spirited comments that create feelings of embarrassment, fear, intimidation, and anger among their students.

PROCEDURES IN ASSERTIVE DISCIPLINE

Central to the assertive discipline model is a classroom discipline plan that is created by the teacher and implemented at the beginning of the school year or academic term. The plan includes three major components: a set of classroom rules, types of positive recognition for students who obey the rules, and a hierarchy of consequences for students who disobey the rules.

The Canters (1992) provide specific guidelines regarding the establishment of the classroom rules, the first component of the discipline plan. They recommend that teachers develop a limited number of rules, with five as a guideline, to allow students to easily learn and remember these expectations. These rules should focus on observable student behaviors and should apply at all times in the classroom. The rules should deal with behavior only and not address academic issues, such as homework.

The second component of the discipline plan includes identification of strategies for recognizing students who abide by the rules. The Canters (1992) believe that positive recognition of students who obey the rules encourages appropriate behavior, increases self-esteem, creates a positive learning environment, and establishes positive relationships within the classroom. Examples of positive recognition include praise, positive phone calls or notes sent home to parents or guardians, tangible rewards, and special privileges. In addition to individual student recognition, the Canters suggest that teachers also consider a classroom recognition system, which allows students to earn class-wide rewards for their on-task behaviors. When a predetermined number of points are earned by students in the class, the class is rewarded with a special party or event.

The third component of the discipline plan involves the development of a hierarchy of consequences that is administered to students who disobey the rules. The hierarchy includes approximately five consequences, with the first consequence a warning followed by additional consequences, which increase in severity. The more severe consequences involve referral to parents or guardians and school administrators. The hierarchy also identifies a severe clause specifying that students who commit

serious infractions be referred immediately to the school principal. The Canters (1992) recommend that teachers select age-appropriate consequences that students do not enjoy. Teachers should have a system in place to easily track the level of consequence for each student and administer the consequences calmly and quickly. To ensure that students learn from their previous mistakes and to motivate them to stay on task, each day the teacher begins administering the consequences at the lowest level of the hierarchy to give students a fresh start.

To ensure that students are familiar with the plan, the Canters (1992) recommend that teachers teach the plan to students by using the following procedures: explain why rules are needed, teach the rules, explain how positive recognition will be used, explain why consequences are needed, begin immediately reinforcing students who follow the rules, and review rules frequently. The plan should be posted in a prominent location in the classroom, and copies of the plan should be shared with school administrators and distributed to parents and guardians at the beginning of the school year or academic term.

EFFECTIVENESS OF ASSERTIVE DISCIPLINE

Both advocates and critics of assertive discipline have expressed strong opinions regarding its effectiveness in the classroom (Canter, 1988; Curwin & Mendler, 1988; Curwin & Mendler, 1989; McCormack, 1989; Render, Padilla, & Krank, 1989). Proponents indicate that the model is easy for students and parents to understand and for teachers to implement in the classroom, and practitioners point to benefits of the system in their own schools and classrooms (McCormack, 1989). Critics, however, suggest that the model does not teach students self-discipline and conflict resolution skills they need in the long term but rather relies on the use of consequences and rewards to secure student obedience to rules in the short term (Curwin & Mendler, 1988; Wade, 1997).

Much of the published literature on assertive discipline highlights the implementation of the model in particular settings (e.g., Malmgren, Trezek, & Paul, 2005; Wade, 1997) and reports the results of teacher survey data related to various aspects of the model (e.g., Ellis & Karr-Kidwell, 1995). There is, however, a scarcity of research on the effectiveness of assertive discipline in general, and the research that does exist is inconclusive. For example, two studies conducted in England examined the impact of assertive discipline on student behavior after teachers received assertive discipline training. The first study reported uneven implementation of the model across teachers in the school and no obvious positive impact on student behavior (Martin, 1994), while the second study reported improved rates of on-task behavior and a reduction in the

numbers of disruptive incidents among students with emotional and behavioral problems as teachers increased their use of positive feedback and praise (Swinson & Cording, 2002). While some research appears to support the effectiveness of assertive discipline, the scope and quality of the research has been called into question. Render, Padilla, and Krank report in a 1989 study that the research is sparse and unsophisticated, that no generalizable data has resulted from the research, and that no study has compared the effectiveness of the model with other discipline models.

Clearly, given the widespread popularity and use of assertive discipline in classrooms, a need exists for additional research on the model. Many questions regarding the effectiveness of assertive discipline remain.

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PUNISHMENT

In common usage, punishment is typically conceptualized as a painful or otherwise unpleasant consequence that is delivered after an undesirable behavior. Punishment is usually associated with images of spankings, loud verbal reprimands, or loss of privileges. In applied behavior analysis, punishment is simply defined as any event that occurs after a behavior that results in a decrease in the frequency, intensity, duration, or latency of that behavior. There are two types of punishment: Type I punishment, also called positive punishment, involves the introduction of either an aversive stimulus or an aversive activity immediately following a behavior; Type II punishment, or negative punishment, involves the removal of a positive stimulus or preferred event immediately following a behavior. When used correctly, both Type 1 and Type 2 punishment procedures can be effective adjunctive methods for managing behavior in the classroom.

PUNISHMENT AS PART OF CLASSROOM MANAGEMENT

Type I punishments fall into two general categories: aversive activities and aversive stimuli. According to Brown-Chidsey and Steege (2004), the most common classroom application of aversive activities is overcorrection. Overcorrection takes place when a student is required to engage in an effortful behavior contingent on each incidence of a particular behavior. There are two components of overcorrection. The first, restitution, is a procedure whereby the student corrects what was damaged in the environment as a result of the behavior and restores the environment to a condition better than existed before the problem behavior. For example, a child who colors on her desk with a marker might be required to clean not only her desktop but also all the desktops in her row of desks. The second component of overcorrection is positive practice, in which a student, following a problem behavior, immediately engages in a correct version of appropriate behavior. For instance, a child who knocks over his chair and runs out the door to recess might be required to push his chair in appropriately and walk from his desk to the door ten times before joining his classmates at recess. Restitution and positive practice

may be used singularly or in tandem, depending upon the circumstances of the situation.

The procedures most often used in the classroom that fall in the application of aversive stimuli category include verbal reprimands (e.g., telling a student “No”), negative social feedback, disapproving body language such as frowning or sending a negative letter home to parents. In some instances, teachers use these strategies in a systematic manner contingent upon specific behaviors. In many cases, teachers deliver these consequences without regard to their actual effect on behavior. Whatever the case, it is important to remember that, if delivery of aversive stimuli is going to be used as part of a classroom management, it should not be physically, psychologically, or emotionally harmful to the student.

There are several varieties of Type II punishment, or the removal of a reinforcer. The most effective form of Type II punishment is time-out, also known as time-out from positive reinforcement. Time-out involves removing a student from a reinforcing situation to a neutral or less reinforcing setting following the occurrence of problem behavior. The duration of a time-out may range from as little as thirty seconds to as much as five minutes. Although there are several different kinds of time-out, the ones most commonly used in schools are exclusionary and non-exclusionary time-out. Exclusionary time-out refers to situations in which the student is removed from the classroom and thus all possible sources of positive reinforcement are minimized or eliminated. Non-exclusionary time-out refers to instances in which the student remains in the room but does not have easy access to positive reinforcers (e.g., teacher and/or peer attention, activities, games). Non-exclusionary time-outs are often easier for a teacher to implement, as they do not require the teacher to leave the rest of the class unattended to escort the timed-out child to another setting. For example, if a student is being disruptive while the class is playing a math game to earn points, the teacher might ask the student to stop participating and stand by the flag at the back of the room for one minute. As mentioned earlier, a well planned and executed time-out procedure is one of the most effective behavior management tools available to teachers (Sterling & Watson, 1999).

Another regularly used form of Type II punishment is response cost. With the response cost procedure, a previously earned positive reinforcer is removed contingent upon the occurrence of an undesirable behavior. Response cost is most useful in classrooms in which teachers have some type of tangible reinforcement system (e.g., points, tokens, class money, coupons, or popsicle sticks) already in place. For example, teachers who reinforce academic work completion and appropriate social behavior with coupons

that can be exchanged for small prizes at the end of the week may remove previously earned coupons when students either fail to do their work or exhibit inappropriate social behavior.

Attention extinction, or planned ignoring, is another effective form of Type II punishment when used correctly and in the appropriate situation. For example, a student who routinely asks questions of the teacher while she is giving directions may eventually stop if the teacher gives no indication that she is paying attention to the student's questions. However, planned ignoring would only work in this case if the attention being withheld by the teacher were actually reinforcing the behavior. That is, if the student's classmates laughed at the questions, it is unlikely that planned ignoring will result in a decrease in the ill-timed question-asking behavior.

While the types of misbehaviors that children exhibit invariably changes in topography and/or frequency, intensity, or duration as they age, teacher's preferred methods of discipline seem to remain fairly constant. As noted by Carter and Doyle (2006), verbal reprimands are sufficient for most mild misbehaviors that occur in early childhood and elementary classrooms. For more major forms of acting out, teachers usually prefer to use time-outs (most often some type of exclusionary time-out in which students are either removed from the classroom or sent home from school) or some other form of Type II punishment, such as restitution. Although misbehaviors among adolescents are much more complex and, if left unchecked, may be more likely to escalate into seriously disruptive behavior, verbal reprimands and time-outs are still the most common forms of punishment used even in secondary school settings (Emmer & Gerwels, 2006).

PROBLEMS WITH PUNISHMENT

Although punishment, by definition, is effective for reducing a behavior, the use of punishment as part of classroom management is controversial due to a number of problems associated with its use. First, punishment may result in a temporary increase in the undesirable behavior or the form of the behavior may change. Second, if the intensity of a punisher is gradually applied, students may tolerate very harsh forms of punishment. Third, some students may become physically aggressive when punishment is applied, particularly those students who are more prone to aggressive behavior. Fourth, punishment may produce unanticipated emotional side effects such as crying, general fearfulness, and social withdrawal. Fifth, students may model the behaviors exhibited by the adults who are delivering the punishment (e.g., yelling, finger pointing, rough handling). Sixth, there is a tendency of adults to over-rely on punishment strategies because it brings them temporary relief in the form of a brief escape from, or reduction in, a

student's problematic behavior. Seventh, some educators are ethically opposed to the use of punishment, although this opposition is typically in response to the physically and emotionally harmful types of punishment. Eighth, teachers use punishment procedures every day, whether intentionally or unintentionally, without systematically evaluating the intended and unintended effects on behavior. Ninth, and perhaps most important, punishment does not teach a student what to do, it only teaches what not to do. Thus, any time a punishment procedure is used in the classroom, there should be a simultaneous plan in place that focuses on teaching and reinforcing a more appropriate behavior.

RECOMMENDATIONS FOR EFFECTIVE USE OF PUNISHMENT

Probably due to the negative consequences sometimes associated with, or produced by, punishment procedures, Landrum and Kauffman (2006) suggested that punishment should be reserved for serious misbehaviors and used only in the context of ongoing behavior management programs. The former suggestion is not necessarily true as using punishment for mild offenses can often prevent more serious infractions in the future. Prior to systematically using punishment as part of classroom management, several factors should be considered. First, teachers must be careful not to administer punishment in anger and use only a matter-of-fact tone of voice, not a threatening tone. Second, punishment should be fair, consistent, and an immediate response to problem behavior and, whenever possible, relevant to the misbehavior. Third, consistency is one of the most important factors in using punishment effectively. Teachers should pick a punisher that can be used frequently, is not physically or psychologically harmful, and then use the punishment in a systematic and planned manner in the classroom.

ALTERNATIVE APPROACHES TO DECREASING PROBLEM BEHAVIOR

Numerous procedures besides punishment can be used to decrease the occurrence of problem behavior in the classroom. Two of the most effective procedures involve implementing some type of positive reinforcement system and/or manipulating the antecedents of problem behavior. When using positive reinforcement to manage classroom behavior, the teacher should be clear as to which behavior will be reinforced and then provide reinforcement contingent on that behavior. Ideally, the behavior that is being reinforced is incompatible with the undesirable behavior. For example, if a student is running around the classroom disrupting other students, providing reinforcement for work completion should reduce the problem behavior. Completing work is likely to be incompatible with being out of one's seat disrupt-

ing others. Manipulating antecedents involves removing the triggers or cues for misbehavior (Watson & Steege, 2003). Although there are many methods for altering antecedents, the first step is to identify the variables that are actually triggering the problem behavior. After doing so, even small changes in these variables can have a significant impact on behavior. For example, if a teacher determines that difficult academic tasks reliably lead to problem behavior, she may a) decrease the difficulty of the task, b) provide additional instruction and modeling prior to assigning the work, c) assign a peer helper to assist with task completion, and/or d) intersperse very difficult problems with easier problems.

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RULES AND PROCEDURES

Classroom management is a problem that both impedes student learning and impacts teaching tenure. Approximately 46% of all new teachers in the United States leave the profession within five years of entering the classroom. Almost half of all teachers who leave the profession report problems with student behavior as the source of their dissatisfaction (U.S. Department of Education, 2002). Many schools and their classroom staff rely on discipline policies that are reactive, punitive, and exclusionary. In contrast,

school-wide positive behavior support (SWPBS) is an empirically supported, preventive approach that teaches social skills to students across all school environments and all school personnel (Lewis, Sugai, & Colvin, 1998; Luiselli, Putnam, Handler, & Feinberg, 2005; Putnam, Luiselli, Handler, & Jefferson, 2003; Safran & Oswald, 2003; Sugai & Horner, 2002). Reductions in discipline concerns using these procedures at the school-wide level have been reported across a number of studies (Bohanon et al., 2006; Lassen, Steele, & Sailor, 2006; Luiselli, Putnam & Handler, 2001; Luiselli et al., 2005; McCurdy, Mannella & Eldridge, 2003; Rey et al., under review; Warren et al., 2006).

The use of class-wide behavior support practices (CWPBS) has also been shown to reduce problem behaviors in classrooms (Lambert, Cartledge, Heward & Lo, 2006; McCurdy, Mannella & Eldridge, 2003; Putnam et al., 2002). Utilizing a problem-solving model, teachers identify the problem(s) in their classrooms, validate the problem(s) using data, design solutions that include empirically supported practices, and then learn to implement and evaluate the solution(s). The development of a CWPBS program requires five components: (a) establishment of positive, class-wide behavioral expectations, (b) active teaching of these behavioral expectations to students, (c) methods to monitor student performance, (d) a system for reinforcing students, and, (e) managerial and instructional strategies to prevent and reduce problem behaviors.

Class-wide positive behavior support offers an approach that is very different from traditional discipline practices. The practices are designed to move from (a) reactive to proactive practices, (b) punitive to instructive practices, and (c) exclusionary to inclusionary practices. Reactive practices are used only after a student misbehaves, whereas proactive practices identify the challenging behaviors that students are displaying in school, and use this information to understand the areas in which students lack appropriate social skills and then teach these skills. Punitive discipline procedures punish students for acting inappropriately using a variety of events that are meant to serve as deterrents. However, research has shown that a punitive response to challenging behavior is ineffective for many students. In some cases, a punitive response can actually encourage inappropriate behavior, by providing the student with adult attention or with an escape from challenging academic tasks or social demands. In contrast, CWPBS employs an instructive approach to help students correct challenging behaviors. Often when students misbehave they are experiencing either a “skill deficit” or a “performance deficit.” When students do not understand how and when to exhibit appropriate behavior or have not learned this behavior, they demonstrate a skill deficit. In this instance, the students will need to be taught new

Behavioral expectations – do’s and don’t’s		
Behavioral expectation	Examples	Non-examples
Compliance	<ul style="list-style-type: none"> Follow the teacher’s directions. Do what the teacher asks after one request. 	<ul style="list-style-type: none"> Don’t talk back or argue with teacher. Don’t take too long to do what you’re told.
Preparation	<ul style="list-style-type: none"> Have books, pencils & paper with you when you enter the classroom. Bring completed homework to class. 	<ul style="list-style-type: none"> Don’t forget your stuff. Be ready for class.
Talking	<ul style="list-style-type: none"> Ask questions and make comments relevant to the topic only. Use quiet voices when working with groups or independently. 	<ul style="list-style-type: none"> Be polite and respectful to your peers. No talking when the teacher is talking.
In class behavior	<ul style="list-style-type: none"> Keep your hands and feet to yourself. Leave your seat only with permission. 	<ul style="list-style-type: none"> Do your best! No cheating, lying or stealing. No gum, candy or soda in class.
Being on time	<ul style="list-style-type: none"> Be in your seat before the bell rings. Be in class with paper and pen out by 8 a.m. 	<ul style="list-style-type: none"> Don’t be late
Transition behavior	<ul style="list-style-type: none"> Remain in your seat while changing academic activities. Line up quietly before walking to the next classroom. 	<ul style="list-style-type: none"> Don’t leave before the bell. No backpacks, coats or hats in the classroom.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

behavioral skills. Sometimes students have been taught these skills but are not motivated to use them or have difficulty generalizing the skill across different locations, situations, peers, or adults. In this case, the students are demonstrating a performance deficit (i.e., they have the skill but do not consistently demonstrate it). In this instance, the students will need to be monitored and provided with feedback to reinforce their use of the new skill. The goal of a CWPBS is to address both sets of problems.

The first step in the development of an effective CWBSP is to define the behavioral expectations for the classroom or other area so that the students clearly understand how they should behave in the designated area. Overall, there are six different student performance areas that impact student learning and the functioning of the classroom: (a) compliance with requests, (b) preparation for learning, (c) talking in class, (d) in-classroom behavior, (e) being on time, and, (f) transition behavior. It is important to identify at least two behavioral expectations per rule (e.g., “bring homework to class”; “come prepared with

books and pencils”). These expectations should be specific, observable, and measurable behaviors. They should be stated positively as behaviors to be performed. For example, teachers should identify the behavior that should be present rather than behaviors that should not occur. Table 1 lists some examples of these rules.

In the designing of rules and expectations, it is important to identify and address any environmental factors that could impact the successful implementation of those rules. It is also important to establish guidelines about how to manage and monitor all areas in the classroom, and how to arrange areas that are potentially problematic so students are prompted to meet the behavioral expectations.

Student behaviors can be frustrating, and it is sometimes easy to overlook the fact that students can get confused about what is expected of them. Too often, school staff assume that students know how to behave. Yet expectations tend to vary among different communities, teachers, parents, and administrators. The goal should be to have predictable routines to increase the likelihood that students can and will navigate through the class period successfully, toward a goal of independence and self-management.

Once the behavioral expectations have been developed it is essential to teach and review these behavior expectations. It is most effective to teach social skills to students in the same way academic skills are taught through lesson plans. For example, teachers can teach students rules and behavioral expectations by (a) telling students the rules, (b) showing them the rules by modeling positive examples of how to follow the rules, (c) practicing giving students opportunities to practice these new skills through role-play situations, written assignments, or actual situations, and assess whether students have mastered the rule, and (d) reinforcing providing students with positive feedback on their understanding of the rule during their role-play or other assignments. Once the behavioral expectations have been taught they should be reviewed frequently and strategically. For example, these expectations should be actively reviewed before beginning or transitioning between classroom activities, after weekends and vacations, and particularly before activities or subjects that tend to have produced the most problematic behavior.

Another effective strategy within a CWBSP is proactively monitoring student behavior as a strategy to prevent problem behaviors from escalating, and minimizing attention to inappropriate behaviors. This entails three teacher behaviors: (a) moving walking around the entire room, using proximity control to prevent problem behaviors; (b) looking using frequent visual scans of the room, making eye contact with students; and, (c) interacting reinforcing

students when they demonstrate positive behaviors, and correcting students when they break a rule.

Another major shift in classroom management is an active focus on recognizing students who follow the rules. Teachers should focus on positive behaviors more than negative behaviors to bring about a change in students. For the quickest change in behavior, teachers should aim for a 4:1 ratio of positive (reinforcing) to negative (corrective) statements. In addition to simple verbal and nonverbal feedback, teachers may want to use a more formal system to reward individual or groups of students for appropriate behavior.

Finally, there should be a system in place to correct inappropriate behaviors. The major emphasis should focus on being positive, proactive, and preventive. Then, teachers should follow a hierarchy of planned corrective responses, from least to most intrusive based on severity of problem behavior. Some students may continue to exhibit inappropriate behaviors despite a teacher’s most creative attempts to provide positive reinforcement. In such instances teachers need to respond to inappropriate behavior by using corrective responses. Understanding students’ motivations will help teachers establish consequences that do not inadvertently reinforce the inappropriate behavior. For example, if students cause trouble toward the end of lunch because they do not want to return to class, sending them to the office will not be effective. Instead, they should be sent directly to class.

Before planning corrective consequences, problem behaviors should be specifically defined. Next, the teacher should determine when problem behaviors occur at the beginning of the day, during transitions, language arts, or during independent seatwork? Then the possible function of the behavior should be determined. For example, a student might act out to obtain attention or to avoid or escape undesirable activities, for example, a test.

Overall reductions in office discipline referrals and disruptive behavior have been observed in classrooms using this approach (Lambert, Cartledge, Heward, & Lo, 2006; McCurdy, Mannella, & Eldridge, 2003; Putnam et al., 2003a). Reductions in office discipline referrals or suspensions, or both, on playgrounds (McCurdy, Mannella, & Eldridge, 2003) and on buses (Putnam et al., 2003a) also have been demonstrated. Research published in 2003 by McCurdy, Mannella, and Eldridge reported that these interventions are particularly effective with students who come from challenging family and community circumstances and who display significantly disruptive behaviors.

Finally, the development of a CWBSP will not impact problem behavior in the classroom without the effective implementation of classroom behavior support interventions. A 2007 study by Sanetti, Luiselli, and Handler found that the provision of performance feedback on the implementation of the plan produced greater

improvements in student behavior than when the plan was not implemented. Verbal plus graphic performance feedback was more effective than just verbal feedback in improving treatment integrity with the plan.

Teachers can improve their students' performance with the implementation of these procedures described above. Performance feedback may be helpful in assisting educational staff in the effective implementation of these procedures.

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TOKEN ECONOMIES

In a classroom token economy, students earn tokens for appropriate behavior. Later, they exchange their earned tokens for back-up reinforcers. Back-up reinforcers could include a variety of preferred stimuli, such as extra time at recess or access to preferred activities. A token economy can represent a practical approach for achieving class-wide behavior management.

The basic principle underlying the token economy is the concept of generalized conditioned reinforcement. That is, tokens are intended to become generalized conditioned reinforcers by virtue of the fact that they can be exchanged for a variety of back-up reinforcers (Cooper, 1987). Conditioned reinforcers are items, which students do not automatically find rewarding, but after associating them with positive experiences, such as praise and privileges, become rewarding. Tokens are generalized conditioned reinforcers because they are exchanged for a variety of reward options, rather than one. In this respect, tokens are similar to money.

CLASSROOM IMPLEMENTATION

A token economy includes five components. These components need to be clearly outlined before implementing the system. A token economy can be successfully implemented provided that five basic elements are clearly defined: (a) target behaviors, (b) tokens, (c) token distribution, (d) backup reinforcers, and (e) the exchange system.

Examples of backup reinforcers	
Natural	Items
Attend special period with another class	Pencils
Be first in line	Pens
Care for class pets	Notebooks
Extra time with class games	Folders
Sit at the teacher's desk	Paper
Eat lunch in a special location	Small toys
Sit next to a friend	Stamps
Take shoes off	Stickers
Skip one homework assignment	Baseball cards
Special display of work	Markers
Spend time in another classroom	Gel pens
Tutor a younger student	Art supplies
Use the teacher's special pen	Erasers
Visit the principal (for praise)	
Water class plants	
Wear a hat to school	
Extra computer time	

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

TARGET BEHAVIORS

First, target behaviors are selected. Target behaviors must be distinct behaviors that a teacher can clearly identify as occurring or not occurring (Moore, Tingstrom, Doggett, & Carlyon, 2001). For example, having a nice attitude is not acceptable because one cannot observe a student's attitude. However, staying seated at the desk can be observed by the teacher. For starters, teachers ought to select a small number of behaviors for the token economy, adding more when students demonstrate success. The target behaviors should be positive social or academic skills that the teacher wishes to increase in the classroom.

TOKENS

Tokens fall into one of two categories, objects or symbols (Alberto and Troutman, 2006). Objects are actual items, such as poker chips, checkers, washers, marbles, or tickets. Symbols are representations, including check marks, tally marks, or holes punched into paper.

Good tokens meet several standards. First, the token must be safe, durable, and cost efficient. Also, tokens must be individualized and difficult, if not impossible, to counterfeit (Cooper, 1987). This is important to ensure that students do not unfairly acquire tokens by taking them from other students or creating their own tokens. For example, if a teacher used pennies as tokens in a class wide system, any student could bring pennies from home and accumulate unearned tokens. Counterfeit tokens can be prevented by selecting uncommon items as tokens or marking tokens with a special code, such as teacher initials. For example, if a teacher opted to use poker chips as tokens, a

special signature on the chips including the student's initials would help prevent counterfeit.

In addition, tokens must be easy to distribute. Tokens should be delivered immediately after the display of the target behavior, so they must be accessible to the teacher at all times, such as in a pocket. Ideally, tokens are delivered to a student with very little disruption to the class. Last, the appeal and value of the tokens themselves must be considered. Tokens should not be intrinsically valuable so that the students are unmotivated to exchange them. For example, if a teacher distributed scratch-and-sniff stickers as tokens, students might be less motivated to exchange them. Such stickers may also be distracting.

TOKEN DISTRIBUTION

Tokens must be distributed to students in a way that is rewarding, but not distracting. For example, teachers can whisper a word of praise or give a thumbs-up when distributing a token. Students must also have a place to store their tokens. A jar or cup placed on the student's desk is an easy storage method for object tokens. A container with a slotted lid would prevent students from playing with the tokens or spilling them. A small index card taped to students' desks is an easy method for collecting symbolic tokens. Placing token collections away from the students' desks, in the front of the classroom, may reduce distraction during distribution, but the rewarding effect of the token may be compromised. Last, there must be a plan for token collection when students are away from the classroom. Students may not be able to carry token jars when they leave the room; however, tokens can be awarded if there is a procedure in place, for example, students put tokens in pockets until they return to the classroom.

BACKUP REINFORCERS

Backup reinforcers are classified as activities or items that have positive value for the students (Alberto and Troutman, 2006). Activities are special events that occur naturally. They are ideal because they are free and relatively non-disruptive. Natural activities include acting as hall monitor, passing out papers, and a pass to the library. Actual items should also be included as backup reinforcers. However, it is unethical to withhold necessities and basic comforts, such as meals, air conditioning, heat, access to medical care, and educational activities (Cooper, 1987). (See Table 1 for more examples of activities and items that could be used as backup reinforcers.)

According to Alberto and Troutman (2006), backup reinforcers must meet several criteria. First, a wide variety of backup reinforcers should be available to ensure that each student will be motivated by at least one item. Also, the actual rewards or pictures of the rewards should be visible to the students at all times. In other words, a

classroom store could be set up. If this is not possible, then a reward menu should be visible instead. Last, the cost system should be proportional to value. Smaller, cheaper items should cost fewer tokens than larger, more expensive items. For example, a pencil should cost fewer tokens than a teddy bear. This applies to naturally occurring activities as well. For example, if computer time was coveted by students more than a library pass, then computer time should cost more tokens than the library pass.

EXCHANGE SYSTEM

A clear routine for exchanging tokens must be established in order to prevent class disruption. When a token system is first implemented, students must be allowed to exchange tokens for backup rewards frequently, as much as four times per day. Frequent exchanges are necessary to teach the connection between tokens and rewards, thus increasing the value of tokens. As students learn the token economy, the duration between exchange opportunities can be increased. Younger students and students with disabilities may never benefit from infrequent exchanges; therefore, some token economies must maintain frequent exchanges. However, older children may eventually be able to manage a token system with only one exchange per week (Alberto and Troutman, 2006).

REVIEW OF THE RESEARCH

Research has shown that token economies can be successful in a variety of settings, including both general and special education classrooms. Token economies have been used with success in inclusive settings across ages (Carpenter, 2001; Filcheck, McNeil, Greco, & Bernard, 2004; Higgins, Williams, McLaughlin, 2001; Lannie & Martens, 2004). Several studies have demonstrated the success of token economies in special education settings, including resource rooms (Buisson, Murdock, Reynolds, & Cronin, 1995) and self-contained rooms (Cavalier, Ferretti, & Hodges, 1997; Truchlicka, McLaughlin, & Swain, 1998).

Token system success is also flexible across student characteristics and abilities. Token economies have been successful for typically developing children (Filcheck et al., 2004; Lannie & Martens, 2004). They have also been effective for students with disabilities, such as hearing impairments (Buisson et al., 1995), learning disabilities (Cavalier et al., 1997; Higgins et al., 2001), mental retardation (Carpenter, 2001), speech delays (Kahng, Boscoe, & Byren, 2003), attention deficit hyperactivity disorder (Bender & Mathes, 1995), and behavior disorders (Truchlicka et al., 1998).

Research has also demonstrated the success of token economies at managing a variety of target behaviors in school settings. Substantial research has shown the effectiveness of token systems in managing inappropriate or

challenging behaviors (Buisson et al., 1995; Carpenter, 2001; Cavalier et al., 1997; Filcheck et al., 2004; Higgins et al., 2001). Furthermore, academic tasks such as math, reading, spelling, history, and language have been successfully improved using token systems (Lannie & Martens, 2004; Truchlicka et al., 1998) as well as social skills, such as sportsmanship and class participation (Boniecki & Moore, 2003; Hupp & Reitman, 1999).

In sum, the research on token systems has demonstrated that this is an effective strategy for increasing appropriate classroom behavior and managing inappropriate behavior across a variety of classroom settings and students.

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WITHITNESS

Withitness is a teacher characteristic that is evident when a teacher communicates awareness of a student's inappropriate behavior in a timely and accurate manner. A timely communication is one that occurs before the misbehavior has escalated or spread, and an accurate communication addresses the correct student. Thus, teachers who are *withit* detect inappropriate behavior promptly and let students know they are aware of it. Teachers who lack this skill either ignore inappropriate behavior or they fail to detect it until it is too late; that is, the inappropriate behavior has taken root and spread.

The term, *withitness*, was developed and operationalized by Jacob Kounin (1970) in a series of classroom studies. Kounin and his colleagues were interested in identifying how teachers dealt effectively with inappropriate student behavior. Initially they studied *desist* events (i.e., communications that are intended to stop some student behavior) to attempt to determine if properties of desists such as their clarity, firmness, or intensity had an impact on student work involvement or disruptive behavior. Unable to detect any significant effects for properties of desists, Kounin turned his attention to the timing of desists and their accuracy. Using videotapes of classrooms, a measure of teacher *withitness* was obtained by classifying desists according to whether each addressed the correct target and did so in a timely manner. The teachers' *withitness* scores (the percentage of desist events that were timely and accurate) were correlated moderately to highly with both student work involvement and freedom from deviancy in recitation settings (i.e., teacher led, whole class activities).

The concept of *withitness* is intuitively appealing. In common parlance, it is the measure of the "teacher with eyes in the back of her head." Kounin's great contribution was to develop a reliable observational measure of the concept and to demonstrate empirically its importance for the management of student behavior in group settings.

Some other research has provided support for the importance of *withitness* as a management skill. For example, in research on elementary and middle school classes, Evertson, Emmer, and Anderson operationalized *withitness* as a combination of effective teacher monitoring and stopping inappropriate behavior promptly. Their research found that teachers who were rated highly on these constituents of *withitness* had classes with higher levels of on-task behaviors and lower amounts of disruptive behaviors. In a study of physical education classes, Johnston found that desists that were accurate and prompt were successful in returning students to the task around 80 percent of the time, compared to 45 percent for desists that targeted the wrong students or were late.

An explanation for the effectiveness of *withitness* is that early detection of inappropriate behavior allows the teacher to communicate with the focus student before other students are involved. Waiting too long to address the problem or catching the wrong student risks escalation of the misbehavior. When such events occur frequently, the teacher ultimately has to use more intense interventions that take time and are distracting to other students. Typically the flow of classroom activities is disrupted, creating more opportunities for disorder to spread.

While it is tempting to conclude that *withitness* is directly causative, affecting student behavior and related outcomes, several cautions should be noted. *Withitness* might be partly a function of the population served. In a classroom with large numbers of troublesome students, teachers might find it more difficult to exhibit *withitness* because they need to keep the activity moving. Too much attention to problem behaviors will distract student attention and interfere with instruction. Conversely, in a generally cooperative class, inappropriate behaviors stand out, making it easier for the teacher to detect and treat problems in short, to be *withit*. Finally, *withitness* may be part of a more general teacher skill set so that other correlated skills contribute to the teacher's effectiveness.

The relationship between *withitness* and problematic student behaviors is likely to be recursive. Early in the school year, a teacher who exhibits *withitness* will obtain more appropriate student behavior, resulting in a more orderly setting; subsequently students are less likely to misbehave because their behavior has accommodated to the classroom norms and also because they know that they are more likely to be caught. A teacher who does not exhibit *withitness* in early encounters with students is likely to have more disorder, leading to greater difficulty displaying *withitness* and, as a consequence, further deterioration in student behavior.

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Edmund T. Emmer

COGNITIVE APPRENTICESHIP

Throughout most of history, teaching and learning have been based on apprenticeship. As Rogoff (1990) makes clear, children throughout the world learn how to speak, grow crops, and make clothes by apprenticeship. They do not go to school to learn these skills; instead, adults in their family and communities show them how and help them practice. Even in advanced societies, people learn through apprenticeship, such as gaining a first language, acquiring critical skills in a new job, and doctoral training for scientists. When people have the resources and a strong desire to learn, they often hire a coach to teach them by apprenticeship, because apprenticeship is a more effective for learning. But for most kinds of learning, schooling has replaced apprenticeship.

Collins, Brown, & Newman (1989) have argued that computer-based learning environments could provide students with apprenticeship-like experiences, providing the attention and feedback that are associated with apprenticeship. Their research builds on the ideas of Vygotsky (1978), whose view of how social interaction fosters cognitive development resembles apprenticeship, in which a novice works with an expert in the zone of proximal development.

FROM TRADITIONAL TO COGNITIVE APPRENTICESHIP

In her study of a tailor shop in Africa, Lave (1988) identified the central features of traditional apprenticeship. Learning is instrumental to the accomplishment of meaningful real-world tasks and embedded in a social and functional context. The apprentice observes the master modeling the target process. The apprentice then attempts to execute the process with coaching from the master. A key aspect is guided participation (Rogoff, 1990): the support that the master provides until the novice has acquired the needed skills. As the learner develops increasing skill, the master provides less help, eventually fading away completely.

Cognitive apprenticeship (Brown, Collins, & Duguid, 1989; Collins, Brown, & Newman, 1989) updated traditional apprenticeship to apply to subjects taught in school. The *cognitive* emphasizes that the focus is on cognitive skills, rather than physical ones. Traditional apprenticeship

KEY PRINCIPLES FOR COGNITIVE APPRENTICESHIP

CONTENT—TYPES OF KNOWLEDGE REQUIRED FOR EXPERTISE

Domain knowledge: subject matter specific concepts, facts, and procedures

Heuristic strategies: generally applicable techniques for accomplishing tasks

Control strategies: general approaches for directing one's solution process

Learning strategies: knowledge about how to learn new concepts, facts, and procedures

METHODS—WAYS TO PROMOTE THE DEVELOPMENT OF EXPERTISE

Modeling: teacher performs a task so students can observe

Coaching: teacher observes and facilitates while students perform a task

Scaffolding: teacher provides supports to help the student perform a task

Articulation: teacher encourages students to verbalize their knowledge and thinking

Reflection: teacher enables students to compare their performance with others

Exploration: teacher invites students to pose and solve their own problems

SEQUENCING—KEYS TO ORDERING LEARNING ACTIVITIES

Increasing complexity: meaningful tasks gradually increasing in difficulty

Increasing diversity: practice in a variety of situations to emphasize broad application

Global to local skills: focus on conceptualizing the whole task before executing the parts

SOCIOLOGY—SOCIAL CHARACTERISTICS OF LEARNING ENVIRONMENTS

Situated learning: students learn in the context of working on realistic tasks

Community of practice: communication about different ways to accomplish meaningful tasks

Intrinsic motivation: students set personal goals to seek skills and solutions

Cooperation: students work together to accomplish their goals

evolved to teach domains in which skills are visible. But students lack access to the cognitive processes of instructors as a basis for learning through observation. Cognitive apprenticeship is designed to bring these processes into the open, where students can observe and practice them.

There are two other major differences between cognitive apprenticeship and traditional apprenticeship. First, because traditional apprenticeship is set in the workplace, the tasks arise not from pedagogical concerns, but from the demands of the workplace. In cognitive apprenticeship tasks are sequenced to reflect the changing demands of learning. Second, whereas traditional apprenticeship emphasizes teaching skills in the context of their use, cognitive apprenticeship emphasizes generalizing knowledge, so that it can be used in many different settings.

A FRAMEWORK FOR COGNITIVE APPRENTICESHIP

Cognitive apprenticeship focuses on four dimensions that constitute any learning environment: content, method, sequence, and sociology.

Content. Experts have to master domain knowledge, the concepts, facts, and procedures associated with a specialized area. In the late twentieth and early twenty-first centuries, researchers have been identifying the strategic knowledge that supports people's ability to make use of these concepts, facts, and procedures to solve real-world problems:

1. Heuristic strategies are techniques for accomplishing tasks that might be regarded as tricks of the trade; they do not always work, but can be quite helpful. Most heuristics are tacitly acquired by experts, but there have been attempts to address heuristic learning explicitly (Schoenfeld, 1985).
2. Metacognitive strategies control the process of carrying out a task. Metacognitive strategies have monitoring, diagnostic, and remedial components; decisions about how to proceed in a task depend on one's current state relative to one's goals, on an analysis of current difficulties, and on the strategies available for dealing with difficulties.
3. Learning strategies pertain to learning domain knowledge, heuristic strategies, and control strategies. For example, Chi and her colleagues (1989) have identified strategies students should follow to learn how to solve math and science problems.

Method. The six teaching methods associated with cognitive apprenticeship fall roughly into three groups. The first three methods (modeling, coaching, and scaffolding)

are the core of traditional apprenticeship. The next two methods (articulation and reflection) are designed to help students to generalize their learning. The final method (exploration) is aimed at encouraging learner autonomy.

1. Modeling involves an expert performing a task so that the students can observe the processes that are required to accomplish it. In cognitive domains, this requires externalization of internal processes. For example, a teacher might model reading in one voice, while verbalizing thoughts in another voice. In mathematics, Schoenfeld (1985) models problem solving when students bring him difficult problems to solve in class.
2. Coaching consists of observing students' work and offering hints, challenges, scaffolding, feedback, modeling, reminders, and new tasks aimed at more expert performance. In Palincsar and Brown's (1984) reciprocal teaching of reading, the teacher coaches the students while they ask questions, clarify their difficulties, generate summaries, and make predictions.
3. Scaffolding refers to the supports teachers provide to help students carry out tasks. These supports can take either the form of suggestions or hints, as in Palincsar and Brown's (1984) reciprocal teaching, or they can take the form of physical supports, as with the short skis used to teach downhill skiing. Fading involves the gradual removal of supports until students are on their own.
4. Articulation includes any method of getting students to explicitly state their knowledge and reasoning in a domain. Inquiry teaching (Collins & Stevens, 1983) is a strategy for questioning students to lead them to articulate their understanding.
5. Reflection involves enabling students to compare their own problem-solving processes with those of an expert or of other students. Reflection is enhanced by use of various techniques for replaying the performances of both expert and novice for comparison (Collins & Brown, 1988).
6. Exploration involves guiding students to problem solving on their own. Enabling them to do exploration is critical, if they are to learn how to frame interesting problems that they can solve. Exploration is the ultimate fading of support.

Sequencing. Cognitive apprenticeship provides principles to guide the sequencing of learning activities.

1. Increasing complexity. Tasks should be sequenced to include more and more of the skills and concepts necessary for expert performance. For example, in reading, students progress from relatively short texts

with simple syntax to longer texts with complex ideas that make interpretation difficult.

2. Increasing diversity. Tasks should be sequenced so that a wider variety of strategies or skills are required. As skills become well learned, it is important that the student learns to distinguish the conditions under which they apply.
3. Global before local skills. In tailoring (Lave, 1988) apprentices learn to put together a garment from pieces before cutting out pieces themselves. Having a model of the overall activity helps learners make sense of the portion they are carrying out, improving their ability to monitor progress and develop self-correction skills.

Sociology. Tailoring apprentices learn their craft in a busy shop, surrounded by masters and apprentices they can talk to and observe. They engage in activities that contribute directly to the production of garments. Hence, apprentices learn skills as applied to real-world problems, within a culture of expert practice. These considerations suggest several characteristics affecting the sociology of learning.

1. Situated learning. A critical element in fostering learning is having students carry out tasks in an environment that reflects the nature of such tasks in the world (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991). For example, Dewey created a situated-learning environment in his experimental school by having the students design and build a clubhouse, a task that emphasizes arithmetic and planning skills.
2. Community of practice. This refers to the creation of a learning environment in which the participants communicate about and engage in the skills involved in expertise (Lave & Wenger, 1991). Such a community develops a sense of ownership, personal investment, and mutual dependency.
3. Intrinsic motivation. It is important that students perform tasks, because they are intrinsically related to a goal of importance to them, rather than for some extrinsic reason, such as getting a good grade or pleasing the teacher.
4. Collaboration. Exploiting cooperation refers to having students work together in a way that fosters collaborative problem solving. Collaboration is a powerful motivator and a powerful mechanism for extending learning resources.

THEMES IN RESEARCH ON COGNITIVE APPRENTICESHIP

In the years since 1989 when cognitive apprenticeship was first introduced, there has been extensive research

toward developing learning environments that embody many of these principles.

Situated Learning. Goal-based scenarios (Schank et al., 1994) embody many of the principles of cognitive apprenticeship. Learners are given real-world tasks and the scaffolding they need to carry out such tasks. For example, in one computer-based scenario learners are asked to advise married couples as to whether their children are likely to have sickle-cell anemia, a genetically-linked disease. In order to advise the couples, learners must find out how different genetic combinations lead to the disease and run tests to determine the parents' genetic makeup. There are scaffolds in the system to support the learners, such as recorded experts who offer advice. Other goal-based scenarios support learners in a variety of challenging tasks, such as putting together a news broadcast or developing a computer-reservation system. Goal-based scenarios make it possible to embed cognitive skills and knowledge in the kinds of contexts where they are to be used.

Video and computer technology has enhanced the ability to create simulation environments where students are learning skills in context. A novel use of video technology is the Jasper series developed by the Cognition and Technology Group (1997) at Vanderbilt University to teach middle-school mathematics. In a series of 15- to 20-minute videos students are put into various problem-solving contexts: e.g., deciding on a business plan for a school fair or a rescue plan for a wounded eagle. The problems are quite difficult to solve and reflect the complex problem solving and planning that occurs in real life. Middle-school students work in groups for several days to solve each problem. Solving the problems develops a much richer understanding of the underlying mathematical concepts than the traditional school-mathematics problems.

Communities of Learners. In recent years there has developed a learning communities that approach builds on Lave and Wenger's (1991) concept of a community of practice. In a learning community the goal is to advance collective knowledge in a way to support the growth of individual knowledge (Bielaczyc & Collins, 1999).

Brown and Campione (1996) have developed a teaching model they call Fostering a Community of Learners (FCL) for grades 1 through 8. In the FCL model there are three research cycles per year. A cycle begins with shared activities to build a common knowledge base. Students then break into research groups that focus on a specific topic related to the central topic. For example, a class studying food chains may break into five groups that each focus on a different aspect, such as photosynthesis or consumers. Students research their subtopic as a group, with individuals majoring by pursuing their own research agendas within the subtopic.

Students engage in regular crosstalk sessions, in which the different groups explain their work, ask and answer questions, and refine their understanding. The research activities include reciprocal teaching (Palincsar & Brown, 1984), guided writing and composing, consultation with experts outside the classroom, and cross-age tutoring. Finally, students from each of the subtopic groups come together to form a jigsaw group (Aronson, 1978) in order to share their learning and work together on a consequential task. The consequential tasks require students to share knowledge across groups and serve as occasions for exhibition and reflection.

Scaffolding. Scaffolding helps learners carry out tasks that are beyond their capabilities. Quintana et al. (2004) suggest twenty specific strategies for designing scaffolds to support understanding, inquiry, articulation, and reflection in computer-based environments. In most situations, scaffolding naturally fades as learners are able to accomplish tasks on their own.

Sandoval and Reiser (2004) have developed a computer system called the Biology Guided Inquiry Learning Environment (BGuILE) that supports students in making scientific arguments in the context of population genetics. The system presents the students with a mystery concerning why many of the finches in the Galapagos Islands died during a drought. In order to solve the mystery, students have to analyze extensive data that were collected by scientists and come up with a reasoned conclusion as to why some finches died while others survived. The Explanation Constructor tool in the system prompts the students to put in all the pieces of a sound genetics-based argument, after they have decided what caused the finches to die. Hence, the system scaffolds students to articulate their argument in a much more explicit form than they would normally do.

The concept of scaffolding comes from Vygotsky's 1978 concept of the zone of proximal development, which described how adults support learners to accomplish tasks that they cannot accomplish themselves. The focus of research on scaffolding has been on supporting individuals, but Kolodner et al. (2003) point out that it is important to scaffold groups as well. So for example, in teaching science, they provide students with focused collaboration activities to solve simple problems, which they call launcher units. Engaging in these activities and reflecting on them helps students to collaborate more effectively and to understand the value of collaboration.

Articulation. In order to abstract learning from particular contexts, it is important for learners to articulate their thinking and knowledge. For example, Lampert (Lampert, et al., 1996) showed how fifth grade children can form a community of inquiry about important mathematical con-

cepts. She engaged students in discussion of their conjectures and interpretations of each other's reasoning. Techniques of this kind have been successful with even younger children (Cobb & Bauersfeld, 1995) and may underlie the success of Japanese mathematical education.

A notable method for fostering articulation in science is the Itakura method developed in Japan (Hatano & Inagaki, 1991). First, students make different predictions about what will happen in a simple experiment, where they are likely to have different expectations. For example, one experiment involves lowering a clay ball into water and predicting what will happen. After students make their initial predictions, they discuss and defend why they think their predictions are correct. After any revisions in their predictions, the experiment is performed and discussion ensues as to why the result came out the way it did.

The Knowledge Forum environment developed by Scardamalia and Bereiter (1994) is an environment in which students articulate their ideas in writing over a computer network. The model involves students investigating problems in different subject areas over a period of weeks or months. As students work, they enter their ideas and research findings as notes in an on-line knowledge base. The software scaffolds students in constructing their notes through features such as theory-building scaffolds (e.g. "My Theory," "I Need to Understand") or debate scaffolds (e.g. "Evidence For"). Students can read through the knowledge base, adding text, graphics, questions, links to other notes, and comments on each other's work. When someone has commented on their work, the system automatically notifies them about it. The emphasis is on progress toward collective goals of understanding, rather than individual learning and performance.

Reflection. Reflection encourages learners to look back on their task performance and compare it to other performances, such as their previous performances and those of experts. One of the most effective ways to improve performance is for learners to evaluate how they did with respect to a set of criteria that determine good performance. For example, White and Frederiksen (1998) showed that students who evaluated their performance on science projects using a set of eight criteria learned much more than students who carried out the same tasks, but did not reflect on their performance. In fact, this reflection helped the weaker students much more than the stronger students.

The essential way people get better at doing things is by thinking about what they are going to do beforehand, by trying to do what they have planned, and by reflecting back on how well what they did came out. If they can articulate criteria for evaluating what they did, this will help them as they plan what they do on the next cycle. The wide availability of computers and other recording

technologies makes performances easier to produce and to reflect upon. For example, students can now produce their own news broadcasts, musical performances, or plays, on audiotape or videotape. Furthermore, they can play these back, reflect upon them, and edit them until they are polished.

As these examples illustrate, there has been extensive research in recent years that has incorporated the principles of cognitive apprenticeship in the design of learning environments. As computer-based learning environments become more pervasive, there is likely to be continued development of new ways to embody these principles in their design.

SEE ALSO *Constructivism; Reciprocal Teaching.*

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COGNITIVE DEVELOPMENT

This entry contains the following:

- I. OVERVIEW
Brian D. Cox
- II. BIOLOGICAL THEORIES
David C. Geary
- III. INFORMATION PROCESSING THEORIES
Ray Brogan
- IV. PIAGET'S THEORY
Dorothy G. Singer
- V. VYGOTSKY'S THEORY
Mary Gauvain

OVERVIEW

Methods of teaching are typically predicated on fixed assumptions about the mind of the child to be taught. Is the mind of the child a blank slate, upon which the lessons are written or engraved in wax? Or is the child an opening flower to be guided by the teacher as gardener? Is the development of the mind a simple build-up of habits, a continuous and gradual accumulation of information, or does the child progress through stage-like shifts in understanding, modifying information given to him or her in accordance with that level of understanding? Are those stages ordained by physiology, evolution, or genetics? Or is the mind of a child like an information-processing computer, with hardware capacity and speed of processing limitations, running software: cognitive strategies and procedures? Finally, there is the conception of the child as clay to be passively molded as contrasted with the child as active investigator, constructing reality inside his or her head with or without the help of caretakers, educational materials, cultural prescriptions and prohibitions. All of these views contain some truth, and each is also useful to educators. This entry provides an overview; specific classroom techniques can be found under the individual entry for each theory.

THE POWER OF HABIT: THE EMPIRICIST TRADITION

In *Some Thoughts Concerning Education* (Locke, 1693/1968), the British empiricist philosopher John Locke (1632–1704) provided the intellectual foundation for the dominant theory of cognitive development in England and the United States until the mid-20th century. Empiricism is the philosophy that all knowledge is ultimately based on sense experiences and cognitive reflection on those experiences. Thus, Locke's main childrearing and educational advice was to observe children behaving in their context and to be aware that they are observing their parents' behavior in turn. Rather than forcing children to memorize texts and rules and to beat them if they forgot, Locke recommended that a parent or tutor encourage practice of skills in carefully graduated steps matched to the age, experience, and temperament of the child. Children should be encouraged to work for the praise and good esteem of their parents, rather than to receive concrete bribes or to avoid punishment. Locke believed that children are born without innate ideas and thus are blank slates, but he said that each child has a unique natural temperament that once observed should be taken into account.

Thus in the empiricist school, practice followed by praise or punishment was thought to lead to a buildup of proper habits. At its best, the empiricist tradition promoted a sophisticated pragmatism. E. L. Thorndike (1874–1949), one of the founders of educational psychology at Teachers' College

at Columbia University in the early 20th century, believed that education did not expand general ability. Rather, he believed that every mental task could be decomposed into a series of discrete actions or thoughts that had met with success in particular tasks. Once a process had been trained to mastery in the classroom, only those elements that were the same between the training session and the new situation would transfer. This *identical elements* theory of education deemphasized massive rote learning in favor of taking care that habits should be explicitly useful in the world. For example, Thorndike suggested that quantities in all arithmetic word problems should be given with units of measurement (feet, inches, or pounds), and a child should never have to calculate 16/18ths of a dollar. No habits should be taught that would later have to be broken; thus, careful consideration should be given to the context where habits of thought would be used. Thorndike believed that once basic habits are learned so well as to be automatic, higher-level thinking would emerge. (Thorndike, 1910–1913).

Every time math problem sets are ordered so that the next problem is only slightly more complex than the previous one, the insights of this tradition are used. But the empiricists saw the child as relatively passive, and thus the brunt of learning fell on the teacher to rigorously prepare step-by-step materials. Their notion of learning as the gradual build-up of knowledge largely ignored qualitative developmental shifts in thinking. Much of the bad reputation of this method comes from the fact that its teacher-centered view was corrupted by the so-called factory school, the scale of which undermined Locke's cardinal principle of constantly observing child-teacher interactions, and instead encouraged one-way rote learning.

THE INFORMATION PROCESSING MODEL: THE MIND AS A COMPUTER

Philosophers, psychologists, and educators have frequently proposed metaphors based on the advanced technology of their times to understand the mind. Locke's view of the mind was really a mental chemistry model. Information processing theory sees the mind as a computer analyzing symbolic code data with strings of commands (software programs) through electronic computers with hardware components such as input devices, working memory, and long-term storage. This led to several findings concerning cognition and memory:

1. Adult memory can be characterized by a multistoried model: A vast amount of unanalyzed information is captured for a fraction of a second (visual) to a couple of seconds (auditory) in a sensory store. Attending to information captures it and moves it to a short-term store before it fades. Children as young as 5 have a similar sensory memory size but less attention

capability. Short-term memory, or working memory, holds 7 ± 2 bits of information for a maximum of 30 seconds unless some strategy is used to remember it, such as chunking digits, or rehearsing, linking or grouping items in a meaningful way. Children in Western formal schools have deficiencies in these strategies (software programs) until about age 11 or 12, but they can be taught the strategies as young as first grade. Younger children who use these strategies remember more than their peers, but they may not transfer the useful strategies successfully to new settings. Use of such elaborative strategies sends information to long-term storage, which has large, indefinite size, and duration limits.

- Elementary school children lack the ability to deploy memory and thinking strategies effectively, even though they would be helpful, because they lack *metamemory* or *metacognition*. That is, they may not accurately think about memory or think about thinking the relevant experience to know which strategies to use in which contexts, or find it very difficult to monitor their own thinking processes while using them. However, considerable research suggests that predicting what will come next in a paragraph, estimating how many things they might remember, or the end product of a math problem, helps them learn such skills. Similarly, summarizing, checking one's work, formulating questions about reading passages or other exercises in thinking about thinking promote metacognition, which can be conceptualized as higher order programs about how to deploy strategies and which tend to promote comprehension without endangering calculation or word decoding skills. One useful method is to coax the child to compare the results of using an effective strategy with one that is not effective, rather than the procedures themselves.

The child is seen as a more active learner in the information processing approach, but the major change in development is still the content in the child's head, in terms of meaningful knowledge about concepts, strategies, and metastrategies (strategies for using strategies). Hardware changes less than software and data. In this metaphor, children are also being compared with adults as the standard, rather than taken on their own terms. (For useful summaries of this position, see Klahr & Simon, 2002; Schneider & Pressley, 1997; Siegler, 1996.)

BIOLOGICAL THEORIES

With the advent of the science of brain physiology and the theory of evolution, strong biological theories were entertained beginning in the late 19th century, but lack of scientific knowledge of genetics, combined with race or

class biases in the scientists led at first to egregious errors in interpretation. Beginning with Darwin's cousin, Francis Galton (1869), racist or classist eugenicists believed that intelligence is not only heritable, but also unchangeable, so they argued that poor and minority children cannot or should not be raised up (see Gould, 1996).

This history of biological theories of cognition should remind us to be very careful about how and what conclusions are drawn from the latest biological or genetic information. It is now believed, for example, that racial differences were added far too late in evolution to have caused biologically based racial differences in intellectual capacity, and well-designed research supports this conclusion (e.g. Dickens & Flynn, 2006). But human cognition has undoubtedly been shaped by evolution, and some cognitive differences among children are heritable, at least in part. The role of evolution in cognitive development is examined in the new subfield of evolutionary developmental psychology, and the study of the inheritance of cognitive abilities is the field of behavioral genetics.

Evolutionary developmental psychologists have proposed a counterintuitive argument: that children's inability to think like adults—for a limited time in development may actually help, rather than harm, their chances of survival (Bjorklund, 1997; Bjorklund & Green, 1992). They start with the fact that human children are more immature at birth than any other primate. Children are therefore more defenseless, but also more flexibly open to learn than the offspring of even their nearest evolutionary neighbors. Human children must learn a lot, and fast. Preschoolers are egocentric: they tend to reason from only their own perspective. Although not seeing others' viewpoints has some obvious disadvantages, it has advantages, too. It acts as a kind of cognitive tunnel vision, shutting out all but the most relevant information. Moreover, information relevant to one's own point of view is better remembered—even by adults—than personally irrelevant information, so egocentrism aids memory. Finally, egocentric preschoolers are likely to overestimate their cognitive abilities and are blissfully ignorant of others' performance, and are thus resistant to the negative effects of failure on their sense of ability to control the world.

Evolutionary developmental psychologists note that play, common to juveniles of most mammalian species, also has survival value (Pellegrini & Bjorklund, 2004). Children learn social roles, social interaction, physical coordination, cultural stories, and, through pretend play, symbol use and creativity. (A primate without built-in instincts needs creativity to survive in varied environments.)

Behavioral geneticists are concerned with biologically based individual differences among children in cognitive, emotional, or social behavior. It would be theoretically

useful to know to what degree differences in, say, reading or math abilities are inherited. This work is technically complex and requires subtle interpretation. With the exception of a few specific single-gene disorders, scientists do not yet know the specific differences in a person's genotype (DNA sequences) that underlie differences in cognitive performance, and they strongly suspect that many genes are involved in any complex intellectual skill. Instead, they must infer their conclusions from giving intelligence, vocabulary, or standardized achievement tests to large groups of related individuals, and noting the correlated similarities in their scores. Identical twins share, at least at birth, 100% of their DNA, whereas fraternal twins (and other siblings) share about 50%. If identical twins have higher correlations in achievement test scores than fraternal twins or siblings, a degree of heritability is indicated for the tested cognitive skills. For example, a recent British longitudinal study of thousands of twins (Harlaar, Dale, & Plomin, 2007) has suggested that children's reading scores are stable across elementary school, and that a large proportion of that stability can be attributed to shared genes. And, children who are good in reading are statistically likely also to be good in math (Kovas & Plomin, 2007).

The correlations due to shared environment (shared homes, schools or teachers) are considerably lower, but still significant contributors to the scores (Harlaar, et al., 2007). But interestingly, the relative importance of a good environment is greater for poor families than affluent ones. If all of a sample of children is given every advantage offered by a culture, the differences among them in cognitive ability that remain to be measured are likely due to differences in their inheritance. Poor children still will benefit from enrichment in environmental circumstances to help them reach their full innate potential (Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003). Finally, and most interestingly, behavioral geneticists have wondered about the role of nonshared environment: If all this is true, why are siblings so different (Plomin & Daniels, 1987; Turkheimer & Waldron, 2000)? Even twins from the same family have nonshared experiences, and they may even strive to be different from one another. This shows up in the data, but is hard to measure accurately, because different children will subjectively experience a teacher or parent differently, or demand different things from them for a host of different reasons. This could affect their cognitive development, but scientists are not sure exactly how. For teachers, a summary of this data might be: yes, cognitive abilities are inherited, but this does not mean that enriching an educational environment cannot also make a significant difference for every child. That something is inherited does not mean it is unchangeable.

CONSTRUCTIVISM: THE CHILD AS EPISTEMOLOGIST

Covered here so far, are those approaches that stress learning as a gradual filling up of habits, as in empiricism, or data and programs, as in information processing. Also touched on are nativist approaches, which rely on evolution to provide the timing for a gradual unfolding of capabilities. To Jean Piaget (1896-1980), learning was neither the mere acquisition of knowledge nor the unfolding of development. In his constructivist theory, children cannot merely copy and store what their teachers say, but they must act upon the world, first literally, by grasping it and sucking it, then symbolically, through language, and, finally, logically, through a combination of testing, experimenting, questioning, and reasoning, first with the concrete world and then with the formal logic of science and algebra. Piaget's theory is also a hierarchical stage theory. Each stage represents a qualitatively different, progressively more complex and abstract form of thought that is built on the stages that necessarily must come before it. Piaget was concerned not with child development but with the problem of epistemology, the branch of philosophy that deals with how knowledge of the world is constructed inside people's heads. Only by watching children can this process be seen from its genesis, its beginnings. Hence his theory's formal names: genetic epistemology or constructivism.

A baby cannot think aloud as adults do, because he has no language. A newborn has only senses, reflexes, limited motor activity, and the driving force of what might be called curiosity. Babies want to re-experience interesting and pleasant stimulations and gain control over them by repeating and varying certain actions. As they do so, the world becomes predictable and solid, and each baby's sense of self becomes differentiated from external experiences. Early consciousness in this sensorimotor period before the age of 2 is radically qualitatively different from that of older children and adults, and yet babies are still active, curious investigators, expanding through their own actions outward from an extreme point of egocentrism towards a self that interacts with the world. When they have constructed these self-object poles of existence, their perspective radically changes, and they cannot turn back. There is a radical shift in consciousness, passing into the preoperational period: toddlers can imitate actions that have happened in the past, integrating them into play-roles of cook or doctor, in both their play and their stories. They can name the now stable objects and people, and their language use takes off; their artwork has symbols of stick people, cartoon suns, and animals that do not look like what they are, but are labeled that way. These children assume that because they can control the world, other things are in the world because someone made them that way. They do not wait to explain the world until they understand it as adults

do; they put forth the hypothesis that the sun shines because “God lighted it with a match!” Thus, the structure of reality is informed by the structure of their current state of knowledge. Each new piece of knowledge is interpreted in that light, not copied from the teacher.

Especially when explaining the major stage shifts of the elementary years (the concrete operational period) and later (formal operations), Piaget focused largely on the development of notions of space, time, objects, mathematics, logic, and scientific thinking. These areas of knowledge have a defined right answer in development, unlike those in the humanities. The details on early 20th-century research on these topics can found in other entries in this encyclopedia, but several general principles that are dealt with here.

1. Knowledge forms self-organizing structures. Whereas an empiricist might deal with addition and subtraction separately, Piaget suggested that these two mathematical actions form two halves of the same reversible operation, for example: $3 + 2 = 5$ $2 = 3$. Teaching addition and subtraction as separate habits obscures this relationship. Moreover, in a sense, the structure wants to be completed; the child’s mind is primed for addition by subtraction, and vice versa.
2. The child must invent to understand. Through manipulation of counters or mathematical objects, the child discovers these primed relationships through his own activity. However, it is useful to remember that children need not understand to invent; some of their inventions may be wrong, but fruitful.
3. Contradiction speeds development and widens the “grasp of consciousness”(Piaget, 1976). The self-constructed structures of knowledge are invariably challenged by how the world is: A preschooler who is so egocentric as to think that a doll on another side of a square table sees the same perspective as the child does, is challenged if instead the doll is another child who says, “That’s not what I see!” The preschooler must change her hypothesis about points of view. A child who is so focused on counting to learn addition, can skip the step later in adding $2 + 3$ and can later grab groups of 3’s or 2’s in multiplication. The grasp has widened from 1 by 1 to three 3’s. Later, in algebra (formal operations), the variable x can stand for any number at all.

The teacher must guide (steer wild inventions away from blind alleys) and challenge (contradict to gently point out illogic) and explain (because the child wants and needs explanation for active understanding). According to Piaget, children do not discover properly or efficiently on their own. Children progress through the same major stages but not at the same rates, depending upon experience and skill of educators, but that is not all that matters. Piaget thus viewed

researchers who tried to disprove his theory by showing that younger children could accomplish a task, or who tried to accelerate development with disdain. Alluding to Thorndike and the behaviorist B. F. Skinner, Piaget dismissed this attempt to speed up children’s growth as “The American Question” (Bringuier, 1980; general Piaget references: Gruber & Vonèche, 1977, McCarthy Gallagher & Reid, 1981; for the teacher’s perspective, see Elkind, 1976, and Duckworth, 1996).

THE SOCIAL AND CULTURAL BASES OF COGNITION

Piaget’s focus on the child’s self-constructed structures of knowledge, from egocentrism to abstraction ignores a central truth, which is explored in the theory of the Russian, L. S. Vygotsky (1896–1934), variously called the dialectical, sociogenetic, or cultural-historical school of thought. Vygotsky also criticized the empiricist school and accepted the active role of the child in cognitive development, but children are not the only active players in the drama. In his view, children are social beings from birth, born into a culture with caretakers, peers, teachers, and social structures that actively help a child’s growth and hinder his or her movement into culturally prohibited patterns of behavior. Their actions do not form an environmental layer on top of biological development, nor are they stored in the child; they come to constitute thought itself over time. Language and culture are tools of thought, allowing a child to learn, memorize, and reason in different and better ways than he could without them. There are several basic tenets of sociogenetic psychology:

1. Thought begins as social interaction and is then internalized (Vygotsky, 1978, 1986). For example, at the beginning of life, a parent must remind her child of virtually everything. Complex sequences of activity are kept in the parent’s head, doled out step-by-step to the child. Simultaneously, the parent is teaching the child cultural practices such as putting the book bag by the door so that it will be remembered or, later, keeping a written list. Over time, as the child becomes responsible for larger chunks of activity, the parent might hear the child actually talking herself through the sequence aloud in private speech. The ultimate goal is for the child to use completely internalized, silent inner speech.
2. Children are capable of more advanced behavior with help than they are alone. More advanced peers or adults stand one step ahead of a child and act as a scaffold for more advanced behavior, by sequencing, breaking into smaller steps, reminding, demonstrating, physically guiding the hands, circumscribing, explaining, and prohibiting. At any given time, the number of tasks that a child can accomplish with help is far greater than

those she can accomplish alone. Intelligence, then, is partly social.

3. Language and culture are tools for thought. Children who can talk to themselves are capable of more complex activity than those who cannot. They can rehearse steps of a process or lists of items, state hypotheses to themselves and test them. Those who can write can revise to find out better what they want to say.
4. Culture and history are in every task, even internal cognitive ones. For example, mathematics does have an inner coherent structure, but it also has a social context. People who farm rice are expert in calculation and pricing of those quantities, but not in abstract calculation, although they can easily be taught. Eight-year-old candy sellers in Brazil are error free in complex calculations about candy that older children in formal schools cannot comprehend, but they have trouble carrying their one's (Nunes, Schliemann, & Carraher, 1993).

Thus, teachers in this school of thought promote internalization of higher cognitive processes not merely by lecturing, but by encouraging problem solving through external dialogue among peers of mixed levels of accomplishment in small groups. They model higher-level internalized thought (e.g. summarizing, predicting, questioning) negotiate meaning, referee disputes, keep children on track and generally serve as a guide through the culture of classroom learning, as attached to the larger cultures. Through reciprocal teaching, teachers gradually recede, handing over their tasks to students who take turns acting the role of teacher. Children who can teach have quite sophisticated metacognition: They can consider their audience, break down explanations into steps, ensure that students communicate effectively to one another, and form questions (or else be reminded by their friends that they are unclear). These methods have been used to promote reading comprehension (Palincsar & Brown, 1984; Tharp & Gallimore, 1991), math problem solving (Taylor & Cox, 1997), and science (Hoadley & Linn, 2000).

SEE ALSO *Constructivism*.

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Brian D. Cox

BIOLOGICAL THEORIES

In the fields of biology and psychology, the theory of evolution is used to help to better understand how biological influences on growth interact with experiences to shape developing traits. Examples of this approach are provided by the work of Mary Jane West-Eberhard for the field of biology and David Bjorklund and Anthony Pellegrini for the field of psychology. When applied to people, the basic idea is that there are biases and constraints on the types of knowledge children easily acquire during development, as well as an ability to learn evolutionarily novel and culturally specific knowledge. The corresponding area of evolutionary educational psychology was introduced by David Geary (1995, 2007) and represents an attempt to understand how evolved learning biases interact with the learning of evolutionarily novel knowledge in school.

COGNITIVE EVOLUTION

One basic assumption is that natural selection has resulted in the evolution of cognitive competencies and learning biases that facilitated the survival and reproduction of human ancestors. Evolutionary psychologists such as Leda Cosmides and John Tooby argue that most of these competencies are modular and domain specific; that is, they are supported by brain and cognitive systems that are designed to process only certain types of information. There are, as an example, dedicated brain and cognitive systems that process basic language sounds (e.g., *ba*, *pa*) and different brain and cognitive systems that process other types of information, such as the visuospatial information involved in navigating from one place to the next. The extent to which these modular competencies are *plastic* or modifiable by experiences during development is vigorously debated and not well understood as of 2008.

Whatever the degree of plasticity, modular systems are organized around the domains of folk psychology, folk biology, and folk physics, as exemplified by the work of Scott Atran, Frank Keil, Roger Shepard, and Steven Pinker, among others. The cognitive modules associated with folk psychology appear to be organized around knowledge about the self and about other people. The competencies that allow people to interact with others include language, theory of

mind (e.g., being able to make inferences about the intentions of other people), and abilities that allow people to interpret the body language and facial expressions of others. The competencies associated with folk biology include the ability to classify flora and fauna in the local ecology and learn about the associated growth and behavioral patterns. These are underdeveloped abilities in modern societies, but people in hunter-gather societies have extensive knowledge about the plants and animals in their local area. Folk biological knowledge enables people in these traditional cultures to classify and categorize local species, hunt some of these species, and use plants as medicines, for food, and in social rituals. Folk physics refers to the competencies that allow people to engage the physical world, including the ability to navigate in three-dimensional space, remember the location of objects in the environment, and use objects (e.g., stones) to make tools.

In addition to folk competencies, there are more general cognitive systems that coordinate and integrate the workings of these specialized systems. Alan Baddeley's central executive component of working memory provides a good summary. The central executive is expressed as attention-driven control of information represented by one or several of the more specialized systems, such as the language system. The focusing of attention results in the information being represented in working memory and thus available to conscious awareness. An example is the intentional verbal repetition of information to be remembered, such as a phone number. The central executive also includes mechanisms for inhibiting irrelevant information from intruding into conscious awareness and for integrating information represented in different specialized systems. An example of the latter is integrating the symbol 5 with the sound *five* and with the conceptual knowledge that these represent a set of *five items*.

EVOLUTION, DEVELOPMENT, AND THE BRAIN

The long development of humans has a clear risk—death before the age of reproduction—and thus could only evolve if there were substantial benefits. In cross-species analyses of the relation between length of the developmental period, brain size, and potential factors that may have influenced their co-evolution, Tracey Joffe and many others have identified social complexity as the most important evolutionary pressure. Basically, a long developmental period is found in all social mammals and the length of this period increases with increases in the complexity of the species' social system. These patterns suggest that one purpose of childhood is to practice and refine folk psychological competencies, such as language and other social skills, although learning about other species and the physical world is also

COMPETING PERSPECTIVES ON COGNITIVE DEVELOPMENT

In 2005 Harvard president Lawrence Summers made a statement that would ignite controversy in academic establishments around the world. Women, he suggested, may not be pursuing careers in engineering because they are intellectually inferior to their male counterparts. Summers pointed to possible biological differences between men and women as the culprit of such intellectual differences. Summers' comments brought to light a debate that has perpetually riddled social scientists: are humans primarily the product of nature (biology) or nurture (experience)?

Jean Piaget and Lev Vygotsky were two of the first theorists to examine human development in a learning context. The two have often been pitted against one another as competing for arguments that nature or nurture primarily impact human development. Over the last several decades, researchers have explored and developed these competing arguments. Importantly, even the definitions of "cognition" and "development" have evolved. Development can be understood as any process of change that is organized and adaptive. Cognition can be described as the process of making meaning of information. Cognitive development, then, is an organized, adaptive change that improves our ability to make meaning of information provided by the world around us. It should be clear from this definition that cognitive development relies both on biology and on experience. As a result, social scientists are exploring which aspects of cognitive development are indeed biological and which can be influenced by experience.

One important strand of research focuses on children's development of concepts. A concept is a mental representation of a category (e.g. people, pens, puppets) that helps recognize and organize new information. Concept

researchers disagree about whether concepts are in born or emerge from experience, but they agree that even infants must have some capacity to recognize and organize information. A second strand of research focuses on the timing of experience and its role in cognition. They ask: Does early childhood experience impact cognitive capacity more than later experience? Many argue it does. Partially based on this idea, programs such as Head Start have emerged for low income pre school aged children to ensure they have access to social educational environments early. The "Mozart Effect" (coined by Alfred Tomatis), which refers to the notion that use of classical music can improve psychological disorders, has also been connected to the timing paradigm. Although peer reviewed research does not support the idea that playing classical music for a fetus in utero improves IQ, the practice that grew out of early 1990s theory seems to have maintained popularity through the early 2000s.

In addition to theoretical advances, technological breakthroughs have enabled psychologists to examine brain differences among people who exhibit typical and atypical behaviors. One such development has been the functional Magnetic Resonance Image (fMRI), which can highlight active areas in the brain during specific thoughts or behaviors. Although the technology is new, researchers hope it will help shed light on the possible biological causes of disorders such as Attention Deficit Disorder and Autism. Because the human brain is heavily influenced by genetic heritage, many believe brain research connects much of who people are to their genetic inheritance rather than their experiences. As Lawrence Summers discovered, however, researchers continue to disagree.

Sarah Kozel Silverman

important, especially for children who are growing up in traditional societies.

Play, social interactions, and exploration of the environment and objects appear to be the ways emerging folk competencies are practiced and refined during development. Child-initiated social play, exploration, and so fourth are intimately linked to cognitive and brain development, in that these activities provide experiences with the social, biological, and physical world. These experiences interact with the inherent but skeletal structure of folk modules and

ensure their normal development and adaptation to local conditions. In this view, children are biologically prepared to learn about other people and the biological and physical world and are inherently motivated to seek out experiences that will facilitate this learning.

It is important to note that this is a different perspective than that of Jean Piaget. Piaget proposed that children's inherent curiosity and engagement of the world resulted in broad stages of general reasoning abilities. From an evolutionary perspective, children's curiosity, play, and other

developmental activities are not general but rather focused on fleshing out specific competencies in the domains of folk psychology, biology, and physics. Their interests and motivations are expected to be particularly strong when it comes to social relationships.

NATURE AND NURTURE

For evolutionary developmental biology and psychology, the developing individual and most of the associated traits emerge from an interaction between nature (genetically based programs that guide development) and nurture (experiences that influence how and when these programs are expressed). As described by Sandra Scarr and Kathleen McCartney, the relative contributions of heritable and environmental effects on children can vary from infancy through adolescence. During infancy, the environments children experience are largely controlled by their parents and thus nurture should outweigh nature. As children grow, the influence of parents begins to decline and heritable influences are more strongly expressed. These influences are expressed as children seek their own experiences and build their own niches in their peer groups and in the wider world. In other words, nature influences, to some extent, how children react to other people, how other people react to them, and how interested they are in learning about the biological and physical world, among other traits.

The result is that many estimates of heritable influences on developing traits become larger as people develop into adolescence and adulthood. However, it is not yet fully understood how the expression of heritable influences is influenced by evolutionarily expectant experiences. As described by William Greenough, James Black, and Christopher Wallace, evolution has resulted in a linking of brain development and the expected experiences that will ensure that brain, cognitive, and social development is normal for the species. As an example, human language emerges naturally, that is, without instruction, and is dependent on the maturation and functioning of an integrated system of brain regions. Though heavily dependent on nature, language will not be normal unless the child is exposed to language and social discourse: The natural language systems need experience to develop normally. Variation in language competencies may be partly heritable, but the expression of these heritable differences may also be related to differences in the types of experiences children seek as these competencies emerge.

EVOLUTIONARY EDUCATIONAL PSYCHOLOGY

The cognitive competencies that compose the folk domains have evolved to allow humans to function in and adapt to the social conditions and ecologies of their ancestors. In some cases, as with language, these competencies are just as

useful in the 21st century as they were at earlier points in human evolution. Other competencies, such as those involved in categorizing flora and fauna, may be less useful for many people today. A more central concern in modern society is children's learning of evolutionarily novel competencies, such as reading, writing, and complex arithmetic. Evolutionary educational psychology is the study of the relation between folk knowledge as these influence academic learning in evolutionarily novel cultural contexts, such as schools and the industrial workplace. One core goal of schools and schooling is to organize the activities of children so that they acquire competencies, such as the ability to read, that are important in the wider culture but have no evolutionary history.

David Geary (1995) referred to language and other evolved folk competencies as biologically primary abilities, and skills that build upon these primary abilities but are principally cultural inventions, such as reading, as biologically secondary abilities. The mechanisms by which primary systems are adapted to produce secondary competencies are not yet fully understood, but appear to involve simultaneous activation of the frontal areas of the brain that control attention and working memory and the areas of the brain that support folk competencies.

To illustrate how these interactions might occur, consider the relation between language, a primary ability, and reading, a secondary ability. As proposed by Paul Rozin, the acquisition of reading-related abilities (e.g., word decoding) appears to involve the modification of primary language and language-related systems, among others (e.g., visual scanning). Consistent with this proposal, individual differences in the fidelity of kindergarten children's phonological processing systems, which are basic features of the language domain, are strongly predictive of the ease with which basic reading skills (e.g., word decoding) are acquired in first grade. In other words, the evolutionary pressures that selected for phonological processing systems, such as the ability to segment language sounds, were unrelated to reading, but these systems can be modified to form the sound-letter and sound-word associations that are important components of reading ability.

Implicit knowledge is also built into the organization of folk systems. Sometimes this knowledge can aid in learning and at other times it can interfere with learning. As an example of the former, consider that the initial development of geometry as an academic discipline may have been based on access to knowledge implicit in the primary systems that support navigation in the physical world. The implicit understanding that the fastest way to get from one place to another is to go "as the crow flies," was made explicit in the formal Euclidean postulate, that a line can be drawn from any point to any point. From an evolutionary perspective, the former reflects an

implicit understanding of how to quickly get from one place to another and is knowledge that is built into the brain and cognitive systems that support navigation. The latter was discovered, that is, made explicit, by Euclid. Once explicit, this knowledge was integrated into the formal discipline of geometry and became socially transmittable and teachable.

An example of how implicit knowledge and inferential biases that are part of folk systems can interfere with learning in school is provided by people's naïve understanding of motion. When asked about the forces acting on a thrown baseball, most people believe there is a force propelling it forward, something akin to an invisible engine, and a force propelling it downward. The downward force is gravity, but there is in fact no force propelling it forward, once the ball leaves the player's hand. The concept of a forward-force, called *impetus*, is similar to pre-Newtonian beliefs about motion prominent in the 14th to 16th centuries. The idea is that the act of starting an object in motion, such as throwing a ball, imparts to the object an internal force *impetus* that keeps it in motion until this *impetus* gradually dissipates. Although adults and even preschool children often describe the correct trajectory for a thrown or moving object, reflecting their implicit folk competences, their explicit explanations reflect this naïve understanding of the forces acting upon the object.

Careful observation, use of the scientific method (secondary knowledge itself), and use of inductive and deductive reasoning, are necessary to move from an intuitive folk understanding to scientific theory and other forms of secondary knowledge. Isaac Newton did just this, and in fact he noted: "I do not define time, space, place and motion, as being well known to all. Only I must observe, that the vulgar conceive those quantities under no other notions but from the relation they bear to sensible objects" (1995, p. 13). The "vulgar" individuals only understand physical phenomena in terms of folk knowledge, and Newton intended to and did go well beyond this. Newton corrected the pre-Newtonian beliefs about the forces acting on objects. In doing so, he helped to create the evolutionary novel field of scientific physics. These discoveries, as well as those of many others before and since Newton, have created a gap between children's intuitive, folk understanding of the physical world and modern understanding of these same phenomena. Teaching the latter is made all the more difficult by evolved human biases.

EVOLUTION AND THE MOTIVATION TO LEARN

One important implication is that the motivation to acquire school-taught secondary abilities is based on the requirements of the larger society and not on the inherent interests of children. Given the relatively recent advent of

near universal schooling in contemporary societies, there is no reason to believe that the skills that are taught in school are inherently interesting or enjoyable for children to learn. In other words, one important difference between primary and secondary cognitive abilities is the level and source of motivation to engage in the activities that are necessary for their acquisition. This does not, however, preclude the self-motivated engagement in some secondary activities.

Even though reading is a secondary ability, many children and adults are motivated to read. The motivation to read, however, is probably driven by the content of what is being read rather than by the process itself. In fact, the content of many stories and other secondary activities (e.g., video games, television) might reflect evolutionarily relevant themes that motivate engagement in these activities, such as social relationships and social competition. Furthermore, the finding that intellectual curiosity is a basic dimension of human personality suggests there will be many intellectually curious individuals who will pursue secondary activities. Euclid's investment in formalizing and proving the principles of geometry and Newton's work on motion and gravity are examples. However, this type of discovery typically reflects the activities and insights of only a few individuals, and the associated advances spread through the larger society only by means of informal (e.g., newspapers) and formal education. The point is that the motivation to engage in the activities that will promote the acquisition of secondary abilities is not likely to be universal.

EVOLUTION AND INSTRUCTION

The combination of inherent, built-in brain and cognitive systems and children's inherent motivation to seek out evolutionarily expectant experiences, for example through social play, ensures the appropriate development of biologically primary folk systems. In contrast, there is no inherent structure supporting the acquisition of secondary abilities, nor are most children inherently motivated to engage in the activities that are necessary for all of the different aspects of secondary learning that are necessary for functioning in modern societies. From this evolutionary perspective, one essential goal of schooling is to provide content, organization, and structure to the teaching of secondary abilities, features that have been provided by evolution to primary abilities.

Furthermore, it cannot be assumed that children's inherent interests, such as social relationships, and preferred learning activities, such as play, will be sufficient for the acquisition of secondary abilities, even though they appear to be sufficient for the fleshing out of primary abilities. Instruction must, therefore, involve engaging children in activities that facilitate the acquisition of secondary abilities, whether or not children are inherently interested in engaging in such activities. This does not mean that play and social

activities cannot be used to engage children in some forms of secondary learning. It does, however, mean that it is very unlikely that the mastery of many secondary domains (e.g., reading or algebra) will occur with only these types of primary activities.

In fact, research in cognitive and educational psychology indicates that some forms of secondary learning will require activities that differ from those associated with the fleshing out of primary abilities. These would include, among others, direct instruction, in which teachers' provide the goals, organization, and structure to instructional activities and explicitly teach basic competencies, such as how to sound out unfamiliar words or manipulate algebraic equations. The mastery of secondary domains also requires extensive exposure to the material, distributed over many contexts and oftentimes over many years, as well as extensive practice in using any associated procedures (e.g., to solve mathematics problems). Extensive exposure and practice also appear to be needed for the development of primary abilities, but this exposure and practice automatically occur as children engage in social discourse, play, and exploration. In contrast, most children will not automatically engage in the practice needed to master secondary domains, and, as a result, this practice needs to be built into instructional activities. For some domains, such as in the biological and physical sciences, mastery will also require many hands-on activities, as in conducting experiments, although more traditional methods will be needed as well (e.g., learning basic facts and principles, such as the theory of evolution).

In summary, the core assumption of a biological perspective on children's learning is that evolution has provided a basic brain and cognitive structure to a suite of primary domains. These primary abilities allow people to negotiate social relationships (folk psychology) and the biological (folk biology) and physical (folk physics) world. Children have an inherent bias to seek out and engage in the experiences, such as social play, that will adapt these domains to the nuances of their social group and biological and physical world. However, humans also have an evolved ability to create evolutionarily novel knowledge and to pass this knowledge from one generation to the next (e.g., through books). The cross-generational accumulation of this biologically secondary knowledge has created a gap between knowledge represented by folk domains and that needed to function in modern-day society. Schools emerged in these societies to help children to bridge this gap. In school settings, it cannot be assumed that the cognitive, motivational, and activity biases that support the fleshing out of primary abilities during development will be sufficient for the learning of secondary abilities in school.

SEE ALSO *Brain and Learning: Information Processing Theory*.

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David C. Geary

INFORMATION PROCESSING THEORIES

Information processing theory explains human thinking by relating cognitive processes to the workings of a computer. The model presents the basic components of a

computer as mechanical representations of the components of the human mind used in thinking. The basic components in information process are the sensory receptors, the working memory, and the long-term memory. These relate to the computer's data input device, the data processing area, and the data storage, respectively. Along with these components are the executive functions, such as metacognition, related to the computer's operating system. Research in information processing has helped to develop improved strategies for learning and memory.

Robert Sternberg (1987) claims that information processing is an improvement over traditional views of intelligence because it resolves some long-standing issues. Through information processing theory, any observed deficit in intelligence, such as learning and reasoning ability, can be identified at a process level and improved through training. Deanna Kuhn (2006) recognizes that information processing is an improvement over Piagetian theory because information processing explains how children acquire strategies.

Ann Brown (1997), a sociocultural theorist, integrates ideas from information processing theory. She claims information processing addresses the issue of "what it is that children are ready to learn easily and what (it is that) is resistant to ... instruction (however) exquisitely designed" (Brown, 1997, p. 400). She emphasizes that information processing explains Vygotsky's *zone of proximal development* in which children can perform beyond their developmental abilities if they are given the proper instruction for strategies. Children do not lack the capacity of learning at a higher level than their stage. Often, they are not effectively using the capacity they have. They need education to understand what strategies they have and how to apply them effectively.

INFORMATION PROCESSING THEORY APPLIED TO DEVELOPMENTAL ISSUES

Piagetian theory and information processing theories agree on several points. Both view a child as an active agent in development and learning. Both approaches recognize age-related differences in cognitive abilities and try to explain these differences. Both are concerned with how later advanced understandings can develop from the earlier rudimentary ideas. Finally, both recognize that current understanding can either aid or hinder the development of new understanding.

Differences in the two approaches are based on the explanations of the age-related changes. One of the ways that information-processing theorists account for age-related differences focuses on the increased capacity of the working memory. Kail (2003) notes that "Age-related change in working memory contributes to improved rea-

soning and problem solving during infancy, childhood, and adolescence" (p. 74). Contrary to this, Piaget felt that changes in performance are due to qualitative changes in developmental stages. Piaget attributed little value to repeated exposures or the capacity of memory. Although later in his research career Piaget conceded that there is a relation between memory and strategies, for most of his career he tried to separate memory from understanding.

Piaget emphasized the need to study children's reasoning as exemplified by the broad strategic changes in their approach to problem solving. He felt that older children, having grown into a higher developmental stage, have better logical frameworks and strategies. He did not associate the older children's greater knowledge base and more associations with their improved performance.

Many information processing theorists hold that much developmental change can be explained by greater use of memory strategies, including faster and more efficient diagnosis of memory tasks and monitoring of strategies. Greater task-relevant knowledge also improves the performance based on age. Maturation and experience play an interactive role in the age-related differences observed by information processing theorists (Kail, 2003).

INFORMATION PROCESSING AND DEVELOPMENTAL CHANGES

Some of the key concepts of information processing used to explain developmental changes include the processes involved in memory, thinking, and metacognition. Memory has the functions of encoding, storage, and retrieval. Thinking involves forming concepts and solving problems. Metacognition constitutes the functions bringing about a continuous analysis of one's thinking.

Research in age-related differences conducted from an information processing perspective has discovered phenomena similar to those described by Piagetian theorists. However, there are some new discoveries about children's abilities from information processing research that challenge the Piagetian perspectives. Information process researchers have shown that some skills are developed earlier than suggested by Piaget. Also, some developmental changes previously thought to be qualitative in nature have been shown by information process researchers to progress quantitatively.

An important process of memory is encoding fitting information into long-term memory so it can be retrieved when needed. The age-related differences in encoding involve children's use and application of attention. From infancy until school age, there are distinct differences in the degree to which children are willing or able to attend to an event or activity. Infants quickly habituate to a familiar stimulus; they lose interest in the familiar and look for something new. Infants

demonstrate their processing of information by recognizing that a stimulus is familiar. Infants need change and novelty. Toddlers are also interested in novelty and are not focused very long on any one discovery.

From age 3 on, children spend more time in an activity or challenge that holds their interest. However, the preschool child is easily distracted from an activity by something more sensory arousing than the essential aspects of the task. The child at this age cannot always distinguish the relevant from the irrelevant. In listening to a story or solving a puzzle, children at this age may focus on some inconsequential aspect, distracting them from the essential. After the age of 6 or 7, the child is more efficient at focusing on the relevant characteristics of a task or challenge. Also, at this age children become less distracted and more easily stay on task in their activities. Developmentalists and information processing theorists attribute this change to a cognitive control of attention. The information processing approach explains that the child is learning the importance of developing strategies for concentrating and focusing mental resources.

The grade school child is more efficient at attention tasks than the preschool child because the older child is more likely to plan an effort in maintaining attention. The activities that older children are involved in at school help them recognize the need for organization. When younger children are taught the attentional strategies, they have been able to apply them effectively. However, they do not usually apply them spontaneously. Older children, through experience or maturation, learn to use their minds actively and effortfully. They learn that investing resources produces better results than a passive effort to retrieve available information.

Another age-related difference in encoding is the use of rehearsal, the act of repeating information in the working memory to keep it from fading. Children discover this technique around the age of 5. Before this age, rehearsal is not usually observed. Even when children below the age of 5 are taught this strategy, they usually do not apply it effectively. After the age of 7, children recognize that rehearsal is not the most effective technique for learning and remembering important information. They tend to use it less except in specific circumstances such as remembering a phone number until they can write it down. Information processing theorists explain that the mental effort involved for the younger child is not worth the small return. In addition, younger children who are successful with rehearsal often do not recognize that their success is due to the strategy. Children older than 7 recognize the inefficiency of rehearsals because they have a better repertoire of strategies for remembering, including depth of processing and elaboration.

Elaboration is the mental process of taking new concepts and relating them to personal examples or other

meaningful knowledge or experiences. Elaboration gives the new information more meaning and value. This makes retrieving the information more easy because the memory trail is more distinct. In trying to recover information from long-term memory, encoded among a multitude of code, the memory with the distinct code will be easier to find.

There is a developmental pattern in the use of elaboration. Adolescents tend to use it spontaneously when motivated to remember or learn something new. However, grade school children are not likely to apply it in most circumstances. Grade school children may apply elaboration if they are taught the strategies for a given subject, but will not generalize the skill beyond the given subject. According to Pressley (1982), second graders and fifth graders show little difference in learning vocabulary words without elaboration. With elaboration, the second graders can improve more than 2 ½ times and fifth graders nearly 3 ½ times.

Constructing images is a form of elaboration in which a child creates a mental picture of a concept being learned or remembered. Children 9 years old and older benefit more from being encouraged to use constructing images as a learning strategy than younger children do. Encoding is more effective through organization. Organization involves recognizing and categorizing information based on a hierarchy of the most important characteristics. Organization can be compared to a network in which multiple connections are established based on categories and subcategories of characteristics, properties, and abilities. These various connecting points to a concept can be used as retrieval cues. Children show increased use of organization in middle and late childhood. As with many other strategies, the younger children are much less likely than the older children to apply organization strategies even when taught. Furthermore, the quality of groupings tends to be better among the older children. This is another strategy that is not effort-effective for younger children. "Knowledge (based on networks) can aid memory because it provides special codes that simplify memorization . . . Children's growing knowledge . . . provides more retrieval cues . . . alternative ways to gain access to a concept" (Kail, 2003, p. 72).

Memory time frames are measures of how long relevant information can be retained in sensory and working memory. Sensory memory holds the information from the sensory receptors for only a brief period. Because this information is fleeting it has to be encoded to be saved. A comparison of children's time frame to adult's time frame reveals that adults encode sensory information only relatively faster than children do. However, the small advantage that adults have over children

multiplied by the huge amount of information produces an extremely different cumulative effect.

Short-term memory, also known as *working memory*, has a limited capacity. Most researchers prefer the latter term because the processes are actively applied (as implied by “working”) rather than passively stored (as implied by “short-term”). Information is retained for about 30 seconds in the working memory if not preserved through strategies or encoded to long-term memory. Age-related differences in working memory are attributed to an increased capacity in the working memory and an increased speed of processing. Measures of working memory capacity demonstrate that the increase is based on age. However, there is a wide range of variability at every age because of individual differences. Before age 5, all children are slow at processing. From 5 years old through about 15 years old, speed is closely correlated with age.

Reading is a skill that relies on the working memory. Each word read must be saved in the working memory until the whole sentence is scanned, putting all the words together to form a coherent concept. Kail (2003) notes that “age-related changes in working memory are due primarily to age-related increases in the speed with which children can execute basic cognitive processes” (p. 74).

In a 1989 study by Siegel and Ryan, reading ability and capacity of the working memory were shown to be related. Normal readers and problems readers from age 7 to 13 years old were given a task of working memory. Both groups increased their working memory performance at the same rate, as a function of age. However, they maintained their original group differences in performance gaps.

There is little age-related difference in the capacity of the long-term memory. However, retrieval rates increase with age based on more effective encoding and retrieval strategies. Kail (2003) says “As the capacity of working memory increases with age, children have more resources available to storing and processing operations during reasoning and problem solving resulting in improved performance” (p. 74).

The research into the development of a theory of mind in young children is of interest for various fields of psychology. The finding that a preoperational child can understand another person’s point of view contradicts Piaget’s theory of egocentrism in the preoperational child. Furthermore, researchers have shown a continuous age-related function in acquiring a theory of mind. This means a change more quantitative than the qualitative change that Piaget expected. That there is a wide range of variability in the age that one acquires a theory of mind implies that the change is a function of maturation interacting with experience. Information processing theory takes into consideration the maturation influences and experiential influences more completely than Piaget’s theory does. As with many

other strategies and developmental tasks, the child’s spontaneous application is limited by the working memory. However, the child’s effectiveness can advance based on important experiences or strategy instruction.

Robert Siegler’s 1976 work demonstrates that the application of rules is an age-related function. In solving a problem, young children between the ages of 5 and 9 focus on the most basic rule incorporating only the most visible influence. Children in late childhood recognize that there can be more than one influence but do not necessarily allow for the interaction of influences. Adolescents recognize the influences and the interaction of influences, but rely on guessing in unfamiliar settings. Adolescents stop short of developing and applying a formula that could guarantee success. There is a relationship between the “relative difficulty of the problem-types” and the “developmental trends in performance on them” (Siegler, 1976, p. 518). Illustrative of this is the “balance scale task.” To determine if the arm of a scale balanced on a fulcrum will tip to the right or the left or will balance, the child has to have a concept of the influence of not only the weight of both sides but also the distance of the weight from the fulcrum. The weight of each side multiplied by the distance from the fulcrum determines whether the scale will tip or balance. In reaching a decision young children will only consider the equality of weight on both sides. Older children understand the influence of the distance from the fulcrum but do not fully apply this understanding. Adolescents will apply the influence of the weight and the distance effectively except when one side has more weight and the other side has more distance; they will then guess. Interestingly, the adolescents who have had experience calculating weight by distance will not necessarily apply this solution if they have not had previous experience with this type of scale (Siegler, 1976).

RESEARCH INSPIRED BY INFORMATION PROCESSING THEORY

Among many lines of research that have been inspired by information processing theory, three that are relevant to education include (1) metacognition, (2) critical thinking, and (3) classroom applications.

Kuhn (2006) stresses there is more to know about metacognition and its contribution to improved thinking and reasoning. She notes that Flavell’s seminal research on metacognition in the late 1970s was focused on the underlying strategies that make up memory tasks. However, research since that time has expanded the understanding of the concept of metacognition and increased the theoretical implications needed to be tested. There is still so much that is not known about the development of strategies

relying on metacognitive process. Research needs to study metacognition processes because they help to “explain how and why cognitive development both occurs and fails to occur” (Kuhn, 2006, p. 68). Research has to be increased even in areas in which metacognition has been shown to increase efficiency, such as text comprehension, problem solving, reasoning, and memory. Research in the early 21st century focuses mostly on the effects of metacognition. Kuhn proposes more research on the actual application of metacognition in the process of acquiring new knowledge. Since it is established that individuals change existing ideas to accommodate new knowledge, research should identify the metacognitive processes involved in evaluating the components of the existing ideas in comparison with the components of the new information (Kuhn, 2006).

Critical thinking is another increasing area of research in which the principles of information processing can be applied. Critical thinking involves the active evaluation of the incoming information, questioning the accuracy of information, and verifying the authority of those making the salient statements. Critical thinking leads to more complete analysis of information which in turn leads to (1) a comparison of principles and strategies across domains, (2) an elaboration of information expanded by analogies, richer associations and a hierarchy of accuracy; (3) a willingness to receive and consider the opinions of others, and (4) a higher level of questioning. Other benefits include an intellectual curiosity, effective planning and accurate understanding (Santrock, 2006).

An interesting classroom application of information processing principles is Ann Brown’s 1997 Community of Learners. This program incorporates strategies of metacognition and strategic thinking. The Community of Learners is designed to foster reflection and discussion. Three basic strategies that the students use include teaching each other, consulting with experts through email, and using adults to model how to think and reflect. Students teach each other by sharing insights on the material being studied and seeking more understanding from the others. The experts that the children interact with online encourage the students to think more deeply about the study material through stimulating questions and intriguing discussions. When a visiting expert is expected, the children draw up a number of questions to ask; the teacher helps them organize the questions according to topics and subtopics. Brown’s work is based on the information processing principles she has recognized in her sociocultural research. She has been motivated to help passive students learn strategies to become active agents in their own learning. In addition, she has wanted to demonstrate how learning strategies can be generalized across domains.

SEE ALSO *Information Processing Theory*.

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PIAGET’S THEORY

Jean Piaget (1896–1980), a Swiss psychologist, centered his work on cognitive developmental processes such as perceiving, remembering, believing, and reasoning in children. Piaget was influenced by his experience in the Paris laboratory of Alfred Binet (1857–1911) where he worked on standardizing a French version of a British intelligence test. His studies at the Sorbonne in abnormal psychology, epistemology, mathematics, and the history of science are reflected in his approach to understanding how children think. Piaget used observational methods as well as experimental methodology in developing his theory of intelligence.

Piaget defined intelligence as the individual’s ability to cope with the changing world by continuing to organize and reorganize experiences. He believed that the mental structures necessary for intellectual development are genetically determined and include both the nervous system and sensory organs. These structures set limits on what a child may do at each stage of development. Children are born without logic and construct their own intellectual development based on what they learn at an earlier stage through their informal experiences with the environment. Adaptation, according to Piaget, is the most important principle of human functioning and involves two major processes: assimilation and accommodation. Assimilation occurs when children take in new information from the environment and fit it into a preconceived notion or plan. Babies assimilate food by



Jean Piaget in a classroom. BILL ANDERSON / PHOTO RESEARCHERS, INC.

licking and chewing, but they must also open their mouths to accommodate the size and shape of a spoon. If children once ride on a hobbyhorse and then, in play, use a broom as a hobbyhorse, then assimilation has occurred. However, if children sweep the floor with the broom, then accommodation has occurred. Through accommodation, children adjust to new and changing conditions in the environment. Pre-existing patterns of behavior are changed or modified in order to deal with new situations. Thus, individuals achieve equilibration, a regulatory process whereby a balance is achieved based on the demands of assimilation and accommodation.

STAGES OF A CHILD'S INTELLECTUAL DEVELOPMENT

Piaget conceived of intellectual development as a series of fixed and sequential stages that all children pass through. Although children may go through these stages at different rates, no stage is skipped. The ages at which each stage is entered and completed, however, is somewhat arbitrary. A child, for example, may be in transition in one stage in language usage and at another stage in the understanding of mathematical concepts.

STAGE ONE SENSORY MOTOR STAGE: BIRTH TO AGE 2

The first stage, the sensory-motor stage, consists of six substages. In substage one, random and reflex actions (birth to one month), the newborn uses innate reflexes such as sucking, grasping, blinking, crying, vocalizing, and random movements of arms and legs. Babies may suck their own fingers or even one of a baby near him. Gradually, these movements become more refined and directed, displaying rudimentary intelligence as when babies grasp a rattle and shake it, rub a blanket, tug at their ear, and suck on a nipple when hungry, rather than on a pacifier.

In sub stage two, primary circular reactions (1 to 4 months), babies discriminate among shapes and forms. They may stare at a mobile or mother's face with interest but do not reach out for the mobile to touch the dangling objects. They may not recognize their hands as part of their bodies. If they drop a rattle, they may not search for it. Only later, around 8 months, will the baby search for the rattle, signifying that a lost object is no longer out of mind.

In sub stage three, secondary circular reactions (4 to 8 months), their strategies become more complex and

repetitive. Senses become sharper. Infants may gaze at an unfamiliar object for an extended period of time. They can imitate more complex actions and repeat new sounds. Although they may gaze at their mother's face, they do not purposefully reach for it to touch it. As they advance in age, an important feature of this stage gradually occurs called object permanency, the ability to recognize that when an object is moved from its visual field, the object continues to exist.

During sub stage four, coordination of secondary schemata (8 to 12 months), intentional behavior begins. If babies swat at a mobile hanging over their crib and repeat this act and the mobile moves, a connection is made. The next time they try to reach for the mobile, they do so in a more coordinated way, and a plan or schema for striking at the mobile is formed. Movements become a means to an end. The rattle or bottle may be retrieved if it falls. The notion of object permanency is now a regular part of the babies' intellectual repertoire; it is no longer so easy to divert their attention from something they find desirable. In being able to recall objects even when they are not visible, babies show that their symbolic thought is developing. Babies at this stage smile when their mother approaches the crib; they know she is coming to feed or play with them.

In substage five, tertiary circular reactions (12 to 18 months), babies increase their capacity to explore the environment, constantly inventing new plans if old schemata do not work. Thus, if they want an object outside of the playpen, they may learn to tilt the object to get it between the bars. If they drop food on the floor, they are interested in seeing where this drops. They find it empowering to let go of the food and to repeat this act again much to their parents' consternation. Nesting blocks and shape sorters begin to interest babies who are constantly poking, pulling, pushing objects, testing their strength and trying to make sense out of the environment.

Finally, in substage six, invention of new means through mental combinations (18 to 24 months), toddlers start to think before they act. Some of the information they have assimilated through trial and error in the previous stages can now result in new acts. Limited speech and gestures can convey that they are thinking about a problem and about what they want and intend to do.

Play for toddlers is sensory-motor, the pleasure of using their senses, sucking, biting, touching, and moving toes, fingers, arms and legs. They babble and enjoy listening to sounds of others' voices. They imitate expressions of others such as opening their mouths, imitating hand gestures, and body movements. Ritualistic play or practice play begins in which they repeat acts for pleasure such as swatting at the mobile over the crib or dropping items into a basket. Toward the end of the second year, they

can use a substitute object for an item as when they use a small stick to symbolize a doll or truck. Symbolic imitation in the form of simple play occurs around this time when they attempt, as early as eighteen months, to feed a doll or toy bear.

STAGE TWO PREOPERATIONAL STAGE: AGES 2 TO 7

The term *preoperational* signifies that the toddler has not developed the mental structures to think logically or in abstract terms. There are two substages in this period of preoperational thought, preconceptual (ages 2 to 4 years) and perceptual or intuitive thought (ages 4 to 7 years). During the preconceptual phase, children use rudimentary language and mental images and generalize in illogical ways. In the stage of perceptual or intuitive thought, they solve problems based on intuition and on appearances rather than on judgment or reasoning. This mode of thinking is called transductive reasoning—reasoning from one particular idea to another idea without any logical connection between them. If the train has a whistle, that makes the train move. This cause-and-effect relationship is a distortion of thought.

Preoperational children in the preconceptual phase may also be egocentric, acting on the assumption that the world centers on them. If their food is hot, then everyone's food is hot. If they are cold, then mother must also be cold. Moreover, it is difficult for children in this stage to recognize the difference between reality and fantasy. They believe in animism. The stuffed animals and dolls to which children talk are deemed alive and are given personalities. Sometimes they even become imaginary companions. Preoperational children also believe in artificialism. For example, they may believe that a pond is a giant's footprint that has been filled with rainwater, or that human beings created the moon, sun, stars, and the natural features of the earth.

In terms of language, children who are beginning to talk use echolalia, repeating words that others say and using sounds for pleasure. In this stage they use monologues, a running commentary on what they are doing, without listening or replying to their companions. They also engage in collective monologues: Children will talk at the same time as they sit or play beside each other but not necessarily respond appropriately to each other. Onomatopoeia is often used by preoperational children who enjoy the sounds or noises that objects make such as "choo-choo," "bow-wow," or "meow," long before they can say the actual words that designate the train, dog, or cat. Children in this period have difficulty with centering, the child's tendency to center or concentrate its attention on one aspect of an object at a time and its

inability to shift its attention to other aspects of a situation. They do not relate parts of an object to the whole. A doorknob is a doorknob when attached to the door, but if found on the table, the child may not be able to relate it to its actual purpose. Words are taken literally; these children may interpret “blackmail” to mean that letters and envelopes are the color black, or if a father said he was “tied up” at work, they may envision him with ropes around his legs or arms. They ask many questions but may not expect an answer, or they may answer the questions themselves.

Children in the preoperational stage have difficulty with the concept of conservation of quantity, volume, and size when there are changes in their appearance. For example, when there are two rows of the same quantity of pennies placed one above the other, they look like they contain the same number to a child, but if one row is spread out, the child thinks this row has more pennies than the one that is not spread out. In the same way, two identical glasses filled with equal amounts of water will appear equal, but if one glass is emptied into a taller narrower glass, it will appear to contain more water than the original glass next to it. Two balls made of the same amount of clay look equal to children in this stage, but if one ball is spread out and flattened, the child who cannot conserve believes there is more clay in this elongated clay. Thus, perception rules over logic for the preoperational child. Adults can make the same mistake. For example, a large package of napkins may look as if it contains more napkins than a nearby compressed package. The packages may contain the same number, but adults may need to rely on the label for that information.

The preoperational child’s conception of space is topological. Children can distinguish between open and closed figures, but when asked to copy a triangle or square, children in this stage will draw a circle. If shown open figures of a triangle or square, they will draw an open circle. They think that a bowl is like a dish, but a cup is like a doughnut because they both contain holes.

When preoperational children draw objects, they represent them in two dimensions and only later are able to draw using three dimensions. Young children also have difficulty recognizing and discriminating between two different perspectives of the same object, believing that theirs is the only perspective, termed spatial egocentrism by Piaget. In setting out silverware from the opposite side of a table, they may place all objects on the table from their point of view (upside down) rather than understanding that silverware must be arranged according to the view of the person who will sit at that place setting and use it.

Time is a difficult concept for preoperational children. If it takes one hour to get to a place by airplane, it must be closer in distance from their perspective than if it takes two

or more hours by car. Time also is judged by a concrete action. Supper time and bedtime are designated as periods of time without their knowing clock time. Age is confused with height. A taller child must be older than the smaller child even if they are, in fact, the exact same age.

Imaginative play is at its peak for the preconceptual child and is designated by Piaget as symbolic play. Three- and 4-year-olds engage in pretend or make-believe play and can take on many roles, doctor, prince, queen, or mail carrier. Younger children may play beside their friends without interacting, which is called parallel play, but older preconceptual children enjoy social play by interacting and conversing with each other.

STAGE OF CONCRETE OPERATIONS AGES 7 THROUGH 11

Children at this stage of intellectual development can form interiorized mental operations. In terms of counting, they know that numbers stand for actual objects, and they develop one-to-one correspondence. Numbers are not simply recited in a rote manner, but actually stand for discrete quantities. Gradually, adding, subtracting, multiplying, and dividing are performed mentally. Time has more meaning for them, and some children begin to learn how to tell time. One characteristic of children in this stage is reversibility: Numbers can be counted forwards and backwards; children can trace their path to school and home again; and emotionally, they can put themselves in another’s place and feel empathy.

Classification of objects by color, size, and shape is possible. Demonstrating the ability called seriation, children can arrange objects by size or by weight. Children begin to understand part-whole relationships and can classify using two or more aspects of an entity. For example, they may understand that beads can be both wooden and also be of two colors, white or brown, as in Piaget’s experiments. Thus they can classify by different aspects of an object.

Euclidean geometry can be comprehended in this stage as children learn about different shapes and angles. In this stage of concrete operations, they can coordinate perspectives and rotate surfaces. They can draw a straight line without using an edge. They can understand the difference between curvilinear and rectilinear shapes. They recognize and draw circles, squares, triangles, rectangles, and hexagons.

Children are now capable of conservation, which was difficult in the previous stage; children understand that objects or quantities remain the same even if there is a change in their physical appearance. Piaget carried out various experiments to test children’s awareness of changes in number, substance (mass), area, weight, and volume.

Socialized speech begins and children may use adapted information, an exchange of opinions and ideas in conversation with another child or adult. In this stage, children also begin to use criticism usually based on emotion rather than on logic or reasoning. In this way these youngsters exert their superiority over others. Commands, threats, and requests occur whereby children attempt to influence others. Children enjoy punning, making jokes, and playing with long words. They are capable of argument and use logic and facts to back up their positions.

According to Piaget in the stage of concrete operations, games with rules are enjoyed. Children may still bend the rules, but they are capable of abiding by them, insisting on fair play, and enforcing punishment if rules are broken. Play continues in all of its forms, sensory-motor, imitation, practice, symbolic, and games with rules even into adulthood. Adults use sensory-motor while playing with sand or water at the beach, practice play when trying out a golf swing of an expert, following rules in chess or bridge, and they continually use symbolic play through writing poetry or fiction, acting in a community theater, and engaging in games of pageantry.

STAGE OF FORMAL OPERATIONS AGES 11 THROUGH 16

Piaget's final stage of intelligence coincides with the beginnings of adolescence. Adolescents can think abstractly, use deductive reasoning, and are flexible, rational, and can approach a problem in a systematic way. They can think about space and time in a more abstract manner and are capable of doing more complex mathematics, even physics and chemistry; students can think scientifically. They are capable of mental operations such as drawing conclusions and can construct tests to evaluate hypotheses. The logical or formal operations include theoretical reasoning, combinatorial reasoning, functionality and proportional reasoning, control of variables, and probabilistic thinking. According to Piagetian theory most students in high school are able to exhibit these reasoning patterns. However, research studies (Huitt & Hummel, 2003) have shown that many students have not developed these reasoning abilities. About two-thirds of all people do not develop this form of reasoning fully enough for it to become their normal mode for cognition, and so they remain, even as adults, concrete operational thinkers.

In terms of morality, the adolescent develops an inner values system. Previously, in the premoral stage, toddlers had no obligation to follow rules. Very young children believe in immanent justice: Objects have within themselves the power to punish. Obeying rules literally occurs in the moral conventional stage from about age 4 to 7 when adults are seen as powerful and can inflict punishment. In the autonomous stage, 7- to 12-year-olds

consider the purposes of rules and their consequences if not obeyed. Adolescents, however, understand the appropriateness of punishment, expect others to be fair, and adapt a codification of rules understood by all players and by society as a whole.

PIAGET AND VYGOTSKY

Piaget believed that children construct their knowledge by their own actions on the environment, whereas Lev Vygotsky (1896-1934) placed a greater emphasis on understanding as originating in the social/cultural aspects of society. A Russian educational psychologist, Vygotsky proposed the theory that social interaction and cultural influences lead to a continuous change in children's thought and behavior. Vygotsky disagreed with Piaget's assumption that development could not be impeded or accelerated through instruction. While Piaget believed that concepts should not be taught until a child is in the appropriate developmental stage, Vygotsky suggested that adults could help children learn through scaffolding, reaching a higher level in a subject through being sensitive to their capabilities. He coined the term *proximal development* to refer to that zone or range of tasks that children cannot perform alone but can accomplish with the help of skilled partners, parents, or teachers. Vygotsky criticized Piaget's link between psychology and philosophy. He believed that Piaget was not scientific enough in his methodology. Play was important to Vygotsky who believed that children learn through play, since play is a way of dealing with culture and is necessary for self-regulation and control of behaviors. According to Vygotsky, play also serves to separate thought from actions, thus promoting symbolic thinking. While Piaget discussed play in its many forms, he did not deal adequately with the influence of culture and the social environment on play as Vygotsky did.

EVALUATIONS OF PIAGET

In a scholarly article (1996), Lourenço and Machado rebut criticisms of Piaget's theories; the authors suggest that many writers misinterpret Piaget's conclusions and fail to appreciate the central issues of his theory. Lourenço and Machado also contend that critics do not recognize the post-1970 modifications of Piaget's theories. Lourenço and Machado present in detail ten areas of criticism and their arguments against each. Concepts reviewed in their article include competence in children; age norms concerning when children are able to complete particular tasks; what critics call Piaget's negative view of children; his neglect of cultural and social influences on children; his failure to adequately explain his theory of cognitive development; the descriptive rather than explanatory quality of his work; and finally, his ignoring postadolescent development. Examples of some of the studies that are critical of Piaget appear below.

George Butterworth (1977) and Rene Baillargeon and colleagues (1985) conducted experiments with babies to demonstrate that object permanence occurs much earlier than Piaget believed. Babies appeared to understand that objects continue in existence, but they did not know what to do to find them. Andrew Meltzoff and M. Keith Moore (1983) asserted that babies can imitate human facial expressions as early as two to three weeks of age and imitate movements of others even when they do not see these movements on their own bodies. The discovery of “mirror neurons” (the same regions in the brain that control action also support perception) may be a neurophysiological explanation for these developmental behaviors (Jaffe, 2007). Jean Mandler (1990) found that babies can determine boundaries of objects (separating a cup from a saucer) and can deal with figure and ground experiments at an earlier age than Piaget indicated. Merry Bullock and Rochel Gelman (1979) demonstrated through their studies that children in the preoperational stage could understand cause and effect earlier than Piaget had predicted but are not able to use verbal explanations. These studies suggest that babies are social from birth and that a key way to learn is by observing others, a point more in line with Vygotsky’s premise.

Jean Piaget’s theory, despite many studies that find fault with it, remains into the 21st century an important theoretical explanation of the emergence of logical thought in the development of children.

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VYGOTSKY’S THEORY

The Russian psychologist Lev Semenovich Vygotsky (1896–1934) introduced a theoretical approach that emphasizes the contributions of the social and cultural world to cognitive development. In this theory, basic mental functions, which are regulated by maturation, are distinguished from higher mental functions, which integrate basic mental functions and are used to carry out purposeful, goal-directed action. For Vygotsky, higher mental functions develop from experience in the social and cultural context. He was especially interested in how more experienced cultural members help children learn about the world through the use of cultural tools and symbol systems that support and extend thinking.

For Vygotsky, social and cultural experiences transform cognitive development in that they create thought processes that would not be possible without these experiences. For instance, the cultural practice of literacy transforms the way that people approach memory-related tasks. As the developing child adopts the tools and ways of thinking of the culture, the child’s thought and action become increasingly aligned with the values and practices of their community. To understand how cultural values and practices become integrated with cognitive development, Vygotsky was particularly interested in social interactions involving more and less experienced cultural members. In these interactions, the more experienced partner assists the less experienced partner in ways that support the learner’s engagement in intelligent activities that extend beyond his or her current capabilities. This process is most effective when it is aimed at the learner’s zone of proximal or potential development or the region of sensitivity for learning. For Vygotsky, what people do and learn in the course of collaborative cognitive activity is the foundation of cognitive development.

CORE CONCEPTS

Four core concepts of Vygotsky’s theory are the distinction between elementary and higher mental functions,

the role of mediational means in higher psychological functioning, the importance of social and cultural experience in the development of these mediational means, and the significance of the developmental approach to understanding human cognition.

Elementary and Higher Mental Functions. Vygotsky distinguished two general types of mental functions: elementary and higher-level functions. Elementary mental functions are biologically based and they carry out discrete and basic cognitive functions. Higher mental functions emerge from social and cultural experience, and they are complex in that they integrate many elementary cognitive abilities. Higher mental processes are not simply more complex versions of elementary functions; they are qualitatively distinct in that they also incorporate historical properties of the culture in which cognitive development occurs. These historically based properties are instantiated in the symbol systems (e.g. language, mathematics) and material artifacts (e.g., literacy, technology) of the culture and they are passed onto children by more experienced cultural members. For example, memory has both an elementary and a higher form. The elementary form, which is constructed of images and impressions of events, is similar to perception in that it is unintentional and the environment directly influences its content. In contrast, the higher form of memory involves the intentional use of signs to carry out goal-directed action. For example, when literacy is used to elaborate on or extend the natural memory function it enables a person to carry out an activity that would not be possible without this mediational means. The signs and tools that are used to mediate higher mental functions are conveyed to children through other people in their culture who are experienced with these representational systems and artifacts.

Mediational Means and Higher Psychological Functioning. The use of cultural signs and tools to mediate mental functioning was, for Vygotsky, the single distinguishing feature of human intelligence. Whereas other primates, and human beings when they use basic mental functions, react to and use external features of the world to guide action, human beings are capable of creating signs, such as language and number systems, and tools, such as navigational systems and computer technology, that affect or mediate how people think and interact with the world. Moreover, human beings create and live in an organized social unit called culture, which devises signs and tools that support and extend human thinking and action. Culture passes these systems of representation and cognitive artifacts across generations and, thereby, creates the historical basis of human cognition.

An important part of Vygotsky's theory is the idea that signs and tools are not merely external forces or

stimuli to which children learn to respond. Rather, signs and tools carry meaning and it is the meaning that is learned and adopted by children. By participating in this meaning system, the child is able to engage with others in goal-directed behaviors as well as interpret and act upon the world in ways that make sense to other people in their developmental context. Children come to understand and use cultural signs and tools largely through social interaction, especially with more experienced cultural members. Cultures also provide institutions and formal social settings, such as rituals, and less formal social settings, such as storytelling routines, which provide children with access to valued mediational forms. More experienced cultural members play significant roles in this process. They are the most immediate participants in children's lives who use the mediational means of their culture to support thinking. More experienced cultural members guide children in the development and use of these cultural systems and they model the use of these systems in their own actions.

Language plays a central role in Vygotsky's theory. The acquisition and use of language is a primary component of children's developing intellectual abilities because it provides children with access to the ideas and understandings of other people. Language also enables children to convey their own ideas and thoughts to others in meaningful ways. With development, language, which is a cultural product, comes to mediate individual mental functioning. Therefore, as children learn to use language, the cultural system of meaning is gradually incorporated into their thought processes and, as a result, it both facilitates and constrains thinking.

Researchers have studied several social processes that promote children's learning of culturally valued skills, such as observational learning, the social regulation of attention, deliberate efforts to transfer knowledge from more to less experienced partners, social coordination during joint cognitive activity, and cognitive socialization through conversation and joint narratives. Taken together, this research suggests that social opportunities for children's learning appear in many forms and that culture determines the frequency and manner with which these processes occur.

Development of Mediational Means. To examine social and cultural contributions to intellectual growth, Vygotsky focused on social interactions involving children and more experienced cultural members. In his view, these interactions provide children with opportunity to practice, and thereby develop, cognitive skills under the tutelage of more experienced partners. Because these interactions introduce children to higher-level cognitive processes, Vygotsky saw children's participation in these interactions as a better index of children's potential development than individual performance, which describes what children already are

capable of doing. Vygotsky was less concerned with children's individual intellectual capabilities at any particular point in time than he was with their potential for intellectual growth through social experience.

To assess this potential and to understand how intellectual development occurs, Vygotsky proposed the notion of the *zone of proximal development* (ZPD), defined as the difference between a child's actual developmental level as revealed in independent problem solving and the child's potential level of development when solving the problem with adult guidance or in collaboration with a more capable peer. For instance, a child learning how to count may be able to count to 10, but not beyond 10, on her own. When she tries to count the small collection of coins that she has saved, which exceeds 10 coins, she will not be able to do so on her own. In order to count the coins, the child may enlist an older sibling or parent to help her, or perhaps the sibling or parent may recognize the child's need and offer help. The interaction that ensues will help the child find out how many coins she has, which is her goal, while at the same time it will provide her with a chance to learn about, and practice, counting above 10. During the interaction, the more experienced partner may rely on many different techniques, such as modeling how to count the coins, suggesting ways to organize the coins to make counting easier, and instructing the child in number terms and numerical sequence.

For Vygotsky, the important features of this interaction for cognitive development are (a) the child would not be able to reach the goal of counting all her coins without the help of a more experienced partner, (b) the child is a full participant in the interaction, albeit a participant who has less understanding and skill at the task than does the more experienced partner; (c) the child's participation provides her with access to and experience with the thinking of the more experienced partner, and (d) the child is introduced to a way of solving the problem (counting beyond 10) that is valued in the culture in which the child will eventually be expected to function as a mature member. The reason this interaction helps the child advance in her understanding of counting is not solely due to the input of the more experienced partner, however. The child is able to participate in this interaction and, thereby, learn from it because she is actively engaged in the learning and is intellectually ready to embrace the new level of understanding that is introduced. In other words, the interaction is targeted at the child's zone of proximal or potential development. In contrast, if the more experienced partner were to insist that the child count up to 20 on her own before the partner provided help, the child would be unable to do so and the opportunity to learn, previously described, would not occur.

The concept of the zone of proximal development is twofold. First, it represents an alternative approach to the assessment of intelligence—examining children's intellectual potential under optimal conditions, that is, conditions that are tailored to the child's specific learning needs and that build on the child's present capabilities. These ideas were especially relevant to Vygotsky's research on the learning needs of children with disabilities and mental retardation. Second, the zone of proximal development represents a way of understanding how cognitive development occurs through social interaction with more skilled partners. As such, it builds bridges between the mind of the individual child and the minds of others.

According to Vygotsky, working within a child's zone of proximal development—that is, with the assistance of an adult or more experienced peer—allows the child to participate in the environment in more complex and competent ways. In other words, in social interaction targeted toward the child's zone of proximal development, a child has the opportunity to engage in more advanced cognitive activities than the child could undertake alone. This is because more experienced partners are able to arrange an activity in a way that makes it more accessible to the learner. More experienced partners also help the learner by modeling new strategies for solving the problem and supporting the learner's involvement in the more complex components. For Vygotsky, the most significant aspect of social interaction for cognitive development is the fact that social experiences convey to children the mediational means for adapting basic cognitive abilities to higher cognitive functions.

Importance of the Developmental Approach. Vygotsky considered the developmental method critical to psychological study. His interest in development led him to focus on dynamics of change, both within an individual, as captured in the idea of the zone of proximal development, and in a culture, expressed in the signs and tools that are used to organize and guide intelligent action.

Vygotsky was interested in four different ways in which history contributes to the development of higher mental functions: general cultural history, ontological history, the history of higher psychological functions, and the history of a particular learning experience. General cultural history includes aspects of human social life that are passed across generations and represent collective means of acting and thinking, such as material resources or tools that support thinking and socially organized activities and institutions in which intelligent actions occur. Ontological history is a person's individual or life history, and it includes the integration of biological processes that regulate the development of basic mental functions and sociocultural processes that regulate the development of higher mental functions. The history of higher psychological functions examines how specific mental functions, such as remembering, have

changed over human history as they have adapted to the circumstances and environments in which people live. The history of a particular learning experience includes change at the microanalytic level and is captured in the process described in the notion of the zone of proximal development.

Vygotsky did not believe that any single factor could explain all of mental functioning and its development. He was critical of reductionist views of his time, such as behaviorism, as well as theories that were broader in scope but nonetheless posited single explanatory forces for psychological functioning, such as Gestalt psychology with its emphasis on structural forms. Vygotsky emphasized the multiple forces underlying psychological phenomena and he argued that these forces were only apparent when they were in the process of change or development.

VIEWS ON COGNITIVE DEVELOPMENT

Vygotsky proposed that cognitive development is a product of social and cultural experience. He saw social interaction, in particular, as a critical force in intellectual development. Through the assistance provided by others, children gradually learn to function intellectually as individuals. Vygotsky defined the sociocultural environment of cognitive development in very broad terms, including social interaction, the values and practices of the culture, and the tools and symbol systems that people use to support and extend thinking. However, Vygotsky did not view individual psychology or human cognition as socially determined. He proposed that cognitive development is socially constructed. In other words, individual psychological functioning is an emergent property of the sociocultural experiences of the human organism. During social interaction that supports cognitive development, the child participates in and learns ways of thinking and acting that were not previously available to the child. The cognitive growth that emerges is initially intermental—it occurs between two or more individuals. Following the interaction, if the child's thinking and understanding change so as to resemble what occurred during the interaction, the resulting cognitive change or development is intramental or psychological. Because the child's own capabilities, interests, and goals contribute to the social interaction, what develops is not a duplicate of the partner's understanding. Rather, it emerges as the partners work and think together.

Vygotsky considered cognitive development as a process of qualitative change. He focused on changes that occur when elementary mental functions, such as involuntary memory, are transformed into higher mental functions, such as voluntary memory. For Vygotsky, higher mental functions are the result of the transformation of basic cognitive abilities into mental processes that

are capable, with the aid of mediational means, of devising and carrying out conscious, goal-directed actions. To this end, he concentrated on changes in the mediational means that an individual uses to understand and act upon the world, and social phenomena are instrumental in this process.

Vygotsky was interested in a range of mediational means, both symbolic and material, including language, mathematics, mnemonic devices, artistic symbols, and literacy. For Vygotsky, when children learn how to use and eventually adopt signs and tools that support thinking, the fundamental nature of thinking changes. Furthermore, these mediational means not only support and extend an individual's intellectual functioning; they connect the individual's thinking and action with the social and cultural context in which development occurs.

RELATION TO PIAGETIAN THEORY

In contrast to Jean Piaget's emphasis on individual functioning, Vygotsky stressed the relation between individual cognitive development and the sociocultural environment in which this development occurs. Although Piaget did consider some aspects of the social environment in his theory, in particular peer interaction, Vygotsky defined the social environment in much broader terms. Like Piaget, Vygotsky was a constructivist. However, Piaget concentrated on constructive processes in the individual's mind, whereas Vygotsky emphasized the socially constructed nature of cognitive development.

Another distinction between Piaget and Vygotsky is in their views on the relation of thought and language. For Vygotsky, thought and speech are independent in early development, but around the second year of life they join together when children begin to use words to label objects. Within a year, speech assumes two forms: social or communicative speech and egocentric or private speech. Vygotsky's view of egocentric speech differs markedly from Piaget's concept of the same name. For Vygotsky, egocentric speech is a form of self-directed "dialogue" that the child uses as a guide in solving problems. As such, egocentric speech becomes a tool for intellectual growth. By age 7 or 8, this form of speech becomes internalized in the thought process and becomes inner speech, an internal monologue that guides intelligent action.

For Piaget, egocentric speech reflects a limitation of the preoperational stage in which the child's self-focused way of thinking leads children to explain natural phenomena in reference to the self, for example by claiming that the moon follows the child home at night. Unlike Piaget, who thought that egocentric speech served no useful cognitive function, Vygotsky considered egocentric speech as one step in the path of the development of internalized knowledge. Finally, Piaget suggested that

egocentric speech diminishes at the end of the preoperational period, as the child's perspective-taking abilities improve, whereas Vygotsky thought that this kind of speech becomes internalized as thought. Much of the research evidence tends to favor Vygotsky's position; for example, children use more private or self-speech when encountering a difficult cognitive task and, as a result, their performance improves.

INFLUENCE ON LATER DEVELOPMENTALISTS

At the time of his death from tuberculosis in 1934 at the age of 37, Vygotsky was a prominent psychologist in Russia with a large following of students and colleagues. However, in 1936 his influence was threatened when the Stalinist regime banned his writings. Two of Vygotsky's close colleagues, A. R. Luria and A. N. Leont'ev, who also went on to become prominent psychologists, helped to sustain and advance Vygotsky's ideas during this time. In 1953 Stalin died and by 1956 Vygotsky's writings were again available in Russia. In the early 1960s, the influence of his ideas extended beyond Russia when the first English translations of his writings appeared in the book *Thought and Language*. Since then many other translated works have followed, and these ideas have inspired much theoretical, empirical, and applied research on cognitive development. Vygotsky's ideas are especially influential in some contemporary approaches to cognitive development, such as the sociocultural perspective and cultural psychology.

Vygotsky's theory has had considerable impact in both developmental psychology and education. His ideas have inspired much research on the contributions of adult-child and peer interaction to cognitive development. The form of instruction known as scaffolding was inspired by Vygotsky's ideas. Scaffolding is the process by which the more experienced partner or teacher adjusts the amount and type of support provided for the learner in relation to changes in the learner's needs over the course of the interaction. The concept of guided participation, introduced by B. Rogoff as a way of describing children's informal learning experiences outside of school, was also informed by Vygotsky's ideas.

Since the late 1980s educational programs that draw on Vygotsky's ideas have increased. In these programs more knowledgeable people, especially teachers, play critical roles in arranging and supporting children's learning using techniques like scaffolding, collaboration, and the provision of tools that support learning and thinking. In the method of reciprocal teaching, developed by A. Palinscar and A. L. Brown, the idea of the zone of proximal development is used as the basis of a tutoring program for children in reading comprehension. Another class-

room application is the community of learners model, introduced by A. L. Brown and J. Campione. In this approach, the teacher uses the technique of scaffolding to support children's learning, and the students, who vary in knowledge and ability, actively help each other learn through their interchanges.

CRITIQUE AND CONTRIBUTIONS

Vygotsky's theory emphasizes the culturally organized and socially mediated nature of cognitive development. This theory offers a view of cognitive development that respects the contexts in which this development occurs and, as such, it overcomes limitations in theories that focus solely on the individual or on the environment. Vygotsky's theory has made developmental psychologists more aware of the importance of the immediate social contexts of learning and it has increased appreciation of the importance of culture in cognitive development. This theory also provides a way of conceptualizing how cultural symbol systems and tools get passed across generations as they are incorporated into the developing mind. The shortcomings of the theory include lack of specification regarding age-related changes in cognition and how other aspects of development, such as physical, social, and emotional capabilities, contribute to cognitive change.

Vygotsky left developmental psychology a unique and valuable legacy of ideas. His approach to cognitive development has helped steer the field toward an important set of questions that are not found in other contemporary theories. His emphasis on mediational means as central to intellectual development provides a cornerstone for contemporary research in a wide range of areas including language development, social cognition, problem solving, educational psychology, child socialization, and cultural psychology.

SEE ALSO *Communities of Learners; Guided Participation; Reciprocal Teaching; Scaffolding.*

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Mary Gauvain

COGNITIVE LOAD THEORY

Cognitive load theory (CLT) can provide guidelines to assist in the presentation of information in a manner that encourages learner activities that optimize intellectual performance. Central to CLT is the notion that human cognitive architecture should be a major consideration when designing instruction. This cognitive architecture consists of a limited working memory (WM), which interacts with a comparatively unlimited long-term memory (LTM). The limited WM carries the risk of learners being cognitively overloaded when performing a high-complexity task. According to the theory, the limitations of working memory can be circumvented by coding

multiple elements of information as one element in cognitive schemata, by automating rules, and by using more than one presentation modality.

COGNITIVE ARCHITECTURE: MEMORY AND SCHEMAS

WM is what people use when engage in activities such as reading. The text is a stimulus that enters the sensory register through attention and recognition. WM is used for all conscious activities and is the only memory that can be monitored. Everything else content and function is concealed until brought into working memory. A problem, especially for instructional designers, is that WM is limited to about seven new items or elements of information at any one time when the information merely has to be remembered (Miller, 1956; Baddeley, 1992). Furthermore, when this new information is also used to organize, contrast, compare or work on, only two or three items of information can be processed simultaneously (Cowan, 2000). Finally, WM is not one monolithic structure, but rather a system embodying at least two mode-specific components: a visuo-spatial sketchpad and a phonological loop coordinated by a central executive.

In contrast, LTM is what people use to make sense of and give meaning to activities such as reading. People are not directly conscious of LTM. It is the repository for more permanent knowledge and skills and includes all things in memory that are not currently being used but which are needed to understand (Bower, 1975). Most cognitive scientists believe that the storage capacity of LTM is unlimited and is a permanent record of everything that a person has learnt.

Human cognition thus places its primary emphasis on the ability to store seemingly unlimited amounts of information, including large, complex interactions and procedures, in LTM. Human intellect comes from this stored knowledge and not from long, complex chains of reasoning in working memory. Because of its capacity limitation, WM is incapable of such highly complex interactions using new information elements not previously stored in LTM. It follows, that instruction (and instructional design) that require learners to engage in complex reasoning processes involving combinations of unfamiliar information elements are likely to present problems and not work well. Instruction, thus, must consider how this information is stored and organized in LTM so that it is accessible when and where it is needed.

According to schema theory, after being processed in WM, new knowledge is stored in LTM in schemas. A schema is essentially a mental framework for understanding and remembering information. For example, "the existence of a cognitive schema for the letter *a* allows us to treat each of the infinite number of printed and hand-written variants

of the letter in an identical fashion” (Sweller, 2002, p. 3). Schemas categorize information elements according to how they will be used (Chi, Glaser & Rees, 1982). When new schemas are formed or existing schemas altered, learning occurs. Schemata can integrate information elements and production rules and become automated, thus requiring less storage and controlled processing. Skilled performance and increasing expertise consists of building increasing numbers of increasingly complex schemas by combining elements consisting of lower level schemas into higher-level schemas. Although, WM can process only a limited number of new elements at a time, the size, complexity, and sophistication of known elements the schemata is unimportant, because a schema can be treated as a single entity. In summary, schema construction aids the storage and organization of information in LTM and reduces the risk of a learner being overloaded by an instruction.

COGNITIVE LOAD

As a result of the WM limitation instruction should be designed so that WM is capable of processing the instruction (i.e., the information that constitutes the instruction). The instruction, because of its information elements that have to be processed, as well as the way it is designed, imposes a cognitive load (CL) on a learner. For understanding to commence, the load should not exceed the capacity of the limited WM. Thus CLT is concerned with measures that can be taken to control the cognitive load and the construction of schemata, that is, learning. The challenge for the instructional designer is to ensure that the limits of the learner’s WM load are not exceeded when he or she is processing instruction.

Both causal and assessment factors affect CL (Paas and Van Merriënboer, 1994a; see figure 1). Causal factors can be characteristics of the subject (e.g., cognitive abilities such as expertise), the task (e.g., task complexity), the environment (e.g., noise), and their mutual relations. Assessment factors include mental load, mental effort, and performance as the three measurable dimensions of CL. Mental load is the portion of CL that is imposed exclusively by the task and environmental demands. Mental effort refers to the cognitive capacity actually allocated to the task. The subject’s performance is a reflection of mental load, mental effort, and the aforementioned causal factors (Kirschner, 2002).

WM load is affected by the inherent nature of the instruction (intrinsic CL) and by the manner in which the instruction is presented (extraneous and germane CL). The following (Kirschner, 2002) is a short explication of these three aspects of CL.

Intrinsic cognitive load is a direct function of performing the task, in particular, of the number of elements that must be simultaneously processed in working memory

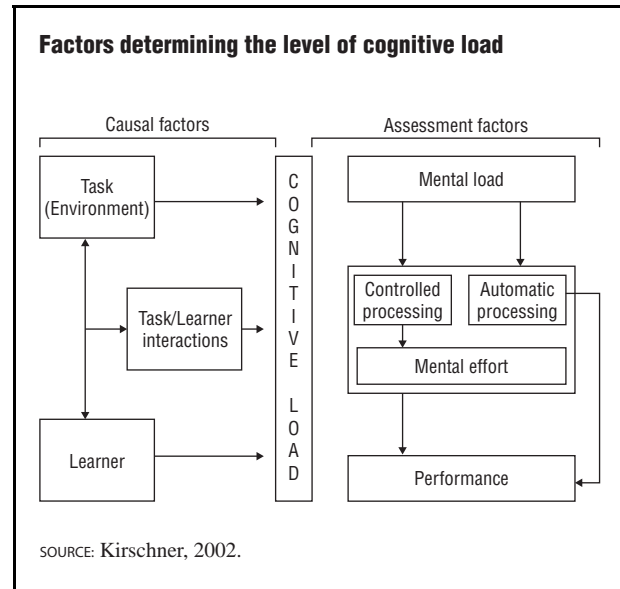


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

(element interactivity). A task with many constituent skills (a high-complexity task) that must be coordinated yields a higher intrinsic load than a task with less constituent skills (a low-complexity task) that need to be coordinated. Cerpa, Chandler, and Sweller (1995) give the following example. Learning basic operations on cells in a spreadsheet program, such as selecting a cell or group of cells, entering data into a cell or modifying data already in a cell are low-complexity tasks with low element interactivity. Each operation can be learned independently with minimal reference to any other operations. By contrast, creating formulas requires learning that cells are intersections of rows and columns, identifying and manipulating them, learning that formulas consist of a number of cells and operations/operators (i.e., equals/=, add/+, subtract/-), all of which must be learned and understood in conjunction with each other.

Extraneous cognitive load is the extra load beyond the intrinsic CL, mainly resulting from poorly designed instruction. For instance, if learners must search in their instructional materials for the information they need to perform a learning task (e.g., searching for data needed in a cell somewhere else in the spreadsheet or determining what the value of a variable in a cell might be while the task is to learn how to use a spreadsheet), this search process itself does not directly contribute to learning and thus causes extraneous CL.

Germane cognitive load is related to processes that directly contribute to learning, in particular to schema construction and rule automation. For instance, consciously

connecting new information with what is already known, rather than focusing on task details (e.g., making explicit that the operator in a specific cell is very much like a different one already learned, but varies with respect to a specific characteristic), is a process that yields germane CL.

Intrinsic, extraneous, and germane CL are additive in that, if learning is to occur, the total load of the three together should not exceed the WM capacity. A basic assumption of CLT is that an instructional design that results in unused working memory capacity due to low extraneous CL because of appropriate instructional procedures may be further improved by encouraging learners to engage in conscious cognitive processing directly relevant to learning, that is, germane CL (Paas & Van Merriënboer, 1994b). Consequently, the greater the proportion of germane CL created by the instructional design, the greater the potential for learning.

According to CLT the limitations of working memory are rarely taken into account in conventional instruction. Conventional instructions tend to impose a high extraneous CL on WM, whereas learning something requires shifting from extraneous to germane CL. CLT states that the instructional interventions cannot change the intrinsic CL because this is *ceteris paribus* intrinsic to the material being dealt with. Extraneous and germane CL, however, are determined by the instructional design (Sweller, 1994). Appropriate instructional designs decrease extraneous CL but increase germane CL, provided that the total CL stays within the limits of WM capacity.

MEASURING COGNITIVE LOAD

Measuring CL can be done with several assessment techniques, subjective, physiological, and task- and performance-based (Paas, Tuovinen, Tabbers, & Van Gerven, 2003). Subjective techniques are based on the assumption that people are able to assess the amount of mental effort they expended. A frequently used measuring instrument in this category of techniques is the one-dimensional ninth-grade symmetrical category scale developed by Paas (1992), in which learners have to rate their perceived mental effort after completing a task on a 9-point rating scale ranging from “very, very low mental effort” to “very, very high mental effort.” Physiological techniques are based on changes in cognitive functioning that are reflected in physiological measurements like heart rate or eye activity. Task- and performance-based techniques consist of primary task measurements, which is the actual task performance, and of secondary task measurements, based on the performance of a second task, which is performed concurrently with the primary task. Some of these techniques have been combined to give a relative indication of the acceptable level of cognitive load. A good example of such a combination is

the instructional efficiency measurement developed by Paas and van Merriënboer (1993), which combines primary performance with the subjective mental effort rating scale developed by Paas to obtain information on the relative mental efficiency of instructional conditions.

EFFECTS GENERATED BY CLT

CLT research has led to the development of a number of instructional formats primarily meant to decrease extraneous CL. These have enabled freed up WM capacity to be used for effective learning, and therefore studies have been conducted in which germane CL was increased when it was considered directly relevant to schema construction (Sweller, 1999). The basic assumption in these studies is that an instructional design that results in unused WM capacity because of a low intrinsic CL imposed by the instructional materials, and/or low extraneous CL due to appropriate instructional procedures, may be further improved by encouraging learners to engage in conscious cognitive processing that is directly relevant to schema construction. Clearly, this approach can only work if the total CL of the instructional design (the combination of intrinsic CL, extraneous CL, and germane CL) is within working memory limits. This is the new frontier of instructional design.

An exhaustive overview of CLT-based instructional formats and their empirical base is given by Sweller, van Merriënboer, and Paas (1998); Paas, Renkl, and Sweller (2003); and Van Merriënboer and Sweller (2005). Six of the most researched instructional techniques are (a) the goal-free effect, (b) the worked examples effect, (c) the completion effect, (d) the split-attention effect, (e) the modality effect, and (f) the redundancy effect.

The goal-free effect occurs when a learner receiving a conventional, goal-specific problem learns less than when he or she receives a non-specific or goal-free problem to solve. Novice learners with a specific learning goal focus primarily on the goal and therefore pay no attention to other information. They compare the current state of a problem (i.e., where they are) to the goal state (i.e., where they want to get to, the solution), and the difference between them is divided up into a series of sub-goals that will have to be achieved to reach the goal, using their own limited repertoire of operators. This so called means-ends analysis approach (Newell & Simon, 1972) operates on the principle of trying to reduce differences between the goal state and problem givens, but it is a weak approach to problem solving, because it is an approach or strategy independent of a particular problem and causes a high extraneous CL. Consequently, it is detrimental to learning. In goal-free problems, a problem solver has no other option than to focus on the information provided (the given data) and to use it where possible, automatically

inducing a forward-working solution path similar to that generated by expert problem solvers. Such forward-working solutions impose very low levels of extraneous CL and facilitate learning.

The worked examples effect involves using known and resolved examples, which diminish extraneous CL and improve comprehension. A worked example consists of a problem and the steps to its solution. Reviewing worked examples eliminates the need to use means-end analysis because, since the solution is provided, it is no longer necessary to search for an operator to reduce the difference between the current state and the goal state. Presenting the problem solution allows the learner to focus on individual problem states, the problem solving moves associated with them, and the problem states resulting from these moves. Because this is the type of information contained in a problem-solving schema it was hypothesized that worked examples would help in schema acquisition and automation as well as in reducing working memory load since they deconstruct a problem solution into its parts.

The completion effect has a similar rationale and effect as that of the worked examples. Instead of providing a completely worked out example followed by a problem, the learner is provided with partially completed worked examples. Such examples provide enough guidance to reduce problem solving search and extraneous CL while problem completion ensures that learners are motivated to continue working.

The split-attention effect occurs when learners are forced to process and integrate multiple and separated sources of information. Many instructional materials make use of both a pictorial component and a textual component of information. Often, the pictorial component (i.e., a graphic) is presented with the associated text above, below, or at the side of it. This manner of presentation introduces a split-attention effect in which the learner must attend to both the graphic and the text, because neither alone provides sufficient information for solving the problem. Learning and understanding can only occur after mental integration of the different sources of information. WM capacity needed for integrating the graphic information and the textual information is subsequently unavailable for processes that foster learning. Good instructional design incorporates (i.e., physically integrates) the graphical and textual information, thus reducing the need for the learner to do this and thus freeing up WM for learning. This is the traditional spatial split-attention effect. In addition, there is also a temporal split-attention effect that holds that learning from mutually referring information sources is facilitated if these sources are not separated from each other in time but, rather, are presented simultaneously.

The modality effect occurs when information is presented in two different sensory modalities, for example

when textual information is presented in auditory form and diagrammatic information is presented visually. By making use of both auditory and visual channels, effective WM capacity is increased. This expanded WM can be used to reduce mental workload and results in better learning than equivalent, single-mode presentations that only use visual information (Tabbers, Martens, & van Merriënboer, 2004).

The redundancy effect holds that the multiple processing of the same information that is presented more than once—such as when a presenter projects a slide and then reads it aloud to the audience—has a negative effect on comprehension since it increases extraneous CL. This effect sounds counter-intuitive because most people think that the presentation of the same information will have a neutral or even positive effect on learning. However, the presentation of redundant information causes learners to unnecessarily attend to individual bits of repeated information that can be understood in isolation. Also, learners must first process the information to determine whether the information from the different sources is actually redundant. These cognitively demanding processes do not contribute to meaningful learning.

EFFECTS OF CLT RESEARCH ON INSTRUCTIONAL DESIGN

In their book Van Merriënboer and Kirschner (2007) discuss how good instructional design can control CL and by doing so increase and/or facilitate learning. The CL associated with performing learning tasks is controlled in two ways. First, intrinsic CL is managed by organizing the learning tasks in easy-to-difficult task classes. For learning tasks within an easier task class, less elements and interactions between elements need to be processed simultaneously in WM. As the task classes become more complex, the number of elements and interactions between the elements increases. Second, extraneous CL is managed by providing a large amount of support and guidance for the first learning task(s) in a task class, thus preventing weak-method problem solving and its associated high extraneous CL. This support and guidance decreases as learners gain more expertise (“scaffolding”).

Because supportive information typically has high element interactivity, it is preferable not to present it to learners while they are working on the learning tasks. Simultaneously performing a task and studying the information would almost certainly cause cognitive overload. Instead, supportive information is best presented before learners start working on a learning task. In this way, a cognitive schema can be constructed in LTM that can subsequently be activated in WM during task performance. Retrieving the already constructed cognitive schema is expected to be less cognitively demanding than

activating the externally presented complex information in working memory during task performance.

Procedural information consists of cognitive rules and typically has much lower element interactivity than supportive information. An example of procedural information is knowing that a voltmeter needs to be attached to a circuit in parallel while an ammeter must be attached in series. Furthermore, the development of cognitive rules requires that relevant information is active in WM during task performance so that it can be embedded in those rules. Studying this information beforehand has no added value; therefore, procedural information should be presented precisely when learners need it. This is, for example, the case when teachers give step-by-step instructions to learners during practice, becoming in effect like an assistant looking over the learners' shoulders.

Finally, part-task practice automates particular recurrent aspects of a complex skill. In general, an overreliance on part-task practice is not helpful for complex learning. But the automated recurrent constituent skills may decrease the CL associated with performing the whole learning tasks, making performance of the whole skill more fluid and decreasing the chance of making errors due to cognitive overload.

SEE ALSO *Constructivism; Information Processing Theory.*

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COGNITIVE STRATEGIES

A cognitive strategy is a mental process or procedure for accomplishing a particular cognitive goal. For example, if students' goals are to write good essays, their cognitive strategies might include brainstorming and completing an outline. The cognitive strategies that students use influence how they will perform in school, as well as what they will accomplish outside of school. Researchers have found that effective learners and thinkers use more effective strategies for reading, writing, problem solving, and reasoning than ineffective learners and thinkers.

SOME IMPORTANT DISTINCTIONS

Cognitive strategies can be general or specific (Pressley & Woloshyn, 1995). General cognitive strategies are strategies that can be applied across many different disciplines and situations (such as summarization or setting goals for what to accomplish), whereas specific cognitive strategies tend to be more narrow strategies that are specified toward a particular kind of task (such as drawing a picture to help one see how to tackle a physics problem). Specific strategies tend to be more powerful but have a more restricted range of use. Effective learners use both general and specific strategies.

Strategies have been distinguished from skills. Although skills are similar to strategies, they are different in that they are carried out automatically, whereas strategies usually require individuals to think about what strategy they are using (Alexander, Graham, & Harris, 1998). Effective learners develop the ability to use strategies automatically while also reflecting upon those strategies when necessary. People who are able to reflect upon their own cognition and cognitive strategies are said to have metacognitive awareness.

One factor that determines whether students use a strategy is whether students know what the strategy is and how to use it. Strategy use can be influenced both by knowledge of what the strategy is and how to use it, and by belief in the effectiveness of the strategy (Chinn, 2006). One reason why students may not use an effective strategy is that they do not know about it. For example, students who study simply by reading a textbook chapter a second time may not know that more effective strategies include actively trying to summarize the text and trying to explain challenging ideas to themselves. A second reason why students do not use strategies is that they may not believe the strategy is effective or worthwhile. The student who is encouraged to summarize the chapter may not believe it will really improve learning, or the student may agree that it will improve learning but that the amount of additional learning is not worth the time that summarizing takes.

STRATEGY USE AND THEORIES OF LEARNING AND DEVELOPMENT

The role of effective strategies in learning and thinking is emphasized by most theories of learning and development. Information processing theorists treat strategies as procedures that act on information in working memory in ways that improve memory and understanding through better interconnections with existing knowledge. For example, elaborating information is an effective strategy because it integrates new information with other information retrieved from long-term memory.

Constructivists emphasize the role of strategies as learners construct new knowledge. Strategies such as

identifying problems with one's own understanding can help learners construct new understandings. Students who learn effectively will have a wide range of effective strategies for constructing knowledge at their disposal.

Lev Vygotsky (1896-1934) developed a sociocultural theory of development that emphasizes the role of groups in enabling learners to master strategies. Learners internalize strategies after first encountering them in group conversations. For instance, students may internalize the strategy of critiquing their own writing after participating in collaborative discussions in which peers critique each other's writing.

Social cognitive theorists emphasize the role of efficient strategy use in becoming a self-regulated learner. Self-regulated learners are those who are adept at controlling their own learning processes without outside supervision or help. Self-regulated learners are able to set goals for learning (e.g., study for an exam), select strategies to achieve these goals (e.g., outline each chapter and make sure each main idea is understood), monitor whether they are achieving these goals (ask themselves questions about whether everything makes sense), and make adaptations if goals are not being achieved (e.g., going back and rereading some hard-to-understand sections).

IMPORTANCE OF COGNITIVE STRATEGIES IN LEARNING AND THINKING

There are several lines of research that support the importance of cognitive strategies in learning and thinking. One prominent line of research compares experts with novices or proficient students with less proficient students (e.g., Chan, Burtis, Scardamalia, & Bereiter, 1992; Chi, Bassok, Lewis, Reimann, & Glaser, 1989). Researchers using these methods have found significant differences in strategy use between more and less proficient learners, reasoners, and problem solvers.

A second line of research experimentally examines the effects of training students to learn by employing a strategy or set of strategies (e.g., Graham, MacArthur, & Schwartz, 1995). Many such studies have demonstrated that students who learn the new strategies outperform those who did not learn the strategies.

A third line of research comes from long-term classroom experiments or quasi-experiments (Brown, Pressley, Van Meter, & Schuder, 1996; Guthrie et al., 2004). These studies usually last many months, often a whole school year. They contrast a traditional school curriculum that does not focus much on strategy instruction with curricula that teach students many different cognitive strategies. These studies have shown that with carefully designed instruction, students' performance on measures of learning, reasoning, and/or problem solving improves.

Finally, researchers have compared high-performing schools with low-performing schools to see if they differ in their emphasis on strategy instruction (e.g., Langer, 2001). A number of studies have found that higher-performing schools do in fact focus more on helping students learn effective cognitive strategies than lower-performing schools do.

Much of the research on cognitive strategies has sought to identify particular strategies that are effective on different kinds of tasks. The remainder of this entry will examine strategies that have proven to be effective in comprehension, writing, problem solving, and reasoning, and discuss several effective domain-general strategies for general self-regulation.

COMPREHENSION STRATEGIES

Comprehension strategies are strategies that help students understand and remember material such as texts and lectures. Most of the research on comprehension strategies has focused on learning from reading texts. Five strategies that have been found to be useful for enhancing comprehension are monitoring, using text structure, summarizing, elaborating, and explaining.

One widely studied comprehension strategy is monitoring (Markman, 1979). When students monitor their understanding, they review as they read in order to check that they comprehend what they are reading or learning. This skill develops with age as students' reading proficiency increases. Many unsuccessful learners mistakenly believe that they understand ideas that they do not in fact understand; they have not mastered the strategy of accurately monitoring their understanding.

The strategy of using text structure involves utilizing the organization of a text in order to enhance comprehension (Meyer & Rice, 1984). The structure of a text refers to how ideas are organized. For example, textbooks are often organized by main concepts with several paragraphs of supporting details and peripheral concepts. Editorials are organized as a claim followed by arguments intended to persuade people that the claim is true. Compare-and-contrast essays are organized around a series of points and counterpoints. Authors use cues such as topic sentences, headings, transition words, and underlined or bold-faced font, to highlight their particular text structure as they write. These cues are used by proficient readers to help them organize the ideas they are learning. Ineffective learners make little or no use of text structure cues.

Three other important comprehension strategies are summarization, elaboration, and explaining. When students summarize, they choose the most important concepts from the text and express them in their own words. Summarization is not an easy task for students (Dole, Duffy, Roehler, & Pearson, 1991). Poor readers often generate

summaries with too much detail and too little focus on key points. In addition to summarization, effective learners elaborate, which means connecting new information to information that they already know (Gagné, Weidemann, Bell, & Anders, 1984). Elaboration is different from mere paraphrasing. When students paraphrase, they simply re-interpret, in their own words, the text that they have read. In contrast, when students elaborate, they actively link the new information to old information. A student who contrasts a text about democracy to information learned earlier about dictatorships has elaborated, as has the student who connects the text about democracy to the student's own personal experiences serving on student council. Finally, when students explain ideas, they ask themselves "why" questions and then attempt to answer these questions. For instance, as students read a book on U.S. pioneers, they could try to explain why the pioneers risked so much to travel west. Studies have shown that generating explanations is a highly effective means of learning (Chi, de Leeuw, Chiu, & LaVancher, 1994).

PROBLEM SOLVING STRATEGIES

Problems occur when a person has a goal but does not immediately see how to achieve that goal. The person must then apply problem-solving strategies to try to achieve the goal.

The mathematician George Polya (1887-1985) devised four effective problem-solving strategies: understanding the problem, developing a plan for a solution, carrying out the plan, and looking back to see what can be learned. In addition to looking back to see what can be learned, learners can check to make sure that the solution makes sense. If a math problem asks how many 40-seat buses are needed to take 120 students on a field trip, the answer 4,800 does not make sense. Ineffective problem solvers often generate solutions such as this that show little or no reflection on what the problem means.

In addition to these strategies, there are other strategies that researchers have found to be highly effective for problem solving. These strategies include representing the problem, identifying sub goals, and noticing commonalities and differences.

When representing the problem, problem solvers develop a clear picture of the problem. Sometimes this means literally making a drawing or a diagram. Sometimes it means creating a mental vision of the problem situation. Useful problem representations (a) are complete, (b) embed initial inferences that can be drawn from the problem information, and (c) exclude irrelevant information.

Real-world problems tend to be complex; they cannot be solved with a simple one-step solution. As a consequence, problem-solvers must set sub goals that must be achieved on the way to achieving the overall

goal (Thevenot & Oakhill, 2006). Effective problem solvers learn to establish sub goals that effectively break down complex problems into manageable steps.

Examining and reflecting on contrasting problems can be an effective way to learn how to solve future problems better. By noticing how a difference in problem conditions affects the best solution (e.g., how a change in the wording of a mathematical word problem changes the solution method), problem solvers gain knowledge that can help them solve problems more efficiently in the future.

WRITING STRATEGIES

Writing can be viewed as an ill-structured problem—a problem with numerous potential solutions but no specifically defined criteria for deciding what counts as a good solution. Therefore, strategies that are useful in writing will be strategies that are more likely to be useful for other ill-structured tasks (such as designing a house or developing a campaign plan) than for well-structured problems with agreed-upon solution procedures.

In a 1986 study John Hayes and Linda Flower developed an influential model of writing that has guided thinking about effective writing strategies. Hayes and Flower identified three basic writing processes: planning, sentence generation, and revising. Planning and revising have been the subject of the most research.

When students plan, they think about what they are going to write about and organize these ideas before they start writing (Kellogg, 1988). Effective planners both *generate* ideas and *organize* those ideas. Effective writers typically generate more ideas than they need; this gives them a reservoir of ideas from which to choose. Organization involves ordering ideas and selecting which to include and which to exclude. Planning can fail either because the writers generate too few ideas or because the writers do a poor job of combining the ideas into a well-integrated fabric. Effective writers spend substantially more time planning than less successful writers. They often start by working at a more general level before fleshing out their ideas with many details. Effective writers are more likely than ineffective writers to make major changes to their plans as they are planning, or even later when they begin writing.

Effective student writers tend to use a planning strategy called *knowledge transformation*, by which they take their existing ideas and fashion them anew into new ideas and new structures of thought (Bereiter & Scardamalia, 1987). Ineffective writers (and younger writers, as well) use a strategy called *knowledge telling*. Knowledge tellers do little or no planning, and they certainly do not fashion their current ideas into new structures. Instead, they write down ideas on paper exactly in the order that they think of them.

Once a draft is composed, effective writers revise their work (Hayes & Flower, 1986). Good writers spend more time revising than poor writers do. But they also differ from poor writers in the quality of their revisions. Poor writers may simply lightly proofread their work, if they do anything at all. More successful writers often make major revisions, perhaps choosing to make major changes to the structure of the paper or rewriting a paragraph to make it more understandable for the reader. Good writers also take the audience into consideration throughout the writing process.

REASONING STRATEGIES

Reasoning strategies are strategies that help people decide what they believe to be true or correct and what they believe to be false or incorrect. There are several strategies that differentiate more successful reasoners from less successful reasoners: generating arguments and counterarguments, fair-mindedness in evaluating evidence, considering control or comparison groups, sourcing, and seeking corroboration.

Generating counter-arguments refers to the ability to come up with arguments that *oppose* one's own argument. Most adolescents and adults can generate two to three times more arguments than counter-arguments; even the number of arguments generated for one's own claim tends to be fairly low. Researchers have argued that an important reasoning strategy is therefore to learn to consider alternative positions and arguments more carefully (Kuhn, 1991).

Ineffective reasoners tend to be biased when evaluating evidence. For instance, they will discount studies that oppose their position by pointing out many flaws in the study, but when they read a similarly flawed study that supports their position, they seem not to notice the flaws at all (Chinn & Brewer, 2001).

Effective reasoners tend to consider relevant comparison groups (Stanovich, 1999). If shown data that students who attended a test prep center increased their test scores by 20% in 2 months, they will not jump to the conclusion that the center improves test scores. They will notice the lack of a comparison group and will wonder whether students who did not attend the center also improved their test scores over 2 months.

A fourth reasoning strategy used by effective reasoners is sourcing (considering the source of the information when evaluating it). Students reading historical documents typically fail to consider—or even pay attention to—who wrote the document (Wineburg, 1991). Thus, they will not notice important issues such as whether the source might have been biased. This is an especially important concern because of the Internet; many sources on the Internet are not credible, yet many poor reasoners do not recognize or consider the credibility of the source.

Finally, effective reasoners employ the strategy of corroboration, which refers to consulting different sources of information to try to verify what is learned from one source with supporting information from another source (Wineburg, 1991). For example, a historian would be more likely to believe a former president's account of how a legislative battle was won if this account is corroborated in important details by documentary evidence.

GENERAL SELF REGULATION STRATEGIES

General self-regulation strategies are strategies that can be used in almost any learning, problem solving, or reasoning situation. Researchers have stressed the importance of a number of general self-regulation strategies (Zimmerman, 1998). Prominent among these are goal setting, self-monitoring and self-evaluation, time management, and executive control.

When students set goals, they are recognizing and identifying what exactly they want to accomplish. Students can set long-term, intermediate-term, or short-term goals. Effective learners will use all three of these types of goals, but pay particular attention to short-term goals as steps toward longer-term goals. Research also supports the value of focusing on process goals (such as the goal of using the summarization strategy effectively) rather than just focusing on outcome goals (such as the goal of getting an *A* on the test) (Zimmerman & Kitsantas, 1999).

Monitoring has been discussed earlier as a comprehension strategy. As a general self-regulation strategy, self-monitoring, together with self-evaluation, refers more generally to the observing and taking note of the activities that one is engaged in. As students self-monitor, they are evaluating their progress toward achieving their goals. Self-monitoring includes deciding what standards one will use to judge one's own progress (e.g., deciding how to judge whether good progress has been made while conducting a science experiment). It also requires students to determine whether they have attained the goals that they have set. If they find that they are not making good progress toward their goals, they will need to develop a revised plan that will lead to better progress.

Effective time management requires students to organize their time effectively in order to accomplish goals. Proficient learners tend to manage their time more effectively than their less proficient peers.

Lastly, effective outcomes demand that the learner be skilled at controlling and managing different strategies and using them when appropriate. When learners can manage strategies effectively in this way, they have achieved executive control over the strategies.

EDUCATIONAL IMPLICATIONS

This entry has briefly reviewed some of the main cognitive strategies that enhance comprehension, problem solving, writing, and reasoning. It has also examined several of the many general-purpose self-regulation strategies that can be used on any kind of learning or thinking task.

Because less successful learners frequently use less effective strategies, teachers can help students learn by identifying strategies that students are using (assessing strategy use) and, if necessary, helping them learn more effective strategies (strategy instruction).

One method for assessing strategy use is to administer formal or informal self-report questionnaires to determine what strategies students themselves say they are using. One type of self-report questionnaire used by teachers is a cognitive strategy questionnaire (such as the widely used *Motivated Strategies for Learning Questionnaire* (MSLQ), developed by Paul Pintrich and colleagues), which asks students about their strategy use. A disadvantage of self-report measures is that students might not answer truthfully, they might misunderstand the questions, or they might lack the metacognitive awareness needed to answer accurately. An advantage of self-report measures is that they can be administered quickly to many students.

The second general way that teachers can assess strategy use is by listening to the strategies students are using as they speak in class discussions and group work or what they write in their assignments. The teacher can also listen to students' strategy use when working with students individually. Teachers can encourage their students to "make their thinking public" by thinking out loud as they are reading a text, solving a problem, writing, or reasoning. By listening to what students say in these contexts, teachers can gain an understanding of their students' strategy use. This will enable teachers to set instructional goals to help students learn more effective strategies that will help them become better learners and thinkers.

SEE ALSO *Critical Thinking; Metacognition.*

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COLLABORATIVE LEARNING

Collaborative learning (also known as cooperative learning) occurs when small groups of students, called collaborative groups, work together to complete an academic task. As its name suggests, in order for collaborative learning to be successful, students must *collaborate* productively and work together on a task, sharing ideas and learning from one another. Researchers have found that if collaborative learning is designed properly, students learn more than when working individually. Conversely, poorly designed collaborative learning does not promote learning goals effectively.

GOALS AND OBSTACLES

For many researchers and educators, the ultimate goals of collaborative learning include the following:

- Each individual in the group effectively learns the academic content, such as gaining a conceptual understanding of photosynthesis or the Great Depression.
- Each individual becomes more proficient in the use of cognitive strategies such as comprehension, problem solving, and reasoning strategies.
- Each individual develops valued social skills, such as engaging in prosocial behavior and the ability to work well in group settings. These are skills that are needed to work effectively in teams as adults.
- All individuals learn to value and respect their peers, to appreciate diversity, and to develop friendships.

Some researchers advocate goals not only at the level of individual learning but also at the level of the overall class. For example, in their 2006 article, Marlene Scardamalia and Carl Bereiter advocate a view of learning, or knowledge building, in which the goal is for the class as a whole to generate knowledge. For example, a class might generate knowledge that is new to them about photosynthesis by reading a variety of sources, conducting their own experiments, and posting their ideas on a shared

computer space. The collaborative learning process is valuable to the extent that the class collectively generates ideas new to most or all students on this shared space.

However, there are common obstacles to achieving these goals (O'Donnell & O'Kelly, 1994; Salomon & Globerson, 1989). First, students in groups may waste time in *off-task behavior*. Second, students in collaborative groups may engage in *social loafing*, in which some of the students in a group do little or none of the work, relying instead on others to do the work for them. Third, *unequal interactions* can occur, in which some students talk most of the time, and/or some students participate very little or not at all. Fourth, *negative interactions* among students can occur (e.g., criticism, ridicule, or harassment). Fifth, there may be *no interactions* at all; although the teacher intends for the students to work together, they may instead work independently. Sixth, even if there are interactions, the interactions may be of *low quality*; students may not engage in the kinds of talk that can drive learning forward. Finally, there is the problem of *social status differences*, in which group work can exacerbate existing status differences among students (e.g., students viewing others as more or less intelligent) (Cohen, 1994b).

PRODUCTIVE GROUP PROCESSES

Researchers investigating different ways of organizing collaborative learning have identified a number of collaborative learning formats that promote the goals described above (Barron, 2003; Cohen, 1994a, 1994b; D. Johnson & Johnson, 1990; D.W. Johnson & R.T. Johnson, 1991; Slavin, 1996; Webb, 1982; Webb & Farivar, 1994). These formats promote a number of interactive processes that are conducive to learning. The first of these processes is *engagement*. When groups are engaged in the task at hand and interested in the task, they are naturally less likely to fall into off-task behavior or social loafing. Second, David and Roger Johnson have emphasized the importance of *positive interdependence*, which occurs when students can only complete a task by working together; the task cannot be completed as effectively or at all when working individually. Effective positive interdependence is likely to result in *joint attention* to the tasks at hand (Barron, 2003). This means that students are focused on the same task, often literally looking at the same information and certainly talking about a common topic. Students will also be more likely to work effectively if they have *mutual respect* for one another. Mutual respect will also reduce negative feelings and discriminatory feelings. Effective groups are also marked by *balanced participation*. When balanced participation occurs, all students in a group are contributing to the discussion. As they listen to each other, they display frequent *uptake*

of ideas. Uptake refers to responding to peers' ideas by accepting and building on them through further discussion, or by engaging in constructive argumentation when students are not in agreement. Finally, students in collaborative learning groups should also engage in *high-quality strategy use*, which includes both social strategies and cognitive strategies.

A great deal of research has focused on cognitive strategy use in groups. Generally, students who use high-level cognitive strategies such as elaboration, explanation, and coordinating theories with evidence learn more from collaborative work than students who do not employ these strategies. Noreen Webb (Webb, 1982; Webb & Farivar, 1994; Webb, Farivar, & Mastergeorge, 2002) and her colleagues have produced a very influential body of work that has emphasized the importance of giving and receiving explanations during group work. For example, if students are working on mathematics problems in groups, when a student explains to another how to do a problem, or how to carry out some of the steps in the problem, the giver of the explanation typically benefits. The receiver of the explanation may benefit if the explanation is sufficiently elaborated and if the receiver proceeds to apply what was learned. In contrast, when one student simply tells another student the answer (this is called *terminal help*), this can even be harmful to the learning of the student who receives terminal help. Webb's research has pointed to the importance of designing collaborative learning formats in ways that increase the frequency of explanations in group work and decrease the frequency of terminal help.

Another class of highly productive strategies is providing alternative perspectives on issues and advancing reasons and evidence (Chinn, 2006). Students benefit from encountering ideas that are different from their own, and they gain a deeper understanding of ideas they are learning when they consider how claims are related to evidence for and against those claims.

INSTRUCTIONAL FORMATS

Researchers have developed many instructional formats intended to promote instructional goals by achieving most or all of the productive group processes discussed above. This section provides an overview of several of these: methods incorporating reward structures, guided questioning, and complex tasks.

Methods Incorporating Reward Structures. Robert Slavin (Slavin, 1990, 1996) is the most well-known proponent of the use of reward structures to promote learning in groups. Slavin has distinguished between three methods for assigning rewards to a group. The first is that the entire group can receive a reward for its performance (e.g., each group member receives the same grade on a

group project). This method does not encourage positive interdependence; the most skilled student may do all the work to ensure a high grade. Other students may loaf or be excluded. In a second method, students work together in a group but receive individual grades. This method discourages social loafing because each group member is individually evaluated, but it provides no reason for students to work together. Lastly, students can receive group rewards based on individual improvement on quizzes or worksheets over class periods. For example, students might receive a group reward based on the average individual improvement on a math quiz to be taken after the collaborative work. This provides incentive for students to help each other. The more proficient students will want to help the less proficient students because their reward depends partly on the performance of those students on the quiz. The less proficient students have an incentive to collaborate in order not to let the group down. Slavin has recommended that the rewards for average group improvement not be grades but rewards such as class points that can be exchanged for free time, computer times, or stationery items.

The use of rewards in group work is controversial because many researchers have argued that tangible rewards undermine intrinsic motivation (David W. Johnson & Roger T. Johnson, 1991). Researchers investigating group rewards for average individual performance have typically not included measures of motivation. In addition, the learning tasks that have been investigated have typically been relatively simple tasks such as the straightforward study of textbook material for a quiz, rather than more complex tasks. Rewards may not be needed for more complex, authentic problem-solving tasks that are more intrinsically interesting (Cohen, 1994b).

Guided Cooperation. In *guided cooperation*, students are directed to use specific cognitive strategies, such as summarization or elaboration. There are many kinds of guided cooperation, including scripted cooperation, peer-assisted learning strategies (PALS), guided peer questioning, and reciprocal teaching. Research has supported the efficacy of all of these methods.

In *scripted cooperation* (O'Donnell, 1999), students (usually working in pairs) are given specific instructions to summarize texts and evaluate each other's summaries. PALS is a guided cooperation method in which pairs work together to improve reading comprehension (Fuchs, Fuchs, Mathes, & Simmons, 1997). One of its core components is a form of scripted cooperation. The stronger reader reads the text for five minutes while the weaker reader acts as a tutor, responsible for correcting any mistakes the reader makes. After the reader finishes reading, the tutor asks the reader to explain what he or she has learned and fills in any missing information.

Then, the students switch roles. In *guided peer questioning* (King, 2002), students are given a series of questions with blanks, such as "How is _____ different from _____ that we learned about before?" Students in pairs question each other with questions that they construct from these question stems. Answers require students to use strategies such as elaboration and explanation. In *reciprocal teaching* (Palincsar & Brown, 1984), students typically work in groups of three or four. Students take turns being the group leader. All students read the passage and then the leader summarizes the passage and asks questions based on the passage, which the entire group should discuss. Then the leader offers a prediction or asks for a prediction about the next part of the text. All of these guided cooperation methods seek to promote learning goals by creating explicit demands for students to employ high-quality cognitive strategies in their conversations.

Complex Tasks. Many researchers have called for the use of more complex tasks in collaborative group work, such as writing skits, conducting research, creating multimedia presentations, investigating scientific questions, and solving real-life problems (Cohen, 1994b). These tasks can take hours, days, or weeks to complete and require much higher-level and complex strategies and thinking. Complex tasks require the use of multiple strategies and diverse knowledge; it is critical that no student has enough knowledge to complete the task individually. Many researchers support the production of public artifacts (such as posters presented in a poster fair) in complex tasks to promote engagement and adoption of high standards for work.

There are several specific approaches to the use of complex tasks that have strong research support. In *Group Investigation* (Sharan & Sharan, 1992), the class begins with a broad topic provided by the teacher. Groups of students choose and investigate specific topics of their choice within this topic. Students work out how to divide the work and work toward a presentation for the whole class.

Constructive Controversy is a method in which students engage in argumentation about a topic. Students work together to discuss reasons or evidence supporting an argument but remain open-minded about changing their minds. In one version of this approach, pairs of students first explore one side and then another side of an issue, interleaving pair work with work in groups of four. Students ultimately work out their final position in groups of four (D. W. Johnson & Johnson, 1995).

In *Complex Instruction* (Cohen, Lotan, Scarloss, & Arellano, 1999), students work collaboratively, moving to different stations in the classroom. For example, in a unit on feudal Japan, students might perform tasks such as preparing a skit addressing life in feudal Japan or

developing a model showing patterns of social stratification in a castle town (Lotan, 1997).

Interventions to reduce status differences are very important in Complex Instruction. One such intervention is the multiple-ability treatment, in which the teacher emphasizes to students that in order to complete complex tasks, the group needs many different cognitive abilities, such as problem solving, writing, planning, public speaking, and hypothesizing. Then the teacher must make it very clear to the students that “*None of us has all of these abilities; Each one of us has some of these abilities*” (Cohen, 1994a, p. 128, italics in original). Complex tasks for which this is true are thus essential to Complex Instruction. A second intervention is providing separate instruction to the lower-status students so that they can become experts on the task and teach it to the higher-status students. Teachers also highlight the contributions of students who make contributions to the groups.

Knowledge Forum provides students with a computer environment in which they can jointly explore issues, posting their ideas and responding to peers ideas (Scardamalia & Bereiter, 2006). The goal of knowledge forum is to create classrooms in which the class taken as a collective whole is engaged in constructing knowledge that is new to all of the students. This simulates real-world knowledge creation that occurs in real settings such as research teams in universities, task forces in government, or design teams in corporations.

SCAFFOLDING COLLABORATIVE WORK ON COMPLEX TASKS

Students will need scaffolding to complete complex tasks successfully. Scaffolding refers to a variety of different kinds of help that enable students to complete tasks that they could not have completed on their own. Scaffolds may be provided by the teacher or built into the supporting materials such as texts, worksheets, or computer software that students are using.

One method of scaffolding is *preteaching needed knowledge and strategies*. Teachers might provide instruction into how to construct arguments before asking students to complete tasks involving written argumentation. Another method, *task decomposition* occurs when teachers break tasks down into smaller parts. Teachers could help students break the process of conducting their own original science investigation into a series of steps such as generating a question, designing an experiment, and so on.

A heavily investigated method of scaffolding is the use of *cognitive prompts*, which are questions or directions to use specified strategies or to reflect on particular issues. For example, students learning about history from original sources could be prompted to consider whether authors of documents might be biased. One kind of prompt asks

students to construct diagrams, such as diagrams of how evidence supports or contradicts a theory.

Researchers have also employed *social and cognitive roles*. A role in collaborative work consists of instructions to focus on a particular kind of task. An example of a social role is to be the discussion leader. Another social role is to take responsibility for making sure that everyone gets the opportunity to talk. An example of a cognitive role is the role of “explainer,” who might be responsible for making sure that the group develops complete explanations for its ideas.

Hints can be provided when students are having difficulty. A number of researchers have developed computer-based learning environments that are capable of providing hints to students at times of difficulty. Researchers generally recommend that the provider of the hint whether a teacher or a computer provide the least possible amount of help to enable students to solve the problem on their own.

Self-evaluation is a powerful scaffolding method that encourages students to regulate their own learning processes. In self-evaluation, groups of students evaluate their own performance along criteria provided by a teacher or developed by themselves (Sharan & Sharan, 1992; Webb & Farivar, 1994). Self-evaluations help students learn the criteria by which high levels of performance are identified. For example, in their 1998 study White and Fredriksen had students evaluate their performance along criteria that included “being systematic” and “writing and communicating well.”

An important principle of scaffolding, regardless of which form of scaffolding is used, is that scaffolds should be *faded* over time. This means that students are given less and less help until they can complete the task on their own.

All of these scaffolding methods are designed to facilitate productive group processes as students work together in groups. Many scaffolding methods are particularly focused on promoting effective use of high-level strategies as students work on complex tasks. The complex tasks themselves are designed to encourage engagement, positive interdependence, and a desire to work well with peers to solve a challenging problem that requires all of their knowledge and abilities to solve.

PREPARING STUDENTS FOR GROUP WORK

Before dividing students into collaborative groups and assigning them tasks, teachers must make sure that they prepare students for group work first so that they can work in groups effectively and productively. One way teachers can do this is through team building exercises to encourage mutual respect and caring among students and sometimes also to show that working in a group can

be more productive than working individually. A second way teachers prepare students is by providing group norms for students to use as a guideline for working in groups. The norms are usually posted in visible places in the classroom to remind students to treat each other with respect, to listen to one another's opinions openly, and to engage in positive interactions.

THE TEACHER'S ROLE

Research on the teacher's role in collaborative learning provides mixed recommendations. Most agree that the teacher needs to be attentively listening to the students and evaluating the quality of the interactions. However, some researchers believe that teachers should be quite active and should intervene frequently and help groups when they need it, whereas others believe that teachers should actively walk around and listen carefully but should interact with the groups only minimally. There is relatively little research on this important issue.

GROUP SIZE AND COMPOSITION

The ideal group size varies according to the task. Many effective implementations of collaborative learning (such as guided cooperation) have employed pairs. Others have used larger groups, typically no larger than six, however. Groups of about four may be best when working on complex tasks such as Group Investigation.

In composition, groups can be heterogeneous (composed of students of different genders, abilities, and ethnic backgrounds) or homogenous (composed of students who are similar to one another in these dimensions). Researchers have not identified a single ideal type of group composition. In addition, the idea of making groups heterogeneous along dimensions such as gender and ethnicity carries with it a major disadvantage: When students see that groups are always mixed in gender and ethnicity, this makes gender and ethnicity highly salient. If a class is made up of 25% of students from a minority group, it would be highly undesirable always to put a single minority student in every group of four, never allowing students from this minority group to work together. A good alternative to any fixed way of assigning groups is to use flexible grouping so that students form different groups on different days, depending on their interests, on who needs to work on a particular skill, or based on diversity of background knowledge relevant to a task.

Collaborative learning is potentially a highly effective method of instruction. However, it is not the case that any way of doing it will be effective, or even that most ways used commonly by teachers are effective. Only those methods that promote productive group processes and provide needed support to students as they engage in complex tasks are likely to be effective.

SEE ALSO *Cognitive Strategies; Constructivism.*

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COMMUNICATION WITH PARENTS TO ENHANCE LEARNING

In its broadest sense, school communication with parents includes all the information that flows intentionally or not from teachers, the school, the district, and the student to the parents (including, for the purposes of this entry, persons fulfilling the role of parent in the child's life outside of school). This entry, however, focuses on features of intentional school-to-parent communication that may increase parents' involvement in schools and improve student learning and motivation, with an emphasis on strategies for individual teachers. The considerations and strategies are presented in the context of written communication, but they are relevant to other forms of communication as well.

A FRAMEWORK FOR PARTNERSHIPS

Increasing parents' positive involvement in their children's education is one short-term goal for most school-to-parent communication. Epstein's framework of school, family, and community partnership comprises six types of involvement: parenting, communicating, volunteering, learning at home, decision making, and collaborating with community. Epstein's model acknowledges challenges for each type of involvement and identifies potential results of each type of involvement for students, parents, and teachers. Because school-to-parent communication is often a means for promoting other types of involvement, illustrative practices for each of the six types of involvement are presented in Table 1. These activities are not intended as to-do list. Teachers, schools, and districts choose one or several of these activities or develop their own activities, depending on their needs, resources, and goals. These efforts may have both short- and long-term goals.

Research suggests that school-to-parent communication can promote productive parental involvement, and that productive parental involvement in schools can, in turn, have a positive impact on student achievement (Henderson & Mapp; Jeynes). Because of limitations in financial and human resources and because ineffective attempts at parental communication may result in educators' abandoning rather than refining their efforts, it is important for every school-to-parent communication effort to be as effective as possible. How can teachers, schools, and districts effectively communicate with parents to promote the positive parental involvement that may result in improved student achievement?

OUTSIDE ASSISTANCE FOR SCHOOL TO PARENT COMMUNICATION

There are alternatives to traditional do-it-yourself school-to-parent communication efforts. Some educators have access to a communications department or public relations professional within their school districts to help them assess their needs, develop a communications plan, draft documents, and similar tasks. The National School Public Relations Association includes school communications professionals who support the communication efforts of schools and districts. Organizations such as the National Network of Partnership Schools offer extensive resources and comprehensive support for schools and districts whose goals include developing a strong parent involvement program. The school- or district-wide commitment required for participation, however, could present a barrier for teachers lacking the broad-based support required for participation in most networks.

Educators taking the do-it-yourself route may supplement their own work with print materials from professional organizations or commercial providers. The International Reading Association, for example, offers booklets and brochures for parents in both English and Spanish at a minimal cost. Commercial providers' products include audio compact disks for parents, videos, web content, and print materials, many of them in several languages. Even for educators who have access to outside support and resources, however, developing effective school-to-parent communications requires more than joining a network or selecting commercial products and sending them home. Effective school-to-parent communication requires consideration of parents as an audience for the school's information.

AUDIENCE AWARENESS FOR SCHOOL TO PARENT COMMUNICATION

According to McIntyre, Kyle, Moore, Sweazy, and Greer (2001), the efforts of parents and teachers gain synergy

Six types of involvement in school, family, and community partnership and examples of related activities	
Type	Examples of related activities
Parenting	Assist families with parenting and child-rearing skills, understanding child and adolescent development, and setting home conditions that support children as students at each grade and level. Assist schools in understanding families.
Communicating	Communicate with families about school programs and student progress through effective school-to-home and home-to-school communications.
Volunteering	Improve recruitment, training, work, and schedules to involve families as volunteers and audiences at the school or in other locations to support students and school programs.
Learning at home	Involve families with their children in learning activities at home, including homework and other curriculum-linked activities and organizations.
Decision making	Include families as participants in school decisions, governance, advocacy through PTA/PTO, school councils, committees, other parent organizations.
Collaborating with the community	Coordinate resources and services for families, students, and the school with businesses, agencies, and other groups, and provide services to the community.

SOURCE: National Network of Partnership Schools, retrieved from <http://www.csos.jhu.edu/p2000/sixtypes.htm>.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

when they know one another and are aware of one another's efforts. McIntyre and his colleagues suggest that teachers who know more about the child's experiences at home are better able to provide classroom instruction suited to the child's needs. Similarly, teachers who know their students' parents or at least know about their students' parents can tailor both the format and content of their messages to meet parents' needs.

Presumably when educators have information to convey to parents, they choose the most effective medium (or media) available, but limited resources mean limited choices. Commercial media, such as radio and television, are not among the media options for most educators, particularly teachers working independently. Most school-to-parent communication involves some form of text printed in a newsletter, posted on a Web site, or sent in an e-mail created with the expectation that parents will not only receive the message but also read and understand it. To increase the chances of that occurring, educators must meet parents' needs as an audience. Important audience awareness features include parents' literacy levels, their cultural differences, their need for specific information, and their prior experiences with schools.

COMPREHENSIBILITY

Any form of written communication requires selecting or composing text for an audience of parents. Educators routinely consider readability when choosing or creating text for students, and similar considerations are important when composing writing for an audience of parents. A widely cited reference in medical literature asserts that patient education materials should be written at a sixth-grade level to reach 75% of the U.S. adult population and a third-grade level to reach 90% of the same population (Doak,

Doak & Root). Most word processing programs apply one or more readability formulas, weighing such factors as sentence length, the frequency of multi-syllable words, and the use of unusual words, enabling educators to revise text so the audience has an opportunity to understand the message.

Words with specialized meanings in different contexts, such as fluency and factor, pose a special challenge for educators. Teachers and students likely know what these words mean, but will parents know what they mean in the education context? Educators can provide context clues defining specialized terminology to help parents understand text that might otherwise be not only confusing but also off-putting to frustrated readers. As noted previously, teachers should describe their intended meaning for vague words, such as read and master. Finally, educators must attempt to communicate with parents in a language the parents understand. When translation services are not available, the educator may need to enlist the help of a student, teacher, or community member who can translate text reliably, or he or she may need to rely on commercially available products until resources for translation can be located.

CULTURAL DIFFERENCES

Cultural differences between educators and parents may affect the way a parent perceives information provided by the school. For example, a culture-based preference for collectivity and interdependence in the home may conflict with a school culture that values individuality and autonomy (Torrez, 2004; Van Velsor & Orozco, 2007). These differences may result in mutual concern and confusion over the roles of parents, teachers, schools, and the community in children's education. Parents' volunteering in schools and

personally participating in their children's formal education may be another source of concern and confusion for some parents. Far from being cultural universals, these concepts are unfamiliar to some parents. Educators who know more about their students, their parents, and their cultures are more likely to understand these differences and be able to communicate in ways that promote positive parent participation at home and at school while minimizing conflicts between the culture of the school and the cultures of their students' homes.

SPECIFICITY

Even when parents can read the information and there are no apparent cultural barriers, parents' lack of familiarity with instructional processes may present a challenge to their cooperating with teachers' requests. In a case study involving two urban elementary students, their parents, and their teachers, Musti-Rao and Cartledge found that teacher communication lacking specific instructions for parents may result in frustration for both the parents and the teacher. For example, a teacher may try to encourage parents to read with their children by sending home information about the benefits of practice: "Children who read more become better readers." She may even go a step further: "Please read with your child for ten minutes every day." The teacher has made what she perceives as a specific request, but without a definition of "read with," do these statements tell the parents precisely what the teacher wants them to do? Some parents would have questions: "How much do I read during each session? How do I structure these readings? What should I look for when we are reading? How do I know he is making progress? How can I measure this progress? Would you show me how I should read to/with him?" (Musti-Rao & Cartledge, 2004, p. 16).

Based on the case studies, Musti-Rao and Cartledge suggest that the parent who does not know how to comply with the teacher's request may perceive vagueness as a reflection of indifference or insensitivity to the parent's needs. When the parent does not comply, the teacher perceives the noncompliance as indifference on the part of the parent. In this scenario, what started as a well-intended suggestion resulted in a mutual perception between the parent and the teacher that the other is indifferent to the child's needs. If the teacher provides specific instructions, parents will know—or at least have a better idea of—how to help: "One way you can help your child develop her reading skills is to read (this book) out loud to her for two minutes and then have her read (this book) out loud to you for two minutes for a total of ten minutes every day." The message could be tailored with suggestions for follow-up activities to address the students' needs while respecting the parents' ability to comply. If a written explanation is too

daunting, a video explanation and demonstration could accomplish the same purpose.

PARENTS' PREVIOUS EXPERIENCES WITH SCHOOLS

In contrast to problems that arise from parents' unfamiliarity with classroom processes, some problems arise from parents' familiarity with schools and programs. Many parents have had negative experiences with schools, both as parents and as students themselves. As suggested by McBride, Bae, & Blatchford (2003), parents whose school experiences were negative may be less likely to respond positively to a school's communication with them as parents than parents whose own school experiences were generally positive.

To appeal to members of their audience whose negative experiences present a barrier, educators should make a particular effort to present sincere and accessible information these parents will perceive is important and relevant to them and their children. Whitaker and Fore propose replacing "the traditional open-house program in which parents are urged to come to school to listen to teachers explain rules and expectations for the school year" (2001, p. 31) with interaction between parents and teachers, establishing a relationship on which further positive communication could be built.

BROADER APPLICATIONS

As suggested by Epstein's framework, some school-to-parent communication aims to inform parents about matters other than academic endeavors. Audience awareness considerations discussed in this entry apply to these types of parent communication, too. For example, a group of teachers may want to address their concerns that parents do not believe their actions can affect their children's behavior or performance at school. The educators may be aware of Shumow and Lomax's finding that parental efficacy, "the extent to which parents believed that they could influence the context in which their adolescents were growing up" (2002, 127–128), among parents of adolescents predicted parental involvement and monitoring, and that parental involvement and monitoring predicted adolescents' academic and social-emotional adjustment.

Shumow and Lomax do not claim the study demonstrates a causal connection between parental efficacy and particular outcomes for children; nevertheless, educators who become aware of this research could reasonably decide to act on it. Deciding how to act on this or other important research would be challenging, however. Sending parents an abstract of the study's methodology and findings would not address most parents' needs: few parents would find the information accessible and relevant in that format. If the information were presented in a comprehensible, culturally

sensitive way, however, it is reasonable to expect that many parents would perceive such information as important and relevant to them as parents, at least as compared to information about classroom rules.

SEE ALSO *Discussion Methods*.

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Kim Walters-Parker

COMMUNICATION WITH STUDENTS TO ENHANCE LEARNING

For much of the 20th century, instructional communication researchers (who study human communication processes and related messages as they occur in instructional contexts across subject matter, grade levels, and types of settings) have relied on a teacher-centric rhetorical framework acknowledging that the primary difference between knowing and teaching is communication (Hurt, Scott, & McCroskey, 1978). The teacher-centric perspective provides a manageable framework from which to understand communication within any instructional context because, (1) roles are generally restricted and adhered to carefully, (2) a majority of classroom communication is concerned with dispensing information and creating understanding, (3) the primary focus is on improving student competencies, and (4) evaluation is a major component of most educational environments. Within these parameters, it is possible to understand how teacher communication behaviors and strategies can enhance student learning. A comprehensive review of three decades of social scientific research focusing on the role and effects of communication in instructional settings is beyond the scope of the current review but is available in the *Handbook of Instructional Communication* (Mottet, Richmond, & McCroskey, 2006). The purpose here, however, is to summarize what is known about teacher communication competencies, focusing especially on teacher concerns, teacher immediacy, teacher clarity, and content relevance as rhetorical strategies for improving teacher communication in ways that promote student motivation, equity in the classroom, and effective classroom management.

TEACHER COMMUNICATION COMPETENCIES

In his review integrating research from education and communication literature intended to isolate effective teacher behaviors, Nussbaum (1992) cautioned against the creation of prescriptive lists because teacher effectiveness is largely dependent upon such dimensions as timing, context, content, and student ability. Effective teachers must have the

ability to adapt to each particular context they encounter. There are general competencies, however, that are applicable across contexts. The National Communication Association (the oldest and largest national organization to promote communication scholarship and education) has outlined five broad teacher communication competencies regarding informative, affective, imaginative, ritualistic, and persuasive instructional messages. Effective teachers should demonstrate competencies in sending and receiving messages that (1) give or obtain information, (2) express or respond to feelings, (3) speculate or theorize, (4) maintain social relationships and facilitate interaction, and (5) seek to convince or influence (Cooper, 1988). Beyond these competencies, several teacher communication behaviors and strategies have been demonstrated to enhance student learning.

TEACHER CONCERNS

The original model for examining general teacher concerns (e.g., assessing student progress, excessive non-instructional duties) was provided by Fuller (1969) in her framework for examining three major categories of teacher concerns that teachers experience at different developmental stages in their career: (a) concern about self (concern about how one is perceived as a teacher); (b) concern about task (concern about instructional duties); and (c) concern about impact (concern about student learning). According to the model, teacher socialization occurs as a natural flow from concerns about self to concerns about task (teaching) followed by concerns about impact (student learning). Every teacher will have concerns in all three areas but the balance among the three can significantly affect the learning climate in the classroom. Borich (1994) cautions that when teachers are unaware of a preponderance of self concerns to the exclusion of task and impact concerns, they run the risk of unintentionally creating a learning climate that may be contrary to the goals of instruction.

Since the late 1970s communication researchers have chosen to narrow the focus of Fuller's original model by focusing specifically on teachers' communication concerns (e.g., ability to adequately present ideas and required material) and the resulting behaviors in an effort to discover how a teacher's communication strategies and tactics affect classroom interaction and impact the overall climate for learning (Staton & Hunt, 1992; Staton-Spicer, 1983; Staton-Spicer & Bassett, 1979; Staton-Spicer & Darling, 1986; Staton-Spicer & White, 1981; Feezel & Myers, 1997). The results of this research program provide support for Fuller's original dimensions and indicate that teachers express communication concerns about their individual communication abilities (self), their ability to communicate with their

students (task), and the effects of their messages and communication behaviors to increase student learning (impact).

Self concerns. Communication concerns about self are primarily related to establishing credibility as a teacher and achieving flexibility in teaching. Teachers attempt to establish credibility through self-disclosure behaviors that communicate that they are human, that they have good intentions, and that they are competent. Learning student names also allows teachers to be perceived as personable. Teacher concerns about flexibility are most apparent in assignment and schedule changes, re-teaching of course concepts, and in-class digressions.

Task concerns. Determining the best way to make abstract concepts concrete and finding the most appropriate teaching strategies are the two most critical communication task concerns expressed by teachers. The use of numerous examples and the integration of guest speakers have been demonstrated as effective communication strategies for making abstract concepts more concrete for students. Teachers are also genuinely concerned about their ability to lead an effective discussion, lecture, and employ other appropriate teaching strategies. Unfortunately, the choice of any instructional teaching strategy seems to be more a function of comfort than appropriateness.

Impact concerns. The two primary communication concerns about impact are related to facilitating student understanding and establishing a non-threatening instructional environment. Teacher communication behaviors that provide a clear and organized structure for lectures (i.e., define, restate, elaborate, and provide an example) and discussions (i.e., teacher asks a question, student responds, teacher paraphrases, elaborates, and provides a clear example) are more successful in facilitating student understanding. Non-threatening environments are established when teachers use reinforcement, self-disclosure, comprehension checks, and convey clear expectations. Teachers are more successful managing communication concerns about impact when they use comprehension checks to encourage student questions and elicit feedback, ask questions, give examples, and use classroom technology (e.g., chalkboard, handouts, computer presentations) to provide graphical representations that clearly communicate course concepts (for additional examples see Angelo & Cross, 1993).

Results of instructional communication research have provided a clear link between teacher communication concerns and actual classroom behavior. Teachers communicate differently depending upon whether they are concerned with (1) being accepted, credible, liked, and respected (self communication concerns), (2) teaching performance (task communication concerns), or (3) student learning and establishing a non-threatening



Effective communication between teachers and students includes much more than simple knowledge transmission. WILL & DENI MCINTYRE/PHOTO RESEARCHERS, INC.

climate (impact communication concerns). Prospective teachers express more self than task or impact concerns whereas student teachers express more task than impact concerns. Likewise, in-service teachers express more impact than self or task concerns and prospective teachers express more self concerns than student or in-service teachers. Finally, student teachers express more task concerns than prospective or in-service teachers, and in-service teachers express more impact concerns than prospective or student teachers. Taken together, the results demonstrate that teacher classroom communication concerns direct and affect classroom communication behavior that, in turn, serves to either enhance or hinder student learning.

TEACHER IMMEDIACY

Teacher immediacy was defined from a communication perspective by Andersen (1979) as a set of verbal and nonverbal behaviors that reveal a teacher's willingness to approach and be approached by students. The use of teacher immediacy behaviors enhances closeness and generates positive attitudes by decreasing the physical and/or

psychological distance between communicators (Mehrabian, 1969). Teachers who exhibit immediate behaviors reduce psychological distance by recognizing individual student ideas and viewpoints, incorporating student input into course and class design, and communicating availability and willingness to engage in one-to-one interactions.

Nonverbal immediacy behaviors include behaviors demonstrating variety in vocal pitch, loudness, and tempo, smiling, leaning toward a person; face-to-face body position, decreasing physical barriers (such as a podium or a desk) between themselves and their students, overall relaxed body movements and positions, spending time with students, and informal but socially appropriate attire. Verbal immediacy includes a teacher's use of humor, praise, actions and/or comments that indicate willingness to converse with students both in and out of the classroom, teacher self-disclosure, using inclusive pronouns (i.e., "we," "us," "our") when referring to coursework, willingness to provide feedback, and asking students about their perceptions about assignments and due dates.

Teachers using verbal behaviors and nonverbal immediacy behaviors appear more human and accessible to their

students. In turn, student-teacher interaction contributes to the quality of the overall learning experience. Findings from a significant amount of instructional communication research have demonstrated the profound effects of teachers immediacy behaviors to positively impact student achievement (for a complete review see Richmond, Lane, & McCroskey, 2006). Results provide a clear and substantial link between teacher immediacy and student favorable attitudes toward course content and the instructor, as well as improvement in student attention, concentration, retention, and recall. In addition, teacher immediacy increases student interaction and student motivation while decreasing student resistance. Finally, teachers who exhibit verbal and nonverbal immediacy behaviors are perceived as more competent communicators and receive higher course and teacher evaluations.

TEACHER CLARITY

Teachers who are content experts must also possess specific communication competencies that allow them to transfer the cognitive dimensions of teaching into visible instructional behaviors that are clear, organized, understandable, and effective. Teacher clarity, therefore, is the teacher's ability to effectively stimulate the desired meaning of course content and processes in the minds of students through the use of appropriately structured verbal and nonverbal messages (Chesebro, 2002). Instructional clarity has also been defined as an instructional message variable that constitutes a cluster of teacher behaviors that contributes to the fidelity of instructional message (Chesebro & Wanzer, 2006). Put simply, teachers who present knowledge in a way that students understand are perceived as clear. As such, clarity functions to connect content and pedagogy. Students tend to judge a teacher's effectiveness based largely on perceptions of teacher clarity. In fact, researchers have demonstrated a fairly robust positive relationship among teacher clarity, student satisfaction, student motivation, and student achievement.

Teacher clarity is a multidimensional construct that includes three broad behavior clusters: (1) presentation or verbal clarity (e.g., verbal fluency, explanations, and examples); (2) structural or message clarity (e.g., previews, organization, transitions, summaries, outlines, illustrations and visual aids); and (3) instructional process clarity (e.g., stresses important aspects of the content, assesses and responds to perceived deficiencies in student understanding, connects and integrates specific concepts into course curriculum, provides content relevance, communicates classroom policies and violation consequences).

Inexperienced teachers (because of self and task concerns) have a tendency to focus too heavily on detailed content and, as a result, create cognitive overload by trying to cover too much information. When inexperienced teach-

ers are worried about whether they are perceived as credible they inadvertently provide too much information (TMI) to their students. Unfortunately, students don't seem to care about the leaves on the trees in the forest until they know what the forest is and where it is located relative to other places with which they are familiar. Clarity increases as teachers develop and as impact become more salient. That is, clear teachers will begin to "essentialize" and "chunk" the curriculum using a deductive strategy that focuses on the most important information presented in a logical sequence before providing specific details. Teacher clarity can best be understood using a jigsaw puzzle example. Clear teachers first provide students with a jigsaw puzzle box top so students have a complete picture (clear direction for learning). Next, clear teachers extract and assemble the edge pieces to distinguish the border clearly before requiring students to focus on any individual puzzle piece (color, shape, possible location). Finally, clear teachers provide the details of the puzzle pieces and provide a context for which they can be organized.

Results across three decades of research demonstrate that teacher clarity, as it occurs in each of the three broad clusters of instructional behaviors (presentation, message, and process) is relatively stable across varied populations and academic contexts. Clear teaching reduces student anxiety, increases student motivation, improves student affect for both instructors and course material and ultimately functions positively to enhance student achievement.

CONTENT RELEVANCE

Content relevance was originally defined by Keller (1983) as a student's perception of whether the course instruction and its content, or both, satisfied personal needs, personal goals, and career goals. As is readily demonstrated by the teacher classroom behaviors explicitly related to teacher concerns, immediacy, and clarity, perceptions of content relevance can be enhanced when teachers make a conscious effort to make the content of their instructional messages relevant to students' personal and career goals. However, just as teacher effectiveness is largely dependent upon such dimensions as timing, context, content, and student ability, content relevance is influenced by teacher characteristics (e.g., credibility, competence, immediacy), message characteristics (e.g., clarity, structure), and by individual student characteristics (e.g., aptitude, interests, etc.).

There are six types of strategies that can be implemented by teachers to increase the likelihood that more of their students will perceive their instructional messages as personally relevant (Keller, 1987). However, because instruction does not take place in a vacuum, the implementation of any strategy to increase content relevance will obviously require that teachers have some knowledge and understanding of their students. Included in the six types of strategies are

(1) experience (state explicitly how the instruction builds on the learner's existing skills, relate learner's interests to instruction, build on common student experiences); (2) present worth (provide examples of how the content is meaningful and important, have students relate course concepts to personally interesting contexts); (3) future usefulness (state explicitly how instruction relates to future learner activities, ask learner to relate instruction to personal future goals); (4) need matching (link content to specific student needs); (5) modeling (use guest speakers, alumni, or tutors to demonstrate the value and relevance of course content; and (6) choice (provide meaningful alternative assignments, provide personal choices for organizing work (Keller, 1987).

It seems logical to conclude that student motivation to study is positively related to whether students are able to connect course content presented by their teacher to their personal needs and career goals. Research comparing students on the dimensions of content relevance support this claim and consistently demonstrate that students who perceive instructional activities as having increased value and as something worthy of their effort, report increased affect for teachers and subject material, a sense of greater empowerment in the classroom, and higher levels of achievement and state motivation (Frymier & Shulman, 1995; Frymier, Shulman, & Houser, 1996; Frymier, 2002).

IMPLICATIONS FOR EDUCATORS

What teachers need to know obviously goes beyond how to enhance self-presentation, how to keep students on task, and how to manage student resistance. Effective communication includes much more than simple knowledge transmission. There are critical moral and intellectual dimensions of teaching that supersede concerns for technique, climate, and control. In addition, because of the scope of the current review is relatively narrow, it does not include research focused on student characteristics (e.g., students' motives for communicating with teachers, student immediacy and nonverbal influence, or student resistance) or research from a more relational perspective (e.g., teacher caring, power, humor, and affinity seeking). What researchers know (from a teacher-centric rhetorical framework) is that teachers who are interested in improving their communication with students can integrate knowledge gleaned from three decades of research about teacher concerns, immediacy, clarity, and relevance to promote student motivation and enhance student achievement.

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Derek R. Lane

COMMUNITIES OF LEARNERS

In the early 1990s the Fostering a Community of Learners' classrooms (FCL) research project became renowned for modeling the practical instantiation of a set of theoretically grounded "first principles" of learning and teaching. When Jerome Bruner and Courtney Cazden, among others, visited FCL classrooms, they witnessed students talking, writing, thinking, and using technology in the service of both science understanding and literacy skills in a classroom environment specifically designed to support such activity. They saw formerly disenfranchised students, who typically had little exposure to advanced science curricula or sophisticated literacy tasks, become active participants in their own learning. Cazden, reflecting on FCL's 1990s efforts, has said:

FCL ... became one of the most visible school reform programs in the U.S. well documented for the quantitative achievements of its students over successive years on both standardized literacy tests and criterion referenced tests in both literacy and science developed within the program, and also discussed in the writings of numerous academic visitors. (Cazden, 2005, p. 1)

The origins of FCL lie with Ann Brown and her closest collaborator and husband Joe Campione. The couple had moved from the University of Illinois, Champagne Urbana, to the University of California Berkeley's Education in Mathematic Science and Technology Department in 1988. They immediately established a research team of faculty, graduate students, postdoctoral scholars, and skilled technical staff to design classroom *communities of learners* in the Berkeley/Oakland area. Brown (1992) described the FCL classroom design in this way: "I attempt to engineer innovative educational environments and simultaneously conduct experimental studies of those innovations" (p. 141).

Their goal was to put theory into practice in visible, equitable, and intellectually honest ways. The FCL project encompassed K-8 classrooms, in several schools, including a multigrade spiraling curriculum in John Swett Elementary School and Sequoia Middle School, both in East Oakland. The goal was to design robust classroom learning environments in which everyone (students, teachers, researchers) learned to "use their minds

First Principles

- Active, strategic nature of learning
- Metacognition
 - Awareness and understanding
 - Intentional learning, self-selection, and direction
 - Self monitoring and other-monitoring for common good
 - Reflective practice
- Multiple zones of proximal development
 - Multiple expertise, multiple roles, multiple resources
 - Mutual appropriation
 - Guided practice, guided participation
- Dialogic base
 - Shared discourse, common knowledge
 - Seeding, migration, and appropriation of ideas
- Legitimizing of differences
 - Diversity, identity and respect
 - Creation of community and individual identity
 - Multiple access, multiple ways in
 - Peripheral of full participation
- Community of Practice
 - Communities of practice with multiple overlapping roles
 - Sense of community with shared values
 - Element of ownership and choice
 - Community beyond the classroom wall
- Contextualized and situated
 - Theory and practice in action
 - Repeatable participant structures
 - Fantasy and sociodramatic play (being a researcher, being a scientist)
 - Intellectually honest curriculum
 - Responsive transparent assessment.

SOURCE: Adapted from Brown & Campione, 1994, p. 237.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

well." Learning and teaching were viewed as a social process within which mutual appropriation is facilitated by talk, gesture, drawing, computers, and text (Brown & Campione, 1994). FCL promoted dialogic modes of communication in ordinary classrooms.

The underlying principles (Brown & Campione, 1994) are listed in Table 1.

Brown and Campione's first principles were influenced by branches of psychology, linguistics, anthropology, sociology and out of school learning, and by the leading scholars of the time, including Bruner (1990), Cazden (1984), Cole and the Laboratory of Comparative Human Cognition (1998), Heath (1991); Latour & Wolgar (1986), Lave & Wenger (1991), Rogoff (1994), and Wertsch (1991) among others. FCL design was grounded in sociocultural views of learning and teaching, especially Vygotsky's (1978) concept of the *zone of proximal development* (ZPD). Disciplinary content goals were predicated on Bruner's views of learning and development. As Bruner put it, "We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development" (Bruner, 1996, p. 33).

Participant structures			
Participant structure	Configuration of participants	Frequency	Purpose
Research rotations	Research teams were divided into 3 activities: research, Reciprocal Teaching, computer use.	Daily, when there is no benchmark/cross-talk	Decompose content into researchable units.
Cross-talk	Whole class; students presented emerging research ideas and stances.	As needed, about once a week	Synthesize across different research group expertise areas.
Benchmark lesson	Whole class activity where important content or process ideas were introduced.	As needed, about every two weeks	Infuse foundational knowledge; establish common knowledge and practices.
Jigsaw	Reconfigure in jigsaw groups to teach other classmates the content of their work.	At the end of every unit, or as needed	Recombine content into a whole; synthesize across expertise areas.
Dilemma	Whole and small group; aim was to use new knowledge to collectively solve an ecological dilemma.	At the end, or during, a learning unit; also months later	To assess transfer of ways of reasoning and ability to use ideas from jigsaws, benchmarks and cross-talks.

SOURCE: Adapted from Rutherford & Ash (2008).

Table 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

The life science content was chosen for its “high appeal and engaging qualities to motivate students to learn to read, write, and talk and reason about important ideas” (Rutherford & Ash, in press, p. 5). The life science content was chosen also because high-quality science teaching and learning is less commonly available to the students who most need it. Several in-depth discussions of scientific reasoning in FCL classrooms are available (Ash, 2008; Engle & Conant, 2004; Ricco & Shulman, 2004); these focus on adaptation and interdependence, core principles of FCL’s life sciences disciplinary content.

Anne Marie Palincsar, a collaborator with and colleague of Brown said of FCL:

Fostering a Community of Learners ... had an amazing synthetic quality, both in substance and form ... a diverse array of participant structures in which students engaged as collaborative researchers pursued deep understanding of content knowledge and domain specific reasoning in the biological sciences. (Palincsar, 1999, p. 33)

One key aspect of FCL’s success was translating Vygotsky’s (1978) zone of proximal development to practical classroom design. The ZPD is the distance between current levels of comprehension and levels that can be accomplished in collaboration with people or powerful artifacts; such interpretations emphasize readiness to learn, “where upper boundaries are seen not as immutable but as constantly changing with the learner’s increasing independent competence at each successive level” (Brown et al., 1993, p. 35). Brown designed the classroom to contain multiple and overlapping ZPDs by carefully selecting specific participant structures (involving people, computers, books, videos, TV programs, and other mediational means) encompassing

various goals (content knowledge, computer tech savvy, reading comprehension) in different social configurations.

Students were expected to know different things; they shared this distributed expertise within dialogically based, ritualized participant structures (Brown et al., 1993; Rutherford & Ash, in press), such as reciprocal teaching (Palincsar & Brown, 1984), jigsaw teaching (Aronson, 1978), and whole-group discussion. Such participant structures are now commonly used in many classrooms across the United States.

Schoenfeld (2004) has argued that such classroom design is marked by:

A carefully delineated set of classroom practices, among them decomposing and recombining the topic under discussion into interlocking sub topics that can be studied by subgroups of students and then can be taught to other students. For FCL to succeed, then, the big ideas of the curriculum need to be identified and ‘jigsawed’ in ways that are suitable to the intended organization of classroom practices. (p. 243)

In actual FCL practice, “decomposing and recombining” was reflected in a basic research cycle of research (decompose content); jigsaw teach (recombine content); and consequential task (transfer content) (Brown et al., 1993; Brown & Campione, 1994, 1996).

In most FCL classrooms teams of five to six students researched, talked about, and wrote a collaborative research report, which they would use to teach other students in jigsaw groups. Students were socialized into these patterns of expected participation with particular participation structures such as Benchmarks, Research Rotations, Jigsaw groups,

Cross-talk groups, and Dilemmas. Table 2 lists some participant structures' configuration, frequency and purpose.

Cazden (2005) has described particular FCL participant structures in this way:

- *Research rotations* through several activities: (a) individual research, reading, and note-taking; (b) working at the computer to find new resources, e-mailing each other and outsiders or working on their team's report and conferencing about it with the teacher; (c) participating, initially under the teacher's guidance.
- *Reciprocal Teaching* (RT) comprehension discussions of texts from books, the Internet, or sections of their student reports.
- *Jigsaw groups*: Periodically, as research teams became more knowledgeable about their subtopics, a student from each team met in an ad hoc group with a member of each of the other teams and taught them.
- *Cross-talk*: When the students themselves realized that Jigsaw teaching required them to know all about their team's topic, not just their individual sub-topic, they initiated an intra-team version of Jigsaw that they named Cross-talk. (Cazden, 2005, p. 8).

THE IMPORTANCE OF COMMUNITY OF LEARNERS

FCL design has been extensively cited, reviewed, transformed, borrowed, critiqued, and expanded over the past 15 years. A Google search for the phrase FCL cross-referenced with Ann Brown produced approximately 5,000 sites. A brief scan of the first 50 or so Google pages reveals that researchers and practitioners alike have adapted FCL principles and practices to multiple disciplines and at many levels of the educational system, from elementary to university). The special issue of the *Journal of Curriculum Studies* (2004) illustrates FCL implementation in several disciplines: English language arts, mathematics, science, and social studies. Such work has underscored both the benefits and limitations of the FCL curricular reform.

Perhaps more telling is the fact that FCL principles and practices have influenced leading scholars and researchers in the learning sciences. Scholars from many disciplines have subsequently explored a variety of FCL-influenced research agendas, including *Disciplinary Perspectives on Fostering a Community of Teachers as Learners* (Special Issue of the *Journal of Curriculum Studies*, edited by Shulman & Sherin, 2004); *Instructional Psychology: Past, Present, and Future Trends* (de Corte & Verschaffel, 2006), *Thinking Practices in Mathematics and Science Learning* (Greeno & Goldman, 1998), *Inside Japanese Classrooms: The Heart of Education* (Sato, 2004), *Design Research: Theoretical and Methodological Issues* (Collins, Joseph & Bielaczyc, 2004), to name just a few. The research agendas of these scholars

inevitably have relied, at least in part, on FCL first principles and the notion of design experiments.

There have also been criticisms. Lehrer & Schauble (2004) suggested these limitations:

... two questions about FCL remain open. The first concerns the utility of principles as a way to both describe and spread new educational programs. ... A second major question about FCL is whether it is a good idea for school science to be so exclusively focused on the reading and integration of textual information.

Lehrer & Schauble have accurately suggested that a central challenge in FCL (or any) dissemination is transporting and translating principles and practices, as both are essential. Brown herself was wary of "lethal mutations" particularly when practices, without the principles that informed them, were blindly copied. Brown and Campione argued instead that specific choice of participant structure or content, or form of transfer task, depended on particular contexts, as well as how first principles were specifically interpreted within them. Campione has said that he and Brown:

saw their work as going from laboratory research to learning principles to the design of a learning environment. Then based on their analysis of the learning environment, they would make modifications and additions to the learning principles, which in turn led to modifications of the learning environment and new laboratory experiments. (Collins, Josephs, & Bielaczyc, 2004, p.16).

The emphasis, then, was on the reciprocal interplay between the "first principles" and real-world classroom practices; they saw dissemination itself as "implementation with evolution." They viewed such principles as constantly evolving as further instantiation of the project took place.

The second limitation mentioned by Lehrer and Schauble (2004), lack of hands-on materials (other than texts, computers, and experts), was accepted by Brown and Campione within this complex FCL intervention model. Brown has argued often and convincingly that the students in her classroom practiced science as many scientists practiced it over the centuries, as natural historians, using observation and thought experiment, rather than direct experimentation, as the basis for their reasoning.

Erik de Corte's 2000 study has noted perhaps the biggest challenge to wide-scale dissemination of FCL-like projects, "[the] methodological problem of the confounding of variables in design research, echoing a major criticism of the protagonists of randomized field trials" (p. 6). Such validity arguments have become more common over the past decade in a current climate of standardized tests and accountability.

Competition

Regarding the long-term curricular reform potential of projects such as FCL, Rutherford and Ash (2008) have written:

In the early 1990s, we had more latitude to develop our own curriculum, schedule our day, and embed literacy practices into all our work. . . . Such choices are not so readily available to teachers in current environments. New state and national standards and testing guidelines have narrowed teachers and researchers' choices. But before we say that we cannot create such learning communities in the 2000s, let us take seriously Ann's caution about not throwing the baby out with the bath water and revisit her first principles of learning from the perspective of "possible worlds," to borrow Bruner's (1986) phrase.

Finally the following comment about FCL should be noted:

[It is the] one program discussed in detail by Jerome Bruner in his book, *The Culture of Education*, [in which he calls for a] "more intimate perspective" of what we have learned about how teachers teach and how students learn. Bruner speaks of Brown as "perhaps the leading figure in this advance." (Bruner, 1996, p. 86, cited in Cazden, 2005, p. 8)

SEE ALSO *Constructivism; Design Experiment.*

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COMPETITION

Competition is most commonly associated with sports or athletic events in which individuals or teams of individuals compete for some reward or accolade. Competition is also seen in classroom settings, where either individually or in teams or small groups, students strive to win by being the smartest or fastest on an academic task. Studies on the influence of competition in classrooms have looked at it from multiple perspectives. An earlier one studied forms of classroom competition that involved small groups of students competing with one another, much like what is seen on the field or in a gym. Here, researchers examined cooperative versus competitive learning in small group formats and the impact on motivation and achievement. Subsequent classroom research on competition shifted from a focus on groups

to a focus on the individual and the ways in which classroom structures impact students' level of competitiveness. From this perspective, competition is constructed as a personal attribute that students bring to the classroom setting. Thus, researchers examine classroom goal structures and individual goal orientations to understand what competitive orientations bring resultant motivation and academic outcomes. Additionally, developmentalists have examined how competitive strivings unfold over time and how they vary according to gender, culture, and age.

COOPERATION AND COMPETITION IN SMALL GROUPS

During the 1970s and 1980s, when small group learning was at its height in popularity, researchers studied the nature and function of small group formats for enhancing student motivation and learning. Researchers wanted to understand the tradeoffs of having students work alone versus work in small groups and whether working together (cooperatively) or working to outperform others (competitively) was more effective. A review of this literature reveals that cooperative small group learning activities were largely more successful for student learning and motivation than competitive ones, whether individuals or small groups were involved (Johnson et al., 1981).

Data also suggest that age, group size, and type of learning task matter such that the benefits of cooperation are stronger for younger students than for older students, and for smaller group sizes than larger ones. Further, cooperation is more beneficial for problem solving and other types of higher processing tasks, whereas competition is more effective for rote learning (e.g., Johnson et al., 1981; Johnson, Skon, & Johnson, 1980). Cooperation is also linked to students' positive attitudes towards teachers, the belief that teachers care about them, and feeling liked and accepted by teachers in grades 2 through 12 (Johnson & Ahlgren, 1976). Thus, when it comes to small group formats, activities that promote cooperation are generally more beneficial socially, motivationally, and academically than competitive ones.

GOALS, GOAL STRUCTURES, AND COMPETITION

Throughout the 1980s, and as cognitive processing models emerged, researchers became more interested in students' cognitive orientations (goals) toward schooling and the ways in which they interpreted classroom activities. The focus shifted among motivational researchers from small group settings to a greater concern for individual perspectives about learning. Achievement goal theory emerged as the dominant approach for studying these processes (Ames, 1992; Elliott & Dweck, 1988).

Achievement goal theorists organize individuals' cognitive attributes according to two types of goal orientations that are referred to as *mastery* or *performance*. Students with a mastery goal orientation adopt learning goals that are about mastering the task at hand for the sake of gaining competence or increased knowledge. Performance goals, by contrast, pertain to social comparisons of ability. Performance goals are consistent with notions of competition because competition is about the "relative ability comparisons among students in the classroom" (Ryan & Patrick, 2001, p. 442). Data suggest that students who hold performance oriented goals and who are largely more preoccupied with their achievement performance as it compares to others tend to have less adaptive motivational dispositions and attitudes.

Classroom goal structures have also been studied to understand how teacher-created tasks impact students' attitudes towards learning. Classroom goal structures are communicated to students throughout the many layers of the teaching process, including the type of tasks assigned (difficulty, variety), the nature of student evaluations (norm-based or criterion-based), and the way teacher authority is communicated (e.g., Ames, 1992; Blumenfeld, 1992). Tasks promote competition when they prompt students to compare their abilities with those of other students. Similarly, evaluation systems (i.e., grades, achievement feedback) that stress social comparisons in achievement are associated with performance goal classroom structures, as are authority systems or classroom management techniques that restrict student autonomy and control. Thus, classroom structures that emphasize academic comparisons among students tend to be more maladaptive to student motivation than structures that emphasize academic progress or mastery (see Anderman, 2007).

COMPETITION AND CHARACTERISTICS OF STUDENTS

Research from the developmental literature suggests that competitive natures vary according to gender, race, and age. In terms of gender, most research suggests that males tend to be more competitive than females. Similarly, students from cultures that emphasize individualism such as European Americans tend to be more competitive than students from cultures that emphasize collectivism (such as Latin Americans and African Americans). However, some research has revealed more complexity in these generalizations according to a multidimensional view of competition. Schneider, Woodburn, del Pilar Soteras del Toro, and Udvari (2005) examined competitiveness among a cross-cultural group of seventh graders. They defined competition according to four main types: (a) hypercompetitiveness, the need to win at all costs that is

expressed by hostility and disregard for the opponent, (b) non-hostile social comparisons, the comparison of achievements without hostility, aggression, or jealousy, (c) enjoyment of competition, which gauges the amount of positive affect toward the experience of competition and (d) avoidance of competition. Schneider and colleagues (2005) found cultural and gender-based differences in competitive orientations. Specifically, Canadian boys were more hypercompetitive and emotionally competitive, but Canadian girls were more competitive when it came to making social comparisons. However, the sample from the Costa Rican culture showed the opposite pattern, namely that boys had more social comparison competitiveness than did girls. By contrast, in Cuba girls were more likely to avoid competition all together. Thus, additional research was thought to be needed to explore the manner in which student characteristics interact with one another in order to determine attitudes regarding competition.

Another interesting consideration of competition involves examining whether winning means diminishing the opponent's chances of getting any rewards. Referred to as *interference competition*, researchers tested whether females and males differ according to the manner in which they competed. Data suggest that boys are more likely than girls to harm another's chances of getting rewards or status when they compete (e.g., Knight & Kagan, 1981; Roy & Benenson, 2002). This gender difference appears at all ages and in various contexts. For example, in naturalistic observations of children's play, researchers find that boys are more likely to engage in interference competition than girls in their choice of games such as football or basketball on the playground. By contrast, girls typically engage in games in which one can maximize one's own potential without having to interfere with someone else's potential (Lever, 1978).

Importantly, interference competition emerged only in certain contexts. Roy and Benenson (2002) found that fourth-grade girls tend to avoid competitive interference in conditions of plenty when there were enough rewards to go around. By contrast, they did engage in interference competition when the rewards were scarce. However, fourth-grade boys and kindergartners (both boys and girls) used interference competition to the same extent under conditions of scarcity and plenty. One explanation may be that girls learn over time about strategically using interference competition when the stakes are high (or rewards are scarce). The growing trend in girls' use of indirect aggression against one another may point to a form of interference competition they have learned over time where spreading rumors, backstabbing, and excluding become a form of competitive behavior, the goal of which is to undermine another's popularity status.

NEGATIVE IMPACT OF COMPETITION

Good and Brophy (2008) summarize several ways in which classroom competition may negatively impact students' development, learning, and motivation. For example, if students become preoccupied with winning or losing the competitive activity, they may lose sight of important instructional objectives and content. From the student's perspective, performance takes precedence over learning. Further, inherent in the practice of competition is the necessity for someone to lose. If the same students lose over and over despite their best efforts, they may come to see the world as unfair and are likely to give up when faced with challenging academic tasks, as they have learned that failure will be the outcome no matter how hard they try to succeed. Such students may think, "Why should I put forth the effort or invest in the activity if I'm probably just going to lose anyway?" These students will evaluate themselves negatively and will see school as a threatening place in which to be; these students also may be rejected or evaluated negatively by peers, as classmates are unlikely to be willing to work with a person perceived to be a loser.

Conversely, students who routinely win at competitive tasks may lose interest in the instructional material and over time may put forth the minimal amount of effort required to outperform other students, rather than maximizing effort in order to master the task or material. These students might think, "Why should I try my hardest when I can beat the other students by simply going through the motions? Sure I don't learn as much as I would if I invested 100% in the activity, but I still win the competition, and isn't that what's most important?"

Findings from numerous research studies support these ideas. For example, Johnson and colleagues (1981) conducted a meta-analysis examining the effects of competitive goal structures on academic achievement, as compared to cooperative and individual tasks. Results suggest that across studies, students completing academic tasks under cooperative conditions were likely to perform at higher levels than students completing tasks under either competitive or individual conditions. Interestingly, students in competitive and individual conditions were likely to perform similarly to one another.

More contemporary investigations of competition are based on goal orientation and motivation research and attempt to identify explanations for the negative influence of competition. For example, theoretical and research-based perspectives suggest that competition may promote the development of performance goals rather than mastery goals. As previously noted, this means that under competitive conditions, students approach tasks with a desire to succeed in order to appear competent

in front of others or to outperform peers (i.e., performance orientation), rather than approaching tasks with a desire to expand their knowledge and skills (i.e., mastery orientation). As explained by Ames (1992), students with a mastery orientation are more likely to attribute successful learning outcomes to effort, which increases the likelihood of continued motivation and is associated with the development of self-regulation skills. Conversely, students adopting a performance orientation are more likely to attribute success to ability, which may or may not encourage continued motivation. So how do these concepts relate to competition? If students come to learn that winning at competitive activities will lead to rewards, they may adopt performance goal orientations rather than mastery goal orientations. The goal is to win (or to avoid failure) by outperforming their peers rather than to develop their competence by mastering the task; completing the task becomes a means to an end (i.e., winning) rather than valued as a way of building competence (e.g., Bergin & Cooks, 2000).

Similarly, competition and performance goals may decrease intrinsic motivation towards academic tasks because students rely on rewards from others to motivate them to complete tasks, rather than completing tasks for the reward of building competence and skills. Competition in the classroom also might distract students from learning: they become so focused on performing better than peers that they get distracted from learning or anxious about losing. A review by Meece, Anderman, and Anderman (2006) concluded that many students are not motivated by competitive classroom activities, which is probably especially true for students who perform poorly in comparison to peers. Classrooms that emphasize competition among students are likely to promote the development of performance goals, as students learn that outperforming other students is valued more than learning. Further, the authors present evidence that tasks or activities that require students to enhance their knowledge and skills (i.e., mastery-oriented tasks) are likely to promote motivation and effort among students, as they strive for greater understanding. In this way, teachers' use of competition in the classroom can influence the types of goal orientations that students adopt, which in turn can influence their motivation towards learning.

PERCEIVED BENEFITS OF COMPETITION

Competition is not without its advocates, and several reasons for this are offered in the literature. First, competition may generate interest and excitement in topics or tasks that would otherwise be of limited interest to students. Team-based competitive approaches (e.g., class-wide games) may

be especially effective at making instructional material more enjoyable and engaging. Good and Brophy (2008) suggest that competitive classroom activities may be appropriate if all students have a chance to win, and when a team approach is used rather than individually based evaluations. These practices may reduce the likelihood that the same students are always the winners and losers, in which the losers become embarrassed and demoralized. Further, competition between groups (using a team-based approach) may increase cooperation within groups, as students are unified in working towards a common goal (i.e., outperforming the other teams).

Second, competitive approaches may be appropriate within the context of behavior management, such as when the teacher is attempting to reduce disruptive behaviors and increase positive behaviors. For example, interventions such as the Good Behavior Game and its variations (Tingstrom, Sterling-Turner, & Wilczynski, 2006) use team-based competition to motivate students and modify their behaviors. These approaches provide examples of effective uses of competition in the classroom, as they often result in reduced disruptive behaviors and increased on-task and prosocial behaviors among large numbers of students. These interventions often involve either providing a predetermined reward (e.g., free time, tangibles, spending time with teachers or other adults) to the team with the fewest behavioral infractions over a certain time period or providing a reward to all teams that earn fewer than a predetermined number of behavioral infractions over a certain time period. Such competition-based behavior management strategies can also increase academically relevant behaviors such as work completion. Third, some argue that competition in the classroom will prepare students for competition in their lives beyond school (i.e., the workplace). The reasoning behind this argument is that if all classroom tasks are cooperative, students may become overly dependent on their classmates when completing academic tasks and may be unable to perform in competitive or individual contexts in the future.

In the early 2000s school reform efforts seem to be maximizing potential for competition in learning environments. Under the 2002 No Child Left Behind Act (NCLB), students' academic performance is regularly publicized and scrutinized and used for making significant decisions about teachers and their students. This chronic public accounting of student performance creates a climate that maximizes the likelihood that students will be known primarily in terms of their test score achievement (Nichols & Berliner, 2007). Therefore, NCLB virtually mandates that students compete with one another to demonstrate their achievement as measured by standardized test scores.

Educators would be wise to encourage students to focus on mastering tasks and making improvements in performance on an individual basis rather than to focus on who is scores the highest. Competition is probably rewarding and motivating for students who win regularly, but what about those who do not? With this in mind, educators are encouraged to be mindful when deciding whether to use competition in the classroom and to be able to articulate a well-reasoned rationale for using competition, just as they would for any other instructional decision. Specifically, they ought to be able to explain how making a particular task or activity competitive will enhance students' learning and motivation. They ought to consider how using competition may be harmful to students in this situation. They ought to be able to identify instructional benefits to using competition. They ought to consider from the students' perspective what the stakes involved in winning and losing are. Addressing these considerations will likely help educators apply competition appropriately in the classroom.

SEE ALSO *Goal Orientation Theory*.

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COMPREHENSIVE SCHOOL REFORM FOR HIGH-POVERTY SCHOOLS

Since its inception in 1965, the Federal Title I Program has provided billions of dollars in aid to high-poverty schools, hoping to help these schools narrow the achievement gap with advantaged students. Extensive research on the effects of Title I funding has found that while there are generally benefits to the schools, they are quite small and variable (see Borman, Stringfield, & Slavin, 2001). Yet it has long been observed that individual schools often make outstanding gains using Title I resources in innovative ways to improve the functioning of the entire school. Beginning with the 1988 reauthorization, these findings led the U.S. Congress to progressively reform rules for the use of Title I funding in the highest-poverty schools to allow them to use these monies for professional development, materials, and personnel to improve teaching and learning schoolwide, not just (as had been the case previously) for group remedial services to individual low achievers.

PROGRAMS DEVELOPED IN 1980S AND 1990S

The movement toward schoolwide projects in Title I schools encouraged a flowering of whole-school innovations in high-poverty schools. Much of this innovation

has taken place in individual schools and districts, without any intention to make changes on a broader scale, but there arose in the late 1980s and early 1990s a set of programs, explicitly designed by university researchers and non-profit organizations not only to improve whole schools but also to be replicable, to eventually offer large numbers of schools well-developed alternatives to current practices. These programs came to be known as *Comprehensive School Reform* (CSR). CSR sees the school as the primary unit of change in education. It seeks to implant effective practices in all of the central areas of school functioning most likely to affect student achievement: Curriculum, instruction, assessment, grouping, accommodations for struggling students, parent and community involvement, school organization, and professional development (see Stringfield, Ross, & Smith, 1996; ERS, 1998; CSRQ, 2006a, 2006b; Borman, Hewes, Overman, & Brown, 2003). In 1998 the U.S. Department of Education defined comprehensive school reform as innovative programs that include all of the following elements:

1. Coordination of resources: The program identifies how all resources (federal/state/local/private) available to the school will be utilized to coordinate services to support and sustain the school reform effort;
2. Effective, research-based methods and strategies: A comprehensive school reform program employs innovative strategies and proven methods for student learning, teaching, and school management that are based on reliable research and effective practices, and have been replicated successfully in schools with diverse characteristics;
3. Comprehensive design with aligned components: The program has a comprehensive design for effective school functioning, including instruction, assessment, classroom management, professional development, parental involvement, and school management, that aligns the school's curriculum, technology, and professional development into a schoolwide reform plan designed to enable all students to meet challenging state content and performance standards and addresses needs identified through a school needs assessment;
4. Professional development: The program provides high-quality and continuous teacher and staff professional development and training;
5. Measurable goals and benchmarks: A comprehensive school reform program has measurable goals for student performance tied to the state's challenging content and student performance standards, as those

Summary of research on comprehensive school reform models

	Number of studies	(Third party)
Strongest evidence of effectiveness		
Success for All	41	(25)
Direct Instruction	40	(38)
School Development Program	9	(5)
Highly promising evidence of effectiveness		
Roots & Wings	5	(4)
Expeditionary Learning/Outward Bound	4	(3)
Modern Red Schoolhouse	4	(3)
Promising evidence of effectiveness		
Accelerated Schools	3	(2)
America's Choice	1	(1)
ATLAS Communities	2	(2)
Montessori	2	(2)
Paideia	3	(3)
The Learning Network	1	(1)
Greatest need for additional research		
Audrey Cohen	1	(1)
Center for Effective Schools	0	(0)
Child Development Project	2	(0)
Coalition for Essential Schools	1	(1)
Community for Learning	0	(0)
Community Learning Centers	1	(1)
Co-Nect	5	(4)
Core knowledge	6	(6)
Different Ways of Knowing	1	(1)
Edison	3	(3)
High Schools That Work	4	(0)
High/scope	3	(2)
Integrated Thematic Instruction	1	(1)
Microsociety	1	(0)
Onward to Excellence II	0	(0)
Talent Development High School	1	(0)
Urban Learning Centers	0	(0)
All CSR models	145	(109)

SOURCE: Adapted from Borman, Hewes, Overman, & Brown (2003)

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

- standards are implemented, and benchmarks for meeting those goals;
6. Support within the school: The program is supported by school faculty, administrators, and staff;
7. Parental and community involvement: The program provides for the meaningful involvement of parents and the local community in planning and implementing school improvement activities;
8. External technical support and assistance: A comprehensive reform program utilizes high-quality external technical support and assistance from a comprehensive school reform entity (which may be a

university) with experience or expertise in school-wide reform and improvement;

9. Evaluation strategies: The program includes a plan for the evaluation of the implementation of school reforms and the student results achieved.

Ideally, a comprehensive school reform model is one in which each of the elements is carefully integrated around a shared conception of how students will learn and develop. Most CSR models require that staff members vote to adopt the model, and most require a supermajority in favor (say, 80%). The idea is to engage the energies and enthusiasm of a given school staff around a common vision and a common set of strategies, but not to ask the staff to completely design its own reform model. Comprehensive school reform designs are provided by organizations (mostly nonprofits) that provide professional development, teacher and student materials, and perhaps most importantly a network of like-minded schools around the country that share similar visions and support one another's efforts.

In schools implementing CSR designs, teachers have colleagues who are working toward similar objectives, sharing a vision and a language to describe that vision and sharing practical strategies for achieving the vision. Almost all CSR models include a facilitator or coach within the school who visits teachers' classes, organizes opportunities for teachers to work with one another, facilitates discussions about data, student work, classroom teaching practices, and other elements, ensures coordination among program elements, and acts as a communication link between the principal and the teachers. Comprehensive school reform takes the view that genuine, lasting change takes place in supportive groups of like-minded professionals, and that schools are capable of establishing norms of practice and expectations for continuous improvement that would be difficult to establish on a teacher by teacher basis.

Comprehensive school reform grew explosively in the 1990s, helped first by the 1991 appearance of the New American Schools Development Corporation (NASDC), a coalition of large corporations that funded the development and scale-up of CSR models (Kearns & Anderson, 1996). A second major boost came from the 1997 Obey-Porter Comprehensive School Reform legislation, which made grants available to high-poverty schools to adopt "proven, comprehensive" CSR models. By 2001 there were an estimated 6,000 schools, mostly high-poverty elementary schools, using CSR models, with or without Obey-Porter funding. A lack of support for CSR in the second administration of President George W. Bush ended Obey-Porter and slowed the growth of CSR, but there are still thousands of schools implementing CSR programs. Further, perhaps no edu-

CSRQ center report on elementary school comprehensive reform models

Model	Number of studies rated "conclusive"
Moderately strong evidence of positive effects	
Success for All	34
Direct Instruction (full immersion)	11
Moderate evidence of positive effects	
America's Choice	6
Accelerated Schools PLUS	3
Core Knowledge	3
School Development Program	3
School Renaissance	1
Limited evidence of positive effects	
National Writing Projects	5
Literacy Collaborative	2
Co-Nect	2
ATLAS Communities	1
Integrated Thematic Instruction	1
Different Ways of Knowing	0
Modern Red Schoolhouse	0
Ventures Initiative and Focus System	0
Zero evidence of positive effects	
Breakthrough to Literacy	0
Coalition of Essential Schools	0
Community for Learning	0
Comprehensive Early Literacy Learning	0
Expeditionary Learning	0
First Steps	0
Onward to Excellence II	0

SOURCE: Adapted from CSRQ, 2006a

Table 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

cation reform initiative in history has been as thoroughly researched as CSR, and this research continues.

RESEARCH ON COMPREHENSIVE SCHOOL REFORM PROGRAMS

Comprehensive school reform models have been extensively evaluated in large-scale quantitative as well as qualitative studies. A review of experimental research on comprehensive school reform models was published by Borman, Hewes, Overman, and Brown (2003), who categorized programs according to the numbers of well-designed experiments on each and the consistency of positive achievement effects. A simplified adaptation of their main results appears in Table 1. Reviews using somewhat different procedures were carried out by the Comprehensive School Reform Quality Center (CSRQ, 2006a, 2006b) at the American Institutes for Research. The CSRQ reviews, summarized in Tables 2 and 3, emphasized the number of "conclusive" studies done on each program and the proportion of significantly positive findings. The following sections

discuss research on some of the most prominent of the CSR models.

Success for All. Success for All (Slavin & Madden, 2001) is the most widely used and extensively evaluated of the CSR models. It provides schools with specific curriculum materials and extensive professional development in reading, writing, and language arts, along with detailed assessment, cross-grade grouping strategies, within-school facilitators, and other school organization elements. The program gives one-to-one tutoring to primary-grades children who are struggling in reading, and extensive outreach to parents. It provides detailed teacher’s manuals and about 26 person-days of on-site professional development to enable schools to engage in a substantial retooling process. Originally focused on elementary school, prekindergarten to grade 6, Success for All now has a middle school (grades 68) program as well (Chamberlain et al., 2007). Programs in mathematics, science, and social studies were also developed, and the term *Roots & Wings* was used to describe schools using all of these elements (Slavin, Madden, Dolan, & Wasik, 1994). However, most schools, including many of those categorized as *Roots & Wings* in the Borman et al. (2003) review, use only the reading program, and the *Roots & Wings* term is no longer used. Research on Success for All and *Roots & Wings* are combined for discussion in this chapter.

Borman and colleagues (2003) identified a total of 46 experimental-control comparisons evaluating Success for All, 31 of which were carried out by third-party investigators. A mean effect size of +0.20 (combining Success for All and *Roots & Wings*) was obtained across all studies and measures. A longitudinal study by Borman & Hewes (2003) found that students who had been in Success for All elementary schools were, by eighth grade, still reading significantly better than former control group students and were about half as likely to have been retained or assigned to special education.

Comprehensive School Reform Quality Center (CSRQ) (2006a) rated the strength of evidence for the Success for All elementary program as “moderately strong,” the highest rating given to any program (one other, Direct Instruction, also received this rating). A total of 34 studies were rated as “conclusive.” CSRQ (2006b) rated the evidence for the Success for All middle school as “moderate,” with two conclusive studies.

Since the review by Borman and colleagues, a number of additional studies of Success for All have been carried out. Most importantly, a national randomized evaluation of Success for All was reported by Borman and colleagues (2007). A total of 35 schools were randomly assigned to use Success for All either in grades K-2 or in grades 3-5. The primary grades in 3-5 schools were used as controls, as were the intermediate grades in K-2 schools. By the end of the

CSRQ center report on middle and high school comprehensive school reform models	
Model	Number of studies rated “conclusive”
Moderate evidence of positive effects	
America’s Choice	5
Success for All Middle School	2
School Development Program	2
Talent Development High School	2
First Things First	1
Limited evidence of positive effects	
KIPP	1
Middle Start	1
Project GRAD	1
More Effective Schools	0
Expeditionary Learning	0
Zero evidence of positive effects	
Accelerated Schools PLUS	0
Atlas Communities	0
Coalition of Essential Schools	0
High Schools That Work	0
Making Middle Grades Work	0
Modern Red Schoolhouse	0
Onward to Excellence II	0
Turning Points	0

SOURCE: Adapted from CSRQ, 2006b

Table 3 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

study, Success for All second graders were scoring significantly better than controls on all reading measures (Borman, Slavin, Cheung, Chamberlain, Madden, & Chambers, 2007). Taken together, there are now more than 50 experimental-control studies of Success for All involving more than 200 schools throughout the United States. Since 1998 Success for All has been developed and disseminated by the non-profit Success for All Foundation, and is currently working in about 1,200 schools in 48 states in the United States, and 100 schools in England.

Direct Instruction. Direct Instruction (DI) (Adams & Engelmann, 1996), once known as DISTAR, is an elementary school program originally designed to extend an effective early childhood curriculum into the early elementary grades, in a federal program called Follow Through. Like Success for All, DI is primarily intended to help high-poverty schools succeed with all students, and the program is even more systematically specified for teachers.

The DI reading and math programs have long been marketed by SRA, a division of the McGraw Hill publishing company, under the titles “Reading Mastery” and “Connecting Math Concepts.” The publisher provides limited professional development with the program, but schools can contract with providers of professional

development, primarily the National Institute for Direct Instruction (NIFDI) at the University of Oregon. Such schools receive approximately 32 person-days of professional development in their first year, similar to the services provided in the Follow Through studies. Research on DI has overwhelmingly focused on the model with extensive professional development, not on use of the books alone, and research findings for DI should therefore be assumed to apply only to the program with professional development. Certainly only this form could be considered a comprehensive reform model.

Borman and colleagues (2003) identified 40 experimental-control studies of DI, of which 38 were third party. The mean effect size was +0.15. CSRQ (2006a) rated DI's evidence of positive effects as "moderately strong," with 11 "conclusive" studies.

School Development Program. James Comer developed one of the earliest of the comprehensive reform models, the *School Development Program* (SDP) (Comer, Haynes, Joyner, & Ben-Avie, 1996). The focus of SDP is on the whole child. Rather than focusing on specified curricula and instructional methods, SDP concentrates on building a sense of common purpose among school staff, parents, and community, working through a set of teams in each school that develop, carry out, and monitor reforms tailored to the needs of each school. A school planning and management team develops an overall plan, and mental health and parent teams focus on issues beyond the classroom.

Borman and colleagues (2003, p. 155) listed SDP as one of three CSR programs with "strongest evidence of effectiveness." A set of three high-quality third-party evaluations described mixed evidence of the program's impact. One, a randomized evaluation in Prince George's County, Maryland, found poor implementation and no achievement effects (Cook et al., 1999), but a partially randomized study in Chicago (Cook, Murphy, & Hunt, 2000) and a matched study in Detroit (Millsap, Chase, Obeidallah, Perez-Smith, & Brigham, 2000) found small but positive impacts on achievement. CSRQ (2006a, 2006b) rated the evidence for SDP as "moderate," with three "conclusive" studies at the elementary level and two at the secondary level.

America's Choice. America's Choice (AC) (NCEE, 2003) is a comprehensive reform model that focuses on standards and assessments, instruction aligned with standards, extensive professional development, and parent involvement. In particular, the program mandates a core curriculum in literacy and mathematics, tutoring for struggling students, and a school leadership team to coordinate implementation.

Borman and colleagues (2003) included only one study of the America's Choice design, but more recently

researchers at the Center for Policy Research in Education at the University of Pennsylvania have carried out several evaluations. A longitudinal matched study in Rochester, New York, found that America's Choice students made greater gains than other students from 1998 to 2003 in reading and math (May, Supovitz, & Perda, 2004). A matched study in Duval Co., Florida (Supovitz, Taylor, & May, 2002) compared America's Choice and other schools on state tests, and results favored the AC schools in writing and, to a small degree, in math (but not reading). A 1-year matched study (Supovitz, Poglinco, & Snyder, 2001) also compared matched AC and control schools in Plainfield, New Jersey, and found greater gains for the AC students on the state English Language Arts test. CSRQ (2006a) rated the evidence of positive effects for America's Choice as "moderate" at the elementary level, with six "conclusive" studies, and also "moderate" at the secondary level, with five "conclusive" studies (CSRQ, 2006b).

Modern Red Schoolhouse. Modern Red Schoolhouse (Heady & Kilgore, 1996) is a program that emphasizes standards-based teaching, appropriate uses of technology, and frequent assessment. It provides customized professional development to help schools build coherent curriculum aligned with state standards and then implement aligned practices. In recent years, Modern Red Schoolhouse has begun to focus more on district reform and leadership.

Borman and colleagues (2003) identified four experimental-control studies of Modern Red Schoolhouse, with an average effect size of +0.17. CSRQ (2006a) rated the evidence for Modern Red Schoolhouse as "limited" at the elementary level.

Accelerated Schools. Accelerated Schools (Hopfenberg, Levin, & Chase, 1993; Levin, 1987) is a process-oriented school reform model that emphasizes high expectations for children and giving students complex and engaging instruction. Each school staff designs its own means of putting into practice the basic principles: High expectations, powerful learning based on constructivist principles, and avoidance of remediation.

Borman and colleagues (2003) identified three studies of Accelerated Schools with a mean effect size of +0.21. CSRQ (2006a) rated Accelerated Schools as "moderate" in research evidence, with three studies rated "conclusive."

Expeditionary Learning/Outward Bound. Expeditionary Learning (Campbell et al., 1996, p. 109) is a design built around "learning expeditions," which are "explorations within and beyond school walls." The program is affiliated with Outward Bound and incorporates its principles of active learning, challenge, and teamwork. It makes

extensive use of project-based learning, cooperative learning, and performance assessments.

Borman and colleagues (2003) identified four experimental-control evaluations of Expeditionary Learning, which had positive effects. However, CSRQ (2006a, 2006b) did not rate any studies of Expeditionary Learning as “conclusive.”

The experience of comprehensive school reform shows the great potential of whole-school reform for high-poverty schools. Research on CSR has clearly established that fundamental reforms can be introduced, implemented with quality, and maintained over many years. The longstanding belief dating back to the Rand Change Agent study of the 1970s (McLaughlin, 1990) that every school has to create its own approach to reform was conclusively disproved. Not all CSR approaches have been adequately researched, but in particular those with well-specified designs, clear expectations for what teachers and students will do, and extensive teacher and student materials, have been repeatedly found to be effective, scalable, and sustainable in a broad range of circumstances. Quality of implementation matters, of course (Aladjem & Borman, 2006), but it has been demonstrated that high-quality implementations of CSR can be achieved and that in such schools, children benefit.

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Robert E. Slavin

CONCEPT DEVELOPMENT

Whether finding a classroom, meeting a new teacher, learning to add, or reading a story, children understand the world through their concepts. Concepts are crucial for understanding the world because they represent current experiences as belonging to a category of similar experiences. By having a concept chair, a student who sees a new chair at his desk need not re-discover whether it is alive, whether he should write with it or sit on it, or what the teacher means by "take your seat" when pointing at the new chair. In this way, the concept of chairs—rather the sight of a particular chair—allows the mapping of an open-ended number of appropriate reactions and inferences about chairs onto an open-ended number of particular chairs.

Central concept acquisition is key to cognitive development, and children learn actually many concepts. The most conservative estimate of children's concepts would be the number of words for which they know the meaning—roughly 40,000 by age 10 and 60,000 by age 19, which over the first two decades of life is roughly one new concept every 90 waking minutes (Anglin, 1993; Bloom, 2000; Miller, 1996). In truth, this figure radically underestimates the rate of concept acquisition because words often denote separate concepts (e.g., the mole found in the ground is not the same mole found working for an intelligence agency), and many concepts are expressed in word-combinations (bunk bed, riverbed, flowerbed), in predicates (e.g., old enough to run for president), and in morphemes (e.g., *-ed* in the English past tense or *-s* in the English plural). Further, judging from non-human animals', infants', and languageless adults' performance on learning and memory tasks, many non-verbal concept-like representations (subject, agency, action, cause, consequence, more/less, near/far) appear to exist in absence of language (Fodor, 1975; Furth, 1966; Hauser, 2000; Spelke, 1994). Clearly, even the most ambitious adult could not teach children even a small portion of the concepts that they actually acquire by age 10.

As might be expected, then, most concepts are learned not through direct instruction but through children's experiences. As they encounter the who, what,

where, when, why, how, and how many of everyday events, children accumulate information about categories of people, objects, locations, time, causes, functions, and numbers. Although development of concepts pertaining to each of these categories deserves special treatment, certain common trends have also emerged. Three general trends in conceptual development are described below.

WEIGHTING DEFINING FEATURES

First, children increasingly weight defining features of nominal kinds. Although it is difficult for most adults (and even dictionaries) to list necessary and sufficient features for natural kind concepts such as *oak*, *octopus*, and *onyx*, adults find it easier to define nominal kind concepts, such as *odd number*, *uncle*, and *island*. Unlike natural kind concepts, nominal kind concepts follow simple rules, for example, "A number is odd if and only if it is not evenly divisible by two" (Schwartz, 1977). Development of nominal kind concepts was particularly interesting to developmental psychologists because concepts presented such a straightforward test of Vygotsky's idea that "grouping of objects on the basis of maximum similarity is superseded by grouping on the basis of a single attribute" (1986, pp. 136–137) and of Piaget's idea that children's initial categories group things on the basis of accidental rather than essential features (Inhelder & Piaget, 1964).

To test this idea, Keil (1989) presented children with descriptions of nominal kinds that lacked defining features of the category but possessed characteristic features or that lacked the characteristic features of the category but possessed the defining features. For example, when testing children's concept of *island*, Keil found that kindergartners typically said that a "place that sticks out of land like a finger" with coconut trees and palm trees was an island despite lacking defining features of an island, whereas a "place that is surrounded with water on all sides" and covered in snow was not an island despite possessing defining features of an island. In contrast, second graders typically recognized that palm trees and snow were inessential characteristics of islands and based their judgment of island-hood strictly on the defining features. Moreover, Keil found this age-difference across most of the nominal kind concepts tested, with young children variously averring that "pancakes can't be lunch" (even if eaten at noon) and that 2-year-olds cannot be uncles (even if brothers of somebody's mother).

Although the "characteristic-to-defining features shift" is an important trend in development of nominal kind concepts, subsequent research showed that the shift does not accompany qualitative changes in conceptual representation that Vygotsky and Piaget theorized. First, although adults' knowledge of definitions might allow them to

categorize atypical category members (e.g., whales as mammals; Armstrong et al., 1983), even adults can be swayed by characteristic features for conjunctive concepts. For example, definitions imply propositions like “Rover is a dog-and-pet [the conjunctive concept] because Rover has the defining features of dogs and pets.” Yet, when making judgments about conjunctives, adults typically weight characteristic over defining features (e.g., judging chess as a game-and-sport but not a sport; Hampton, 1997). Also, even 5-year-olds make surprisingly philosopher-worthy judgments regarding such moral concepts as *lying* and *stealing* (e.g., by recognizing that a boy unpopular for his goodness is still lying when he pretends uncharacteristically to be bad; Keil, 1989). These observations are not consistent with Vygotsky’s and Piaget’s broader claims about conceptual development.

SENSITIVITY TO STATISTICAL STRUCTURE

Second, children become increasingly sensitive to the statistical structure of the environment. By their nature, concepts store information about correlations among features, and for good reason: Features well correlated with a category are more reliable cues to category-membership (e.g., wagging tail, furry, barking are correlated with dogs) than features that are not well correlated with the category (e.g., brown-colored is not very well correlated with being a dog since many non-dogs are brown and many dogs are not brown). Barking, for example, would have higher *cue validity* than being brown-colored, and sensitivity to this cue validity would allow recognition of category-membership most reliably. This principle applies to natural and nominal kind concepts. For example, being older-than-2-years-old would not be a feature of uncle because many non-uncles are older-than-2-years-old.

Children of all ages (even infants) are sensitive to the statistical distribution of features over natural categories (Quinn & Eimas, 1996; Rosch et al., 1976), and this fact explains many aspects about infants’ perceptual categories and older children’s concepts. For example, basic-level categories (dog, table, and car) possess features with higher cue validities than both superordinate categories (animal, furniture, and vehicles), which have few features in common, and subordinate categories (collie, coffee-table, and Corvette), which have many features in common with contrasting subordinate categories (Rosch et al., 1976). This is important for conceptual development: Children learn basic-level categories most easily (Horton & Markman, 1980), learn names of basic-level categories earlier than names of superordinate and subordinate categories (Anglin, 1977), are most likely to interpret novel words as basic level categories (Callanan, 1989), and are most likely to generalize novel properties over basic level categories (Gelman & O’Reilly, 1988). Further,

category-members differ in the number of features that have high cue validity for that concept, with prototypical category-members having the most such features. For example, robins are more prototypical birds than are ostriches because robins fly and flight has high cue validity for the bird category. Again, this difference in cue validity is important in the development of category recognition, with younger children typically claiming that robins are birds (but ostriches are not). Older children and adults show a similar effect of cue validity: robins are recognized as birds more quickly than ostriches (Rips et al., 1973). Finally, even infants as young as 3 months can rapidly form category prototypes from brief experiences with novel categories (Bomba & Siqueland, 1983), and adults judge even abstract categories to have prototypical members (e.g., judging 7 a better example of “odd number” than 23; Armstrong et al., 1983).

Although infants and young children are initially quite sensitive to the statistical distribution of many features, much of the statistical structure of the world passes beneath their notice and requires intervention by adult experts. This is especially true of features that are not perceived, either because the feature is perceptible in principle but not in actuality (e.g., because it is too subtle to notice, too small, or too far away) or because the feature is abstract and not even perceptible in principle (e.g., the fairness of a rule, the truth of a statement, or the product of two quantities). Toddlers notoriously overlook subtle properties (such as wicks on candles) when categorizing objects, unless an experimenter explains how the property correlates with its function (Tversky & Hemenway, 1984; Banigan & Mervis, 1988).

The ability to notice correlations among imperceptible properties is especially important in mathematical and scientific reasoning. For example, although children cannot see the movement of plants (because they move too slowly to be perceived), knowing abstractly that plants move helps older children realize that plants are living things like animals (Opfer & Gelman, 2001; Opfer & Siegler, 2004). One cannot directly perceive torque (the product of the weight of an object and its distance from the fulcrum), yet torque tells us which of two sides of a balance beam will go down, and sensitivity to the correlation between torque and balance increases quite dramatically with age and education (Siegler, 1976). Finally, many features are relative (e.g., having more bristles than eyes), and when learning artificial categories, recognition of cue validity of relative features improves with development (Sloutsky, Kloos, & Fisher, 2007).

SENSITIVITY TO CAUSAL STRUCTURE

Third, children become increasingly sensitive to the causal structure of the environment. Beyond representing information about the statistical structure of the world, concepts

also retain information about causal structure. Children do not simply know that birds build nests and can fly and have feathers and are bird-offspring, they also know that birds build nests because they can fly, can fly because they have feathers, and have feathers because they are bird-offspring. Acquiring causal information is important for learning, memory and generalization (Murphy & Medin, 1985).

Children show early evidence of their sensitivity to the causal structure of the environment, allowing them to better learn and remember categories. Provided with a causal theory explaining how the features of fictitious animals were related to their behaviors (e.g., “wugs need armor for fighting” and “gillies need big ears for hiding”), 4-year-olds better remembered the feature/category associations than those who only learned that wugs have armor and gillies have big ears but not why (Krascum & Andrews, 1998). The implication is that children provided with causal information explaining why features co-occur remember categories better than if they have only learned what features co-occur.

Older children become increasingly sensitive to the relative importance of causal similarities. In one study, preschoolers were asked to label, infer novel properties, and project future appearances of a novel animal that varied in two opposite respects: (1) how much it looked like another animal whose name and properties were known, and (2) how much its parents looked like parents of another animal whose name and properties were known. When origins were known, preschoolers generalized to animals with similar origins rather than with similar appearances; when origins were unknown, preschoolers generalized to animals with similar appearance. Results imply that preschoolers actively choose the similarities that best predict accurate generalization (Opfer & Bulloch, 2007). This ability also improves over time. For example, when told that “pizers” have “blickem” in their blood that causes them to have small lungs and purple skin, 9-year-olds are more likely to use causal features, such as “blickem,” to judge category membership than to use an effect, such as purple skin or small lungs (Ahn et al., 2000).

Sensitivity to the causal structure of the world also leads children to hold essentialist beliefs, that is, an idea that categories in the world are based on a true nature that gives an object its identity (Gelman, 2003). These essentialist beliefs can be helpful in leading preschoolers to realize that a pig’s insides are more like that of a cow than a piggy bank (Gelman & Wellman, 1991). However, they can also lead to mistaken beliefs about an underlying true nature for social groups and genders (Heyman & Gelman, 2000; Gelman, Collman & MacCoby, 1986).

At times, young children express funny beliefs that can take them many years to overcome, such as the notion that

“pancakes can’t be lunch”, that “plants are not alive,” and that pink barrettes can turn a boy into a girl. From these examples, it is tempting to think that children’s concepts differ qualitatively from those of adults. Errors such as these can be viewed instead as part of continuous trends in conceptual development, a process that neither begins nor ends at the driveway of their schoolhouse.

SEE ALSO *Concept Learning.*

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CONCEPT LEARNING

A concept is the way in which a category or class of objects is represented mentally. Concepts allow individuals to discern class membership or non-membership, relate different classes of objects, and provide context for learning new information about classes and class membership. There is wide debate about the way in which categories and classes are mentally represented and defined. The way in which concepts are learned can depend on the age of the learner, whether or not explicit instructions are provided, and the type of category or class the concept represents.

TYPES OF CONCEPTS

Concepts can be learned about categories that include people, events, objects, or even ideas. Various divisions have been made between different types of concepts. Concepts can be divided into groups based on the concreteness of the items involved. Concrete concepts have aspects or dimensions that are easily seen, heard, or touched. Examples of concrete concepts include fruit, dogs, and houses. Concepts can also be categorized as semi-concrete. Semi-concrete concepts are those which have roughly equal aspects that are concrete and not concrete. An example of a semi-concrete concept is a firefighter. The concept firefighter is defined along some concrete terms, such as wears a fire hat, and along some less concrete terms such as risks his or her life, and protects the public. Concepts that are not easily comprehended with the senses are abstract concepts. Abstract concepts include justice, freedom, and love. These concepts are often the most difficult to explain and have the most complex rules or explanations for determination. Abstract concepts are often very difficult for younger children, and as development progresses, increasingly complex abstract concepts are mastered.

Other differentiations can also be made between different types of concepts. Some concepts are natural concepts. Natural concepts are those that occur in the environment naturally without human intervention. This type of concept includes water, eggs, and monkeys.

THEORIES ABOUT CONCEPTS

There are many different theories about how concepts are learned, what information people have when they have mastered a concept, and how information about new items is related to previously learned concepts.

The Classical View. The classical view of concepts is based on the idea that concepts are defined by lists of rules. It is the first view on record about the idea of concepts, and dates back to Aristotle (384–322 BCE). Each concept is believed to be defined by a list of relevant rules or characteristics, all of which are necessary for the

object or instance to be a member of that category or class. For instance, the concept “mug,” includes the rule “is able to hold water,” meaning that a mug must necessarily be able to hold water in order to be classified as a mug. All of the rules taken together that govern a category are sufficient to make something identifiable as a member of that category or class.

The view of concepts as defined by relevant necessary characteristics was the main basis for thought and research about categorization and category learning until the 1950s. At that time, cognitive psychologists and philosophers began to question whether it was a good representation of the way people actually think about categories, especially when they are using them to make judgments in daily life. In the 1970s a series of studies was done, many by Eleanor Rosch, that demonstrated that people did not hold lists of attributes when deciding category membership. Instead, she found that individuals had a mental picture or belief about what made up an example of a member of a class, not a list of well-defined rules (Rosch & Mervis 1975).

Prototype Theory. The prototype idea of concept learning was built on the research done by Rosch and her colleagues. Central to this idea is the concept of a prototype that exists as the ideal example of each category or class for which a concept has been learned. A prototype is an object or item that is the most typical of that concept. There is some debate about whether the prototype is a real example that has been seen or experienced, or if it is an amalgamation of various examples of the concept. If it is an abstract amalgamation it can actually be seen as being more typical of a concept than any actual instance of that concept could be. To determine category membership or non-membership of novel items, each new item is compared with the prototype and the degree of similarity reviewed. Proponents of the prototype theory also often believe that information about examples are organized as being more or less similar to the prototype.

A fairly broad body of evidence developed in the 1970s and afterward in support of the prototype theory. Studies found that participants responded faster to questions about category membership when the item in question was a more typical member of the category than when it was not (McCloskey & Glucksberg, 1979). For example, participants would have responded more quickly to the question, “Is an oak a tree?” than to the question, “Is a bonsai a tree?” Although the developing evidence supported the prototype theory much more strongly than the classical theory, some problems with prototype theory became apparent. Researchers began to find that participants judged items to be more typical of a category in some situations than in others, which prototype theory had difficulty explaining. Also, prototype theory did not explain

cases in which an item was very typical of a certain category but was identified as a member of a different category of which it was less typical. For example, although cottage cheese is more typical of pudding than cheese, it is clearly categorized as a cheese.

Exemplar Theory. The exemplar theory of concept learning states that specific examples of concepts are learned, instead of a generalized or prototypical example or a list of specific required characteristics. Proponents of this view believe that although not every example that an individual comes across is stored in the memory, many examples are retained. In this way novel items or circumstances can be compared to examples that are stored in the memory. Novel items that are not similar to any of the stored exemplars are therefore very difficult for people to put into any specific category. Some people believe that the more typical of a category a specific example is, the more likely it is to be stored as an exemplar of that category.

The exemplar view explains many of the results found during research on concept learning and categorization. As discussed above, participants tend to respond more quickly when asked about the category membership of items that are typical of the category in question. This is because these items are more likely to be stored exemplars or more similar to stored exemplars. The exemplar theory also has problems explaining some things. It is not clear how many exemplars are stored or how the determination of storage is made. Another objection frequently raised is that it requires that individuals store many different exemplars for each concept, taking up vast quantities of long-term memory, more so than a single prototype would require.

ACQUIRING CONCEPTS

Views on how people acquire concepts are guided in large part by which theory of concept determination is believed. Research on acquisition of concepts is often seemingly contradictory because individuals use different types of strategies depending on the situation, the type of information involved, and any beliefs about what the structure of the underlying concept is. Concept acquisition is probably a complex process with a number of strategies available depending on the perceived situation.

When individuals are trying to form a concept, and feedback is given about group membership or non-membership, the individuals tend to form and test hypotheses. J. S. Bruner and his colleagues did significant work on this in 1956, examining the way that participants tried to identify a concept provided by the researchers. The participants chose cards and were told whether each card chosen was a member of the group or not. All the participants formed hypotheses and then tested them, but the strategy to achieve this differed across participants. Some

participants picked a card that was a member of the group and then tested cards that differed by it in only one respect to determine which aspects of the cards were critical and which were not. Other participants created complex hypotheses and then chose cards that would test the most attributes at once. A third set of participants formed a number of hypotheses but tested them one at a time (Bruner et al., 1956).

Although the above strategies may work when individuals are given feedback about each successive item, this is not particularly likely to occur in day-to-day life. Instead, other strategies for concept acquisition must be used. When individuals have to determine two categories and then assign novel items to one category or the other, different strategies may be used. According to the classical theory, individuals would create a set of rules for each category that were necessary and sufficient for group membership and then apply those rules to each new item. According to the prototype theory, individuals would form a prototype for each category by examining as many of the example items as possible, and then classify novel examples by comparing them to the two prototypes and determining similarity. According to the exemplar theory, examples from each of the two categories would be memorized, and then novel items would be compared to the memorized exemplars for similarity.

The research indicates that individuals use a variety of these approaches, and that no one approach is completely correct. It appears that the various approaches serve different functions, and may be found to be more effective in different situations. Students use a variety of these techniques as different educational concepts are learned. In some cases the expectation of concept formation is made clear and regular feedback is received, in which case the student may be more likely to use hypothesis generation and testing. In other cases the formation of a prototype may appear to be the most effective method for concept attainment. In some cases, especially when the criteria are dictated by the educator, the classical view may be used. In some cases, especially if the student is not completely clear on the underlying concept, exemplars may be memorized to aide in class membership determination.

TEACHING CONCEPTS

There are many different ways in which concepts can be taught, and there is some debate about which methods are the most effective. In general, methods differ depending on the desired outcome of the educational experience, the age of the learner, and the difficulty or abstractness of the concept being taught.

The most basic way of teaching concepts is by determining a rule or set of rules for the concept and having the

students memorize them. The students can then apply the memorized rule or rules when prompted to make decisions about class membership of novel items. Although this does achieve some objectives of concept learning (i.e., allowing the student to make judgments about class membership), it does not necessarily provide a solid foundation for comparing the concept to previously learned concepts, a basis for learning new concepts, or a strong likelihood that the rule will be applied in novel situations when the student is not prompted.

To provide students with a more solid understanding of the concept, additional information is often useful. Students can be provided with items that are similar to the concept but that differ on one or more dimensions, making them non-members of the category in question. For example, the concept “peninsula” may be defined as “a body of land surrounded by water on three sides.” Relevant examples, such as Florida, may be shown to help give the concept a visual dimension. To achieve more complete student mastery of the concept, students and the educator can discuss what makes other similar items non-members of the class. For example, an island is not a peninsula because it is completely surrounded by water instead of only on three sides. Students can also be shown members of the concept that differ significantly but are still category members, such as the Korean peninsula and a small, local peninsula. Although Florida, the Korean peninsula, and small local peninsulas differ drastically in size and location, they are all members of the category “peninsula.” This can help students create a rich and complex understanding of the concept being studied.

An alternative to teaching concepts through memorization of rules provided by the educator is a more student-centered, hands-on approach. This approach may be more helpful when teaching concepts that do not have simple definitions to older students with more advanced critical thinking skills. Having students decide on the defining characteristics or most ideal examples of a class or category can provide an understanding of a concept deeper than that provided by memorization. Students may be provided with a number of examples of members of a category or class and then be prompted to vocalize their reasoning in categorizing those examples. For more abstract concepts, such as “justice,” or “freedom,” students can be prompted to think critically and debate between themselves why some examples are members of the class when other seemingly similar examples are not. Additionally, the teacher may provide new examples, and the students can discuss where they believe the examples fit, and why they classify them in that way.

PROBLEMS IN CONCEPT LEARNING

Many concepts are a challenge to learn, and are learned slowly as more examples and rules are integrated and information is sorted into more straightforward units. All students learn concepts at different rates, and a student who demonstrates mastery of one concept very quickly may find another particularly challenging. However, some students have more than the expected amount of difficulty learning concepts. Students with learning disabilities often have an especially difficult time learning concepts. Although the degree of difficulty and the types of concepts that commonly present problems differ depending on the learning disability, the degree of disability, and the individual child, some problems are common. Basic math concepts, time concepts including time sequencing, and reading concepts are especially likely to present significant challenges. Students with such problems learning concepts may benefit from additional educational strategies to help prevent the student falling behind as additional information and concepts are built upon concepts that were not completely mastered.

Children and adolescents often bring a lot of information into the classroom. Unfortunately, information gathered through life and experiences outside the classroom is not always completely accurate. Many children have previously conceived notions of concepts before being exposed to them in a classroom setting. When mastering a concept in the classroom involves conceptual change, that is replacing a previously held concept with a new one, students can encounter unexpected difficulties. It is important to identify situations in which previously held concepts are at conflict with the concept being taught, because different educational strategies may be appropriate.

Much of the literature about the difficulties encountered in conceptual change has involved the sciences. This is because students often have ideas about natural phenomena, such as what causes rain, and why it is dark at night, before learning about them in school. In these situations educator-led investigation and discussion may not be the most effective road to concept learning. This is because it may be difficult for students who believe they understand something to think outside that understanding or to accept different ideas presented by other students. In this case, teacher-provided rules and critical criteria can help a student overcome a previously believed, but incorrect, concept. Teaching conceptual change can also be accomplished by discussing student preconceptions about a concept, discussing evidence contrary to the preconceived concept, and guiding the student through a changing understanding to mastery of the correct concept.

SEE ALSO *Concept Development.*

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Helen Davidson

CONCEPT MAPS

Concept mapping is the technique used by individuals and groups to organize, represent, and visualize knowledge and ideas in graphical formats. It is used to develop a structured framework in order to plan or evaluate various types and sizes of projects. Sometimes called knowledge maps, the graphical technique is based on graphically describing topics within one concept and/or relationships found among different concepts.

The diagram used to visualize these relationships among various concepts is called a *concept map*. Within a concept map, networks are drawn that consist of nodes, which represent concepts. Connecting lines, or links, represent a particular relationship between two concepts. Linking words, phrases, and symbols, used to describe relationships between nodes, often appear on the links.

Concept maps are generally, but not always, created so they are read from the top downward. Some concept maps are simple designs that examine one central theme and only a few associated topics. Other concept maps contain complex structures that describe multiple themes and relationships.

HISTORICAL BACKGROUND

The concept map is a relatively new way to visualize complex subject matter. The technique of concept mapping was first developed in the 1960s and 1970s by American educator and research scientist Joseph D. Novak (1930) while at Cornell University, in Ithaca, New York. During this time, Novak, a professor of education and biological sciences, developed an effective

way to strengthen the process for his students performing research. Novak discovered that representing thoughts visually often helped students to effectively associate ideas without being inconvenienced by writing them down in lengthy formats. His students, Novak found, could represent newly learned information by first defining a concept, adding related topics, and linking similar ideas. Such an arrangement helped to organize research information and formulate educational theses.

Novak's work was based on the cognitive learning theory first developed by educational psychologist David Ausubel in the 1960s. Also known as the theory of meaningful learning and assimilation theory, Ausubel's theory became a tool for structuring information in an easy-to-recognize way. He found that students learned new material based on prior knowledge. According to Ausubel, by visualizing past knowledge, students were better able to control the learning process and, consequently, learned new information faster and more efficiently.

The concept map itself is founded in a learning theory called constructivism, which states that humans learn from previously acquired knowledge. Swiss developmental psychologist Jean Piaget (1896–1980) is generally recognized as the first scientist to formalize constructivism into scientific structure.

Later, the theory of concept mapping developed by Novak, and first published in 1977, helped to guide educational research and instruction. Since that time, concept mapping has been widely applied to science, education, business, and government.

COMPONENTS OF NETWORKS

There are several components used when teaching and applying concept mapping. The concept map is generally represented in a defined order, with members arranging parts of the concept map according to a pre-determined ranking. The more general concepts are usually positioned at the top, and the more specific concepts, along with examples, images, and other descriptors, placed underneath. Networks are drawn, consisting of *nodes* usually enclosed in boxes but also represented by points, circles, or other figures. Nodes represent various concepts, with a concept defined as a perceived regularity in, or record of, some event or object.

Nodes are joined together with *connecting lines*, or links, which represent a particular relationship between two concepts. Nodes are always labeled, while links are usually labeled. Links can be nondirectional (with no arrows), unidirectional (with an arrow at one end), or bidirectional (with an arrow at both ends).

Linking words, phrases, and symbols are used to demonstrate the relationship or connection between concepts. Besides words and phrases, symbols such as +, -, and =

are sometimes used. A *proposition* is the term used when two or more concepts are connected with linking lines and linking words, phrases, or symbols to form a meaningful statement.

Cross-links are long connections, which consist of connecting lines with linking words, phrases, and symbols, between concepts in different themes (domains) of the concept map. Cross-links are usually used to help identify how various domains are related.

VARIETY OF CONCEPT MAPS

Three types of concept maps are generally recognized by professionals who have researched and developed the theory behind concept mapping. *Spider concept maps* place the main topic in the center of the map and related themes are linked around it—thus, the map is shaped like a spider's body with its many legs. Spider concept maps are often developed when only one concept is being used. For instance, a single node might state "National Football League" and linked around it could be the various teams of the NFL.

Hierarchical concept maps place the most general, or most important, concept at the top of the map and the more specific, or less important but related, topics below it. For instance, the most important concept contained in a specific hierarchical concept map might be "Sally Ride," and below it the specific, but related, topics of "astronaut," "physicist," "writer," and "businesswoman."

Flow chart concept maps represent a sequence or a process in a linear format. Flow charts are frequently used in businesses and organizations to analyze the steps involved in completing tasks. For instance, a computer manufacturing company might use a flow chart concept map as a guide to assembling its laptops, using such terms as "motherboard," "graphics card," and "hard drive." Alternatively, mathematicians often use flow chart concept maps when analyzing a complicated mathematical equation.

RESEARCH IN SUPPORT

Concept mapping is designed to help students and others clear up ambiguities and clarify misconceptions in information (which often arise in the learning process), along with strengthening the memory and retention process after the learning is accomplished. Such improvements in education with the use of concept maps have been proven by scientific studies.

When performing such scientific studies, researchers want to ask a multitude of questions relating to concept mapping. Some of these questions include: What aspects of achievement and learning can be bettered? How much improvement can be achieved? How do these improvements compare with other approaches? Do all students

(including special needs students) benefit? How do different grade levels compare in their benefits? Do gender, racial, socioeconomic and other differences affect the benefits? Do students and educators like or dislike the process? And how much training is necessary for implementation?

Research scientists have found that concept mapping is very effective in educational settings. The use of concept maps was reported in studies to have the largest positive effect at the university level; however, modest and consistent improvements were also seen at the elementary, middle school, and high school levels.

Numerous studies have found that students with and without disabilities benefit equally from concept mapping. For instance, improvements in verbal and written abilities, reading and comprehension abilities, and other such capacities were increased when students with learning disabilities used concept mapping.

In addition, research studies have found that the use of concept maps during reading lessons early in the educational life of a student were exceptionally beneficial. Other areas in which researchers found a positive correlation between the use of concept maps and educational learning include science, social studies, mathematics, and language arts. Using concept maps to learn mathematics, for instance, was found very useful in teaching a sometimes-difficult subject.

Besides these specific fields of study, researchers discovered that concept mapping is useful to prepare students for their studies. Such areas as taking notes and organizing question-and-answer responses were shown to work well with concept mapping. Many times researchers found that students took less notes in class but were more effective in learning and retaining the information when they used concept maps.

A study funded by the Office of Special Education Programs, within the U.S. Department of Education, showed a slight but consistent improvement in comprehension and a moderate improvement in vocabulary when students used concept mapping during their general studies. The students were tested using such measures as written summaries, traditional tests, concept acquisition tests, and grammar tests, along with the widely used Stanford Diagnostic Reading Test.

The ability and knowledge of educators to implement concept mapping is important to the process. An 11-year study, for instance, showed that learning results in students were more positive when teachers properly instructed them on the use of concept maps, along with providing realistic, informative, and positive ways to use them. It was also learned that computer-based methods to present concept mapping can be effective for the learning and application of educational materials. In addition,

searching on the Web was shown to improve students' abilities to develop more detailed and complicated maps.

A paper written in 2006 by Josianna Basque and Marie-Claude Lavoie, of the LICEF Research Center (Montreal, Canada), discussed the conclusions of 39 research studies conducted between the late 1980s and early 2000s. The studies were performed on the theory, methodology, and results of *collaborative concept mapping* (CCM), a process in which students construct concept maps in small groups. Basque and Lavoie's conclusion praised the collaborative learning style of concept maps.

Extensive research has also been conducted supporting the use of concept maps for business and organizational settings. Several classic research papers explain the research performed on the development of concept mapping. Some of these historic articles include "An Introduction to Concept Mapping for Planning and Evaluation," by American social research scientist William Trochim, and "Concept Mapping For Evaluation and Planning," a compilation of articles edited by Trochim.

In addition, the "Concept Mapping Resource Guide" Web site of the Web Center for Social Research Methods provides additional information on many of the important articles written about concept mapping.

Research has found that six general steps are involved in developing and implementing any concept map. Step one, the preparation step, involves the selection of participants and the development of the basic reason for the project. A broad range of people are sometimes involved because their various areas of expertise will be valuable in the development of a complex project. In other groups, a random sampling of people from a total population might be selected. Small groups are more easily managed when developing a concept map, but larger groups may be needed when the complexity of the project is immense.

Statements are discussed and recorded during the second step. Usually a brainstorming session, or other type of idea-generating meeting, is initiated to produce as many statements as possible. Later, during the third step, these statements are ranked and sorted based on the project's requirements. Participants are often asked to distinguish each item as to importance and how likely each item will affect the final conclusion.

The most difficult part in planning or evaluating a project is conceptualization. How well a project is accomplished is often based on how well it is initially organized. Thus, it is important that all members recognize the project's major goals, resources, and capabilities; and place them at levels of most to least important.

In the fourth step, the concept map is physically generated by using symbols, words, phrases, and pictures to represent the statements developed earlier. Each statement is

given a position (node) within the developing concept map. Closely related statements are positioned physically nearer to one another than are less related statements.

The interpretation of the concept map is the primary focus in step five. All of the parts of the concept map are grouped, ranked, classified, and generally interpreted for use within the final concept map.

The sixth step involves the utilization of the concept map. It is used as a guide to actually carry out the various details of the project such as planning meetings; developing products, procedures, or services; and assessing results.

Research has found that the use of concept mapping with its easy-to-read and interpret structure of symbols, pictures, and phrases helps members to remember the primary mission of the project. Major ideas and concepts are easily visible, making it easier to accomplish goals and coordinate the activities of individuals and the group as a whole.

GLOBAL APPLICATIONS

Concept mapping has been proven to provide meaningful learning in the educational setting by offering clear structure and detailed organization during the process by which students gain knowledge.

Concept mapping does not replace traditional educational systems; it only provides a conduit for better learning, wider discussions, and more positive advancements within those environments. Teachers use concept maps to better assess knowledge gained by their students. Traditional testing, such as with essay, multiple-choice, and fill-in-the-blank questions, is a valuable way to test students.

However, the practice of having students construct concept maps to determine their level and quality of learning has been found to be more effective in showing how well students understand important concepts recently learned. In fact, according to the researchers in the Department of Education at Stanford University, California, teachers and other educators find concept mapping an easy-to-use and effective method for evaluating the progress of their students.

In addition, concept mapping has been found to be conducive to the quantity and quality of material learned based on long-term memory. This relationship is partly based on the work of Australian educational psychologist John Sweller and his cognitive load theory first proposed in the late 1980s. He created the theory based on the research of many earlier scientists including American psychologist George A. Miller from Princeton University, New Jersey.

Sweller stated within his theory that the ability of long-term memory within a person is best when it is not overloaded. He found that long-term memory, when it is

used for problem solving, reasoning, and thinking, is optimized when humans can make clear and direct connections between previously learned materials and newly learned information. Sweller stated it is essential for educators and designers of educational materials not to overload a person's memory with large amounts of information.

Instead, Sweller recommended using smaller segments during the learning process. Concept mapping is ideal for such "piece-work" learning because it helps students to easily make the connection between what was previously learned and what was just learned, and not to forget the information in the future. Concept maps accomplish Sweller's ideas by physically organizing information into small groupings so as not to overload students with too much information at any given time.

Primarily, concept mapping provides for applications within the planning process, the learning process, and the assessment process. Even before students learn material, concept mapping is a valuable tool used by educators to organize the material they want to teach their students during the planning stage. Often, educators have difficulty creating both a comprehensive and an understandable teaching program. However, with concept mapping, they are much more likely to be able to create and implement effective teaching curriculum (including concepts, ideas, and images) that will be communicated more effectively to their students and better comprehended by their students.

During the learning stage, concept mapping is a very important learning tool because it facilitates the learning of material in a meaningful and structured way, by organizing information piece by piece so that it is easy for students to comprehend.

After students learn material, concept mapping is also used to test the learning of students during the assessment stage. It can easily and effectively track, document, and evaluate learning and knowledge gained during the educational process.

More than 40 years of research, development, and application has resulted in the inclusion of concept mapping within many businesses and organizations, large and small, throughout the world. In the United States, Concept Systems, Inc., is one of the leading companies that provide computer software and consulting services in the area of concept mapping. Its clients include national and regional associations, nonprofit organizations, government agencies, and private businesses.

The Web Center for Social Research Methods is an important academic resource in the applied social research and evaluation of concept mapping. It provides introductory materials, research, and case studies involving concept maps.

Conceptual Change

There are many reasons why concept maps are generated in the first place. They are used within an established business, such as taking simple notes at a department meeting and remembering important concepts at a board of director's meeting. A new business might use concept mapping to identify its employees' knowledge base. Computer programmers often use concept maps to design complicated computer programs, such as for creating Web sites and video games. Large organizations often use concept maps to communicate complex ideas to their employees or to the general public.

Lawyers use concept maps to illustrate arguments on both sides of complex issues. Educators frequently use concept maps to help students learn new material, retain historic material, and integrate the two together. Problem solvers use concept maps to better understand and diagnose problems. A troubled company, for example, might use concept mapping to create a shared direction to improve employee morale or increase its customer base.

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William Arthur Atkins

CONCEPTUAL CHANGE

In representational theories of mind, concepts are mental units that are bearers of meaning and that can be mapped onto single words such as *dog*, *animal*, *grow*, and *die*. They are used to form beliefs, such as *Fido is a dog* or *Dogs can die*, guide inference and organize knowledge of the world. Conceptual change occurs when there is change in what these mental units are and how they are articulated within larger conceptual systems. Although there are obviously different degrees of conceptual change, ranging from adding a new concept that fits within an existing conceptual system (e.g., learning about a new type of dog) to changing the organizing principle of an entire classification system (e.g., recognizing species as interbreeding populations of individuals that change over time rather than as unchanging ideal types), the term *conceptual change* has typically been reserved for forms that involve significant restructuring. These changes are notoriously difficult to make because they involve coordinated changes in multiple concepts, rather than simple additions or elaborations. For example, if children say "A lamp is alive," "The Earth is flat," or "This piece of clay weighs nothing at all," they may be expressing beliefs that are true from the perspective of their conceptual systems. Changing their beliefs involves more than telling them they are wrong or providing new information; it involves helping them develop different concepts of the Earth, alive, or weight. An important challenge is to identify cases of learning that involve significant restructuring and to understand how it occurs.

In his influential book, *The Structure of Scientific Revolutions* (1962), Thomas Kuhn (1922-1996) challenged

the view of science as the steady accumulation of knowledge by describing the profound shifts in the meaning of concepts that have occurred when scientists have moved from one dominant paradigm to another. He argued that scientists' work is governed by a paradigm shared by members of that community—a complex structure of theory and laws, preferences about instrumentation, and more general assumptions about what kinds of entities exist and what form laws should take—that helps fix the meaning of common vocabulary, as well as provide the rules for problem solving in a given domain. He distinguished between normal science, periods that involve routine puzzle solving for problems defined by a paradigm, and revolutionary science, periods of crisis during which a dominant paradigm fails to solve key problems and is eventually overthrown by a new paradigm that gains allegiance from the community of scientists. The changes in worldview and commitments about what entities exist and how they interact can be so great when scientists switch paradigms that Kuhn argued that members of the community effectively no longer speak the same language.

In the 1980s George Posner and colleagues (1982) brought these ideas of conceptual change to the science education community. Challenging the prevailing model of learning in which students were seen as gradually accumulating new beliefs based on generalizing from observation, he and his colleagues proposed that in learning current scientific theories, students needed to undergo conceptual revolutions that in many ways were analogous to the paradigm shifts Kuhn had identified in the history of science. They called for a new “conceptual change” model of learning that acknowledged the powerful role children's ideas play in observing, defining problems, and making sense of new information. Indeed, researchers were discovering that adolescents brought a wealth of ideas to the science classroom. Many were strongly held ideas that proved to be extremely resistant to instruction, and some resembled earlier theories in the history of science—for example, the impetus theory in mechanics (McCloskey, 1983) or the source-recipient model of heat (Wiser, 1988).

At the same time Susan Carey (1985) brought the ideas of conceptual change to the developmental psychology community. This group was already keenly aware that development involved *qualitative* shifts in children's ideas about number, physical quantities, space, time, mind, and life, thanks to the pioneering work of Bärbel Inhelder (1913–1997) and Jean Piaget (1896–1980). However, there was growing dissatisfaction with Piaget and Inhelder's explanations of these changes in terms of the progressive construction of more powerful *domain-general thinking structures* (i.e., shifts from sensori-motor, to pre-operational, concrete operational and finally formal operational thought) in part because children's

thinking did not show the kinds of consistency expected on these accounts. Carey proposed that it would be more fruitful to think of children's thought as constrained by *domain specific structures* (intuitive theories akin to Kuhnian paradigms). In her view, even preschoolers and elementary school students have implicit intuitive theories in which their everyday explanatory concepts are embedded and play a role, which guide their patterns of inference and problem solving, and which can be fundamentally revised in the face of new information from their culture. Thus, conceptual change came to be seen not only as occurring in mature scientists and students receiving explicit science instruction, but also in younger children in the normal course of their development.

LEARNING CAN INVOLVE CONCEPTUAL CHANGE

Not all aspects of learning or cognitive development involve conceptual change. Much learning fills in the gaps and elaborates on a given conceptual structure rather than radically restructures it. Change may also involve units other than concepts; for example, beliefs, mental models, strategies, and event scripts. Further, not all aspects of cognitive development involve learning; some profound changes may depend primarily on maturational processes.

However, there are now a number of cases in which change does seem to involve a fundamental restructuring of concepts. In each case, researchers have provided detailed analysis of the changing structure of the concepts across two conceptual systems, empirical evidence that children show the kinds of systematicity expected on these analyses, and evidence that learning shows significant resistance to change. These cases span changes that occur for students during the elementary school years to cases that only rarely occur even among college students. Most of the work has focused on science concepts, but there are some well worked out examples in mathematics and other fields. Indeed, in a couple of cases, relevant conceptual changes in science and mathematics may be linked.

One of the first cases examined was children's concept of the Earth. Joseph Nussbaum (1985) found that how children think about the shape of the Earth has implications for their concepts of space and gravity. Initially children think of the Earth as flat, space as bounded, with an absolute up/down orientation, and objects as falling down to earth. As children come to accept that the Earth is a sphere, they re-conceptualize space as unbounded, extending in all directions from the Earth, with gravity acting towards its center. Stella Vosniadou and William Brewer (1992, 1994) extended this analysis by showing how children's initial Earth concept was constrained by the presuppositions of a larger

framework theory a naïve physics in which the Earth was seen as a kind of flat, stationary, physical object. They found that children invent many synthetic models of the Earth (such as the flat disc and dual Earth models) in an attempt to reconcile the new information that the Earth is round with their initial presuppositions. Coming to understand the earth as spherical, moving, and unsupported involves constructing and assigning the Earth to a new ontological category astronomical object with distinctive properties; this in turn changes the framework they can use for explaining the causes of day/night or the seasons.

The development of children's concepts of matter, weight, and density is another case that may involve restructuring a network of concepts. Carol Smith (2007) found evidence for an initial conceptual system that uses an undifferentiated concept of weight/density (one that unites the elements heavy and heavy for size) and a later system in which weight and density are fundamentally different kinds of quantities that figure in different generalizations. That is, weight is an extensive quantity whose magnitude varies with the amount of matter, whereas density is an intensive quantity whose magnitude is independent of amount of matter. Movement from conceptual system one to two involves coordinated changes in multiple concepts: representing weight and volume as measured quantities mapped to number rather than as perceptual magnitudes, representing matter as a fundamental constituent that occupies space and has weight rather than something that can be seen, felt, and touched; and coordinating weight and volume in a new concept of density. There was evidence of coherency in reasoning patterns among children who failed to differentiate weight and density as well as those who successfully did. In teaching studies, there was both evidence of resistance to change among some children and coordinated patterns of change among multiple concepts for those who were more successful.

The conceptual restructuring that occurs in children's intuitive matter theory may be related to a profound restructuring that occurs in mathematics. During the early years, children develop and entrench a rich concept of counting numbers, positive integers as represented by the integer list and that participate in operations of addition and subtraction. For each positive integer, there is an answer to the question "Which is the next one?" It is the next word in the count list. Later, they are exposed to new entities fractions and decimals. To develop an understanding that fractions and decimals are numbers, children must restructure their concept of number from count number to rational number and make a host of changes, including developing a mathematical understanding of division. They must also rethink many core assumptions about what numbers are. For example, in

the count list, there are no numbers between the integers, but for rational numbers there are. Various reflections of conceptual understanding of fractions develop in parallel across samples of children (Gelman, 1991). Researchers have also found evidence of resistance to change, as children initially try to assimilate fractions to their concept of counting number. Finally, understanding rational number was strongly related to understanding weight as a continuous property of matter (Smith et al., 2005).

There are other cases in which the current scientific theories are deemed even more wildly counter-intuitive and fail to be understood by most adults. Coming to understand Newtonian dynamics, thermal physics, and Darwinian theory of natural selection are prime examples. For example, Andrew Shtluman (2006) identified two contrasting frameworks for understanding evolution: a transformationist framework (that characterized most students) and the variational framework of Charles Darwin (1809-1882). Students think of species as having essences, leading them to downplay variation within species and to think of evolution as a directed process of *transforming* the species essence over time. In contrast, Darwin thought of species as populations of inter-breeding individuals, making individual variation more important and salient, with evolution involving the two-step process of production of new variations followed by selection. Most individuals reasoned about six diverse phenomena in ways that were consistent with a given framework. Further, there was evidence of resistance to change, as students were actually asked to answer as they thought Darwin would.

Researchers have also characterized the contrasting frameworks for understanding knowledge acquisition in science, ranging from simpler knowledge-unproblematic epistemologies in which knowledge is seen as accumulating through observation, to more complex knowledge-problematic epistemologies in which conceptual frameworks guide inquiry. Movement from one framework to the other involves making fundamental differentiations (e.g., differentiating ideas from evidence, theories from hypotheses) as well as reanalyzing the meaning of concepts (e.g., scientific truth; scientific model). Studies have shown some consistency in student reasoning across tasks, as well as considerable resistance to change. Most college students still embrace a limited knowledge-unproblematic epistemology, although significant conceptual restructuring can occur with unusual science teaching experiences in elementary school (Smith et al., 2000).

WHAT CHANGES WHEN CONCEPTUAL CHANGE OCCURS

Most theorists see conceptual change as involving change at multiple interacting levels. First, there are changes in the *internal structure* of concepts: changes in the

attributes represented in a concept and the weighting of those attributes. For example, movement to a differentiated weight concept involves adding a representation of weight as a measured quantity mapped to number, making this new representation central to the meaning, moving felt weight from core to periphery, and removing heavy for size as a relevant attribute of weight at all. Second, there are changes in the *external structure* of concepts: the collection of beliefs stated using the concept, including the relations formulated between concepts and ways that concepts are used in explanations. For example, as children differentiate weight and density, they can explicitly state their relation and use these concepts in separate generalizations.

In addition, many conceptual change researchers and developmental psychologists argue that there are multiple interacting levels of external structure. More specifically, some have proposed a distinction between *larger framework theories* and the more *specific intuitive theories* that can be formulated within a given framework theory (Wellman & Gelman, 1992), inspired by a similar distinction made by philosophers and historians of science. Framework theories delimit different domains of human reasoning by identifying the important classes of entities that need to be considered in the domain (its *ontology*) and the kinds of causal relations that are expected to occur among those entities. For example, preschool children may have at least three framework theories: a naïve physics (centered on *physical objects* that interact via mechanical causality), a naïve psychology (centered on *people* whose actions are caused by their goals, intentions and desires), and the beginnings of a naïve biology (centered on *animals* whose growth and development is governed by innate potential and whose movement and health is powered by vital forces). The existence of framework theories explains how children are able to make certain classes of inferences readily, often in the face of limited data, and why new beliefs, concepts, mental models, and even specific theories can be formed relatively quickly and fluidly when consistent with a framework theory. In contrast, more radical forms of conceptual restructuring involve changes in the larger framework theory. These changes are difficult because they involve changing basic ontological and epistemological assumptions, as well as expectations about types of causal patterns that will occur.

Not all conceptual change researchers embrace the notion that children's concepts are embedded in intuitive theories. Micheline Chi (2008) acknowledges the critical importance of ontological categories in organizing concepts, but describes them more generally as schemas rather than as part of theories. Andrea diSessa (1993) acknowledges the explanatory component to children's concepts, but suggests that children's explanatory ideas

are too shallow and uncoordinated with each other to be well described as a systematic theory, at least in their naïve mechanics. The framework theory proposal, however, may capture the abstract level at which there is consistency in children's thought while leaving room for children to be ignorant about the details needed for a well worked out specific theory, and for much fluidity in children's thought.

Researchers have also considered what stays the same in conceptual change. Carey (2008) notes that not all concepts are reworked even in conceptual revolutions; some survive and serve as sources of stability. DiSessa identifies subconceptual elements, or phenomenological primitives, such as "balancing" or "overcoming," that he thinks are as close as one gets to stable elements of thought and that are the explanatory bedrock of intuitive thought. He sees conceptual change as shifts in salience and cuing priorities among these elements, not replacing or eliminating these elements. Indeed a main contribution of his research program is to call attention to the productive resources within intuitive thought and the ways they continue to be used in later, more well structured theories.

CONTRASTING THEORIES OF HOW CHANGE OCCURS

If student learning is constrained by the assumptions of their guiding framework theory, how can new framework theories be learned? Instructional texts often focus on refuting specific beliefs. But if the faulty student belief stems from a faulty ontology, then refutation at that level will not be that effective. Instead, students will discount the data in numerous ways as they reinterpret it within their existing views rather than perceive it as anomalous (Chinn & Brewer, 1993). Even if they recognized an anomaly, they would not know what they needed to change to resolve it.

Chi argues that instruction in these cases would be more effective if the student were directly taught a new (more appropriate) ontological category. For example, she argues that many of the mistaken beliefs students develop about forces, heat, electricity, light, and magnetism stem from their assigning these concepts to the ontological category of "substance-kind entities" or "direct causal processes," and that these scientific concepts can be better understood if thought of as "emergent causal processes." Because students do not initially have such a category, she advocates directly teaching it by telling students the ways that emergent causal processes are different from direct causal processes. She found that college students who had a brief (1-hour) introduction to the category of emergent causal process, explained with some computer animations and several worked examples,

had improved conceptual understanding of electricity in a follow-up unit compared to controls (Slotka & Chi, 2006).

Carey (2008) argues that conceptual change often rests on multi-step, iterative bootstrapping processes. One step involves the (culture's) introduction of a network of external symbols that function as (at best) partially interpreted *placeholders* (e.g., a drawing of a number line, or children being told "You need to eat to grow and stay alive"). These new networks of symbols may initially be learned by rote, where their meaning is captured more by their relations to each other than to prior knowledge. A second step involves coming to *interpret* the placeholders, using a variety of non-deductive modeling processes (e.g., analogies, thought experiments, inference to best explanation) that allow children to build connections with prior knowledge and observations in the world.

Both John Clement (2008) and Nancy Nersessian (1992) have studied how modeling processes work, both in students and in scientists, and how they can lead to the construction of fundamentally new representations. Crucially, models draw on people's everyday capacity to run mental simulations of events, in which they can both *simplify* their representations of events (by selectively abstracting away from surface details) and *enrich* them (by adding in depictions of unseen entities and processes, such as moving and colliding atoms, that help explain how things work). In creating these representations, individuals combine elements from diverse analogies, visual images and sensori-motor schemes in novel ways. Overall, Clement sees engaging students in incremental cycles of generating, evaluating, and revising explanatory models as at the heart of conceptual change.

Reasoning about models, of course, does not occur in a vacuum, but depends critically on social discourse and argumentation (e.g., dialogue about whether the model makes sense and explains the phenomena in question) and on using a wide variety of external symbols, inscriptions, and cultural artifacts. For this reason, many have extended analyses to include the study of how different discourse practices, participant structures, and cultural tools contribute to learning in conceptual change.

Finally, there is increasing recognition of the active role of students in regulating their own learning (Sinatra & Mason, 2008), guided by personal goals, interests, values, metacognitive understandings, and epistemic ideals.

EXAMPLES OF SUCCESSFUL INSTRUCTION

Successful instruction calls for the careful orchestration of multiple practices that actively engage students' initial ideas and help them restructure them in order to build a better understanding of their world. There is much art

in this orchestration, as well as much that is domain specific. There are a number of examples of instructional sequences that have led to conceptual change in different domains.

Jim Minstrell, a high school physics teacher, is one of the pioneers in crafting a high school physics curriculum that helps students to build a deeper understanding of the core concepts in Newtonian mechanics (Minstrell, 1984). His instruction combines diagnostic quizzes that engage students in making predictions about everyday events and explaining their reasoning, classroom discussion of these predictions that leads to outlining a range of views, classroom demonstrations and experiments that often produce discrepant events, followed by further discussion to sort out and interpret findings in terms of a network of concepts. It also involves the careful sequencing of benchmark lessons and revisiting ideas throughout instruction. More accessible ideas are built up first so they can be used as resources for building other ideas later through logical arguments.

Jim Stewart collaborated with high school teachers to develop modules in genetics, evolution, and observational astronomy that are attentive to student starting ideas and that develop student understanding through engaging them in model-based inquiry (Stewart, Cartier, & Passmore, 2005). All modules start with activities that promote explicit understanding of a model as a conceptual structure used to explain data and guide inquiry, because they found students enter thinking of models only as representations and need a better framework for later discussions. In the evolution module, students contrast three models of species adaptation and diversity: the model of intelligent design, created by William Paley (1743 1805) the model of acquired characteristics, developed by Jean-Baptiste Lamarck (1744 1829), and the model of natural selection, created by Darwin. Contrasting these models was an effective way of helping them sort out what Darwin was claiming from what he was not, thus avoiding many common misconceptions about natural selection. Students then extend their understanding of natural selection through applying this model to make sense of real data sets. The other modules also develop and inter-relate multiple models in a carefully sequenced manner.

Others have successfully engaged elementary and middle school students in model-based inquiry that simultaneously promotes conceptual change and greater metacognitive understanding of science. For example, Barbara White's ThinkerTools curriculum (1993) involved sixth grade students in constructing, testing, and revising models of force and motion, through designing and carrying out investigations with computer micro-worlds and real-world experiments. As students moved

through the curriculum, the microworlds became more complex (e.g., progressively adding in effects of friction, mass, and gravity), allowing them to sequentially build up more complex conceptual models. Microworlds have been used productively as additional resources in promoting conceptual change in a variety of domains (Snir & Smith, 1995; Wiser & Amin, 2001). Finally, some educators have redesigned their whole approach to teaching grades 1 to 6 science (Hennessey, 2003) or science and math (Lehrer, Schauble, Strom, & Pligge, 2001) with a focus on engaging children with model building in the service of developing and testing their own ideas. These complex curricula not only have successfully built domain specific understandings, but showed that elementary school students can develop insights about the conceptual change process and the role of frameworks in inquiry that elude many adults!

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Conflict Resolution

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CONFLICT RESOLUTION

Conflicts may be resolved or managed. A conflict exists whenever incompatible activities occur (Deutsch, 1973). An activity that is incompatible with another activity is one that prevents, blocks, or interferes with the occurrence or effectiveness of the second activity. Conflict resolution is solving the problem so the conflict is ended. Conflict management is handling the conflict so it is under control. Conflicts are constructive to the extent they (a) result in an agreement that allows all participants to achieve their goals, (b) strengthen the relationship among participants, and (c) strengthen the ability of participants to resolve their future conflicts constructively (Deutsch, 1973; Johnson & F. Johnson, 2006).

Whether constructive or destructive outcomes result from conflict depends largely on the context in which the conflict occurs. In situations dominated by cooperation, conflicts tend to be viewed as problems to be solved. Individuals tend to communicate effectively, accurately perceive the other person and his or her position, trust and like the other, recognize the legitimacy of the other's interests, and focus on their own and others' well being. In situations dominated by competition conflicts are viewed as "win-lose" situations. Individuals tend to focus on gaining an advantage at the expense of others, communicate misleading information, misperceive the other person's position and motivation, be suspicious of and hostile toward others, and deny the legitimacy of others' goals and feelings.

CONFLICT RESOLUTION PROGRAMS

Conflict resolution programs are aimed primarily at teaching students the competencies they need to regulate their own and their classmates' behavior so that conflicts may be resolved constructively. Conflict resolution and peer mediation programs have been generated by (a) researchers in the field of conflict resolution, (b) groups committed to nonviolence, (c) anti-nuclear war groups, and (d) lawyers.

Mean weighted effect sizes for peacemaker studies

Dependent variable	Mean	Standard deviation	Number of effects
Learned procedure	2.25	1.98	13
Learned procedure—retention	3.34	4.16	9
Applied procedure	2.16	1.31	4
Application—retention	0.46	0.16	3
Strategy constructiveness	1.60	1.70	21
Constructiveness—retention	1.10	0.53	10
Strategy Two-concerns	1.10	0.46	5
Two-Concerns—retention	0.45	0.20	2
Integrative negotiation	0.98	0.36	5
Quality of solutions	0.73	0	1
Positive attitude	1.07	0.25	5
Negative attitude	-0.61	0.37	2
Academic achievement	0.88	0.09	5
Academic retention	0.70	0.31	4

SOURCE: Reprinted with permission from: Johnson, R., & Johnson, D. W. (2002). *Teaching students to be peacemakers: A meta-analysis*. Paper presented at the Annual Convention of the American Educational Research Association, New Orleans, April.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

While there are numerous programs, some of the most historic and important are discussed below.

Research Theory-Based Programs. The Teaching Students to Be Peacemakers Program (TSP) was developed in the mid-1960s at the University of Minnesota by researchers in the field of conflict resolution (Johnson, 1970, Johnson & Johnson, 2005). Beginning in 1966, teachers were trained to teach students how to resolve conflicts constructively. The Peacemaker Program trains all students in the school in the value of conflict, the five strategies for managing conflicts, the integrative negotiation procedure, and the peer mediation procedure. The training may be integrated into curriculum units. It is repeated every year at an increasingly higher level of sophistication as a 12-year spiral curriculum. The Peacemaker Program has been implemented in schools throughout North America, and in numerous countries in Europe, the Middle East, Africa, Asia, and Central and South America.

Columbia University's International Center for Cooperation and Conflict Resolution (ICCCR) focuses primarily on research and training in conflict resolution (Coleman & Fisher-Yoshida, 2004). Their program is implemented by training school mediators, placing conflict resolution concepts and skills into the curriculum, using cooperative learning and constructive controversy as pedagogical methods, changing the school culture from competitive to cooperative, and involving the broader community in the program.

The Conflict Resolution Model (Davidson & Wood, 2004) was developed in Australia. It consists of four components: (a) developing expectations for “win-win” solutions by teaching that cooperation is the most effective means of managing conflict, (b) identifying each party’s interests, (c) brainstorming creative options, and (d) combining options into win-win solutions.

The Constructive Controversy Program, which was first taught in the early 1970s, consists of teaching students how to engage in intellectual conflict, either in academic or group decision making situations (Johnson & Johnson, 1979, 2007). Constructive controversy occurs when one person’s ideas, information, conclusions, theories, and opinions are incompatible with those of another and the two seek to reach an agreement. Students are trained to prepare the best case possible for their position, give a persuasive presentation to convince others to agree with them, engage in an open discussion in which they attempt to refute opposing positions while rebutting attacks on their position, engage in perspective reversal in which they present the best case for the opposing position, and then reach a joint consensual decision based on their best reasoned judgment. The program has been implemented in schools and universities throughout North America and in many countries in Europe, the Middle East, Africa, Asia, and Central and South America.

Nonviolence Advocacy Groups. In the early 1970s, Quaker teachers in New York City became interested in conducting nonviolence training with their students. Their efforts, known as the New York Quaker Project on Community Conflict, resulted in the founding of the Children’s Creative Response to Conflict in 1972 (Prutzman, Stern, Burger, & Bodenhamer, 1988). Priscilla Prutzman was named its first director. Weekly workshops in public schools are given to teach that the power of nonviolence lies in justice, love and caring, and the desire for personal integrity.

Anti-Nuclear War Groups. In 1985, in partnership with the New York City public schools, the Educators for Social Responsibility began the Resolving Conflict Creatively Program (RCCP) (Selfridge, 2004). The program is aimed at implementing (a) a 10-unit curriculum with lessons on intergroup relations, cooperative learning, and dispute resolution procedures; (b) 20 hours of training in how to be a peer mediator, and (c) 10 4-hour workshops for parents.

Lawyers. In 1977 trial lawyer Ray Shonholtz established the Community Boards in San Francisco to mediate conflicts in neighborhoods. In mediating conflicts among adults, the mediators had to teach conflict resolution

skills. Considering prevention, Shonholtz approached local schools with the idea of beginning a peer mediation program in schools. In 1982 Helena Davis wrote a conflict manager curriculum for elementary schools that was piloted in 1984. In the 1985 1986, middle and high school curricula were developed and implemented. The curriculum has been extended and modified by Gail Sadalla (Sadalla, Holmberg, & Halligan, 1990).

Large-Scale Implementation. The Ohio Commission on Dispute Resolution and Conflict Management and the Ohio Department of Education created a statewide model of teaching conflict resolution education (Batton, 2002). Each school year, they award competitive grants to Ohio’s K-12 public schools to design, implement, and evaluate conflict resolution programs. They also make training, technical assistance, and age-appropriate lesson plans and resource materials available to grantee schools. In 2002 more than 1,400 public schools in 380 or more of Ohio’s 612 school districts reported having a conflict resolution program.

Age-Appropriate Implementation. Some conflict resolution programs are aimed at specific age levels such as elementary or high schools. Other programs are aimed at all ages. There are developmental differences that the programs have to take into account. Young children may be more rule oriented, less able to be empathetic, less able to understand concepts such as reciprocity, and less able to engage in higher-level reasoning. There are also individual differences in self-efficacy, self-regulation, and other characteristics that influence how individuals of all ages manage their conflicts.

Meta-analysis of academic controversy studies: weighted effect sizes			
Dependent variable	Controversy/ concurrence seeking	Controversy/ debate	Controversy/ individualistic efforts
Achievement	0.68	0.40	0.87
Cognitive reasoning	0.62	1.35	0.90
Perspective taking	0.91	0.22	0.86
Motivation	0.75	0.45	0.71
Attitudes toward task	0.58	0.81	0.64
Interpersonal attraction	0.24	0.72	0.81
Social support	0.32	0.92	1.52
Self-esteem	0.39	0.51	0.85

SOURCE: Reprinted with permission from: Johnson, D. W., & Johnson, R. (1995). *Creative controversy: Intellectual conflict in the classroom*. Edina, MN: Interaction Book Company.

Table 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

CLASSIFYING CONFLICT RESOLUTION PROGRAMS

There are at least three ways to describe conflict resolution and peer mediation programs in schools. First, the programs can be described as either cadre or total student body programs. The cadre approach emphasizes training a small number of students to serve as peer mediators. The total student body approach emphasizes training every student in the school to manage conflicts constructively. Second, conflict resolution programs may be divided into pre-planned lessons that teachers take and teach or a conceptual framework that teachers use to plan lessons specially adapted for their students. Third, conflict resolution programs may be divided into skills-oriented approaches in which students are taught the interpersonal and small group skills needed to resolve conflicts constructively; academically oriented approaches in which students can be taught the intellectual procedures and cognitive skills for managing conflicts; and structural change approaches which emphasize changing the school structure to provide a cooperative context for the management of conflict.

While these and many other programs are being implemented, there may be only two conflict programs that are (a) based on principles formulated from theory, (b) extensively and systematically validated by research, and (b) integrated into academic lessons to enhance achievement. These programs are the Teaching Students to Be Peacemakers Program and the Constructive Controversy Program.

Teaching Students To Be Peacemakers. The Peacemaker Program begins with twenty lessons of thirty minutes each. These lessons may be divided into six parts (Johnson & Johnson, 2005). First, students learn the nature of conflict and the potential constructive consequences of conflict. Second, students learn that in conflict they should focus on two concerns: achieving their goals and maintaining a good relationship with the other person. The importance of the goals and relationship determine whether a person should withdraw (giving up one's goal and relationship), force (achieving one's goal while giving up relationship), smooth (giving up one's goal to enhance relationship), compromise (giving up part of one's goal and relationship), or negotiate to solve the problem (achieve one's goal while maintaining relationship). All five strategies have their place, but the most important is problem-solving negotiations, which form part three of the program. The procedure consists of (a) describing what one wants, (b) describing how one feels, (c) describing the reasons for one's wants and feelings, (d) taking the other's perspective, (e) inventing three optional plans to maximize joint benefits, and (f) choosing one option and formalizing the agreement.

Fourth, students learn how to mediate schoolmates' conflicts by (a) ending hostilities and cooling off disputants, (b) ensuring disputants are committed to the mediation process (introducing mediation and setting the ground rules of agreeing to solve the problem: no name calling, no interrupting, be as honest as possible, abide by the agreement made, keep anything said in mediation confidential); (c) helping disputants successfully use the problem-solving negotiation procedure, and (d) formalizing the agreement (disputants sign a Mediation Report Form and shake hands as a commitment to implement the agreement and abide by its conditions).

Fifth, the peacemaker program is implemented. Once these initial lessons are completed, the peer mediation program is implemented. Each day two class members serve as mediators. The role of mediator is rotated so that all students have the opportunity to mediate. If peer mediation fails, the teacher mediates the conflict. If teacher mediation fails, the teacher arbitrates by deciding who is right and who is wrong. If that fails, the principal mediates the conflict. If that fails, the principal arbitrates.

Finally, teachers continue to teach the problem-solving negotiation and peer mediation procedures to refine and upgrade students' skills, integrating them into academic lessons. Each year, the program is retaught in an increasingly sophisticated and complex way.

Benefits of the Peacemaker Program. Eighteen studies have been conducted on the effectiveness of the Peacemaker Program in eight different schools in two countries (Johnson & Johnson, 2005). The studies included students from kindergarten through ninth grades and were conducted in rural, suburban, and urban settings in the United States and Canada involving both majority and minority students. In most of the studies, students were randomly assigned to conditions and teachers were rotated across conditions. Sixteen of the studies were included in a meta-analysis.

Before training, students tended either to force the other to concede or withdraw. The training resulted in the students learning the negotiation and the mediation procedures and retaining their knowledge up to a year after the training had ended (see Table 1). After training, students applied the procedures almost perfectly and were still quite good at them months later. As a result, the number of discipline problems teachers had to deal with decreased by about 60% and referrals to administrators dropped about 90%. The attitudes of trained students toward conflict became more positive. Students used the negotiation and mediation procedures in classrooms, hallways, lunchrooms, playgrounds, and family settings. Teachers, administrators, and parents tended to

perceive the peacemaker program as constructive and helpful.

The Peacemaker training was integrated into both English literature and history academic units to determine its impact on academic achievement. Students who received the Peacemaker training as part of an academic unit tended to score significantly higher on achievement and retention tests than did students who studied the academic unit only. Students not only learned the factual information contained in the academic unit better, they were better able to interpret the information in more insightful ways.

Constructive Controversy Program. Teaching students how to engage in constructive controversy begins with randomly assigning students to cooperative learning groups of four members (Johnson & Johnson, 1979, 2007). The groups are given an issue on which to write a report and pass a test. Each cooperative group is divided into two pairs. One pair is given the con-position on the issue and the other pair is given the pro-position. Each pair is given the instructional materials needed to define their position and point them towards further information. The cooperative goals of reaching a consensus on the issue and writing a quality group report are highlighted. Students then (a) prepare the best case possible for their assigned position, (b) present and advocate their position to the opposing pair, (c) participate in an open discussion in which they attempt to refute the opposing position while defending their own, (d) reverse perspectives and present each other's positions, and (e) synthesize and integrate the best evidence and reasoning from both sides into a joint position. They finalize the report (the teacher evaluates reports on the quality of the writing, the logical presentation of evidence, and the oral presentation of the report to the class), present their conclusions to the class (all four members of the group are required to participate orally in the presentation), individually take the test covering both sides of the issue (if every member of the group achieves up to criterion, they all receive bonus points), and process how well they worked together and how they could be even more effective next time.

The process of constructive controversy is most effective within a certain set of conditions. The more cooperative the context, the more skilled the students are in engaging in the constructive controversy procedure, and the more able students are in engaging in rational argument, the more constructively the controversy will be resolved.

Research Results. A meta-analysis was conducted on the 28 studies involving elementary, intermediate, and college students that were conducted to assess the effectiveness of constructive controversy programs (Johnson and

Johnson, 2007) (see Table 2). The results of the research indicate that compared with concurrence-seeking, debate, and individualistic efforts, constructive controversy tends to result in higher-quality decisions (including decisions that involve ethical dilemmas) and higher-quality solutions to complex problems for which different viewpoints can plausibly be developed. Controversy programs tend to promote more frequent use of higher-level reasoning strategies, more accurate and complete understanding of opposing perspectives, more continuing motivation to learn about the issue, and more liking for the task. In addition, constructive controversy has been found to promote greater liking, greater social support, and higher self-esteem than debate, concurrence-seeking, or individualistic efforts.

Conflicts may be resolved so that an agreement is reached that solves the problem or manages it so that the conflict is controlled. Whether constructive or destructive outcomes result from conflict depends largely on the context in which the conflict occurs and the competencies of disputants. Conflict resolution and peer mediation programs have their roots in research in the field of conflict resolution, advocates of nonviolence, anti-nuclear war activists, and lawyers. While numerous conflict resolution programs are being implemented, the two that have been most thoroughly researched and validated (as well as implemented most widely) are the Teaching Students to Be Peacemakers and Constructive Controversy Programs.

SEE ALSO *Aggression; Egocentrism; Moral Development.*

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CONNECTIONISM

Connectionism is the study of artificial neural networks. These networks are designed to emulate the neural circuits that are found in real nervous systems, although the similarities are sometimes only superficial. As a broad set of concepts and research techniques, connectionism can be divided into two major approaches. First, researchers in psychology, neuroscience, linguistics, and related disciplines use connectionist models to simulate cognitive processes such as perception, memory, learning, and motor skill. Second, researchers in computer science, engineering, and mathematics study the formal properties of connectionist models and also use these models to analyze and solve complex real-world tasks (e.g., pattern recognition, robot planning and control, and non-linear function approximation).

HISTORICAL BACKGROUND

The perceptron, one of the most basic types of artificial neural networks, was proposed by Frank Rosenblatt in 1958. As Figure 1A illustrates, the perceptron includes two layers of simulated neurons: a layer of input units, which is analogous to a simple sensory system (e.g., tactile skin receptors, retinal neurons), and a layer of output units, which is analogous to a simple motor system (e.g., muscle fibers). Each unit in the network can be interpreted as corresponding to a neuron, whose activity level (i.e., simulated firing rate) is influenced by its connections to other units in the network. A given network's architecture is determined by the particular pattern of connections among the units in the network. For example, the perceptron is a two-layer feed-forward network because the activity at the input layer propagates forward and influences activity at the output layer (e.g., from sensory input to motor output). Like real synapses, the connections between units in an artificial neural network can vary in strength, causing each receiving unit either to increase or decrease its activity (i.e., excitation or inhibition).

Rosenblatt's 1958 work helped to highlight an important feature of artificial neural networks: With an appro-

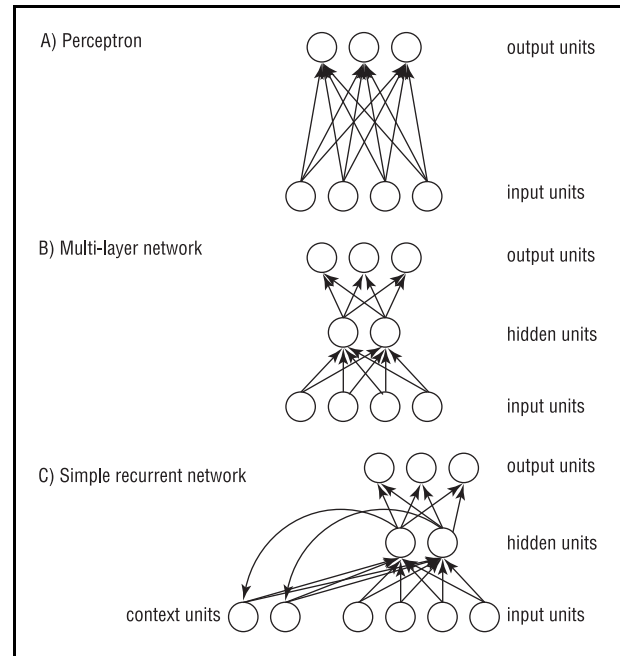


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

appropriate set of weighted connections, a network can be used to transform a given set of input patterns into a desired set of output patterns. For example, imagine that the four input units in Figure 1A are retinal sensors whose activity varies from 0 to 1, depending on the intensity of light stimulating each unit. Similarly, imagine that the units in the output layer either (1) drive an eye movement to the left or right, or (2) maintain the fixation point, depending on which of the three units is most active. With the correct set of connection weights, this network would then be able to perform a simple orienting response, which shifts its gaze laterally toward bright objects in its visual field.

The initial success of Rosenblatt's perceptron was challenged by Marvin Minsky and Simon Papert (1969), who published a critical analysis of two-layer networks. Their critique demonstrated by mathematical proof that the perceptron was severely limited in the kinds of input-output mappings or functions that it could compute. As a result, research on artificial neural networks stalled for more than a decade.

However, in 1986 David Rumelhart and James McClelland published a landmark two-volume text that both revived interest in the study of artificial neural networks and, more importantly, provided a comprehensive response to Minsky and Papert's criticisms. In particular, Rumelhart and McClelland proposed a set of relatively modest changes to the perceptron. One of these changes, as Figure 1B illustrates, was to insert a new layer of units

between the input and output layers. This set of units is called the hidden layer, as it is hidden from the external environment (i.e., only the input and output units make direct contact with the environment). Surprisingly, Rumelhart and McClelland's multilayer networks are able to approximate all of the input-output functions that Minsky and Papert proposed, and under the appropriate set of conditions, they can also be broadly interpreted as universal function approximators.

LEARNING IN ARTIFICIAL NEURAL NETWORKS

Rumelhart and McClelland also promoted the idea that neural networks can learn. More specifically, the connections in a network can be modified by a set of mathematical rules called a learning algorithm. For example, in a Hebbian network, the connection between two units is strengthened when both are active at the same time. Thus, an artificial neural network can "learn" in the sense that as it is repeatedly presented with one or more input patterns, it adjusts or modifies its connection weights, which gradually changes the pattern of output produced by the network.

One of the most common learning algorithms is back-propagation-of-error, which belongs to a set of methods called supervised learning algorithms. These methods are supervised in the sense that after an input pattern is presented to the network, the model-builder compares the output produced by the network to a desired pattern. The network's connection weights are then adjusted so that the output is moved closer to the desired pattern. Thus, a fundamental assumption of supervised learning is that a "teacher" not only is available, but also provides highly specific feedback during the learning process. It is important to note, however, that there are alternative methods for simulating learning in artificial neural networks that do not require explicit feedback from a teacher (e.g., reinforcement learning, unsupervised learning; for a recent review, see Schlesinger & Parisi, 2004).

The learning algorithm back-prop, as it is typically called, derives its name from the fact that in a standard network, activation flows forward, from the input layer to the output layer. In contrast, when the connection weights are modified, the training signal propagates in reverse: Changes are first made to the connections at the output layer, followed by changes to the connections at the hidden layer. While this bi-directional flow of information is a mathematical requirement, it has been challenged as biologically implausible. Indeed, a growing number of researchers advocate for designing artificial neural networks that more accurately represent both the structure and function of the brain (e.g., Sejnowski, Koch, & Churchland, 1988).

APPLICATIONS TO LEARNING AND COGNITION

There are numerous examples of connectionist models that may be relevant to the study of classroom learning. While these models are designed to simulate learning within a particular knowledge domain (e.g., grammar learning, numerical cognition, etc.), they also suggest more general principles that are broadly applicable across domains.

The Importance of Starting Small. Jeff Elman (1993) modified the standard 3-layer architecture to study how a network learns the structure of a small artificial language. As Figure 1C illustrates, the unique feature of this simple recurrent network is that activation from the hidden layer both propagates forward to the output layer and projects back to a set of context units in the input layer. These context units provide a type of short-term memory trace that allows the network to differentiate between two identical input patterns that occur within different contexts (e.g., "I read the book" vs. "They will book a room").

Elman presented the network with sentences from the artificial language one word at a time and trained it to predict the next word in each sentence. Initially, the network was unable to learn the task. Next, he trained a new network that started with limited short-term memory (this was implemented by clearing the memory trace after every few words), which gradually increased during training. In contrast to the first network, the network with limited short-term memory succeeded on the learning task. Elman used these findings to argue that modest limitations on information processing (e.g., memory, attention, etc.) during early learning may be an advantage for novices who are acquiring a new skill.

Growing New Connections. Another important innovation in connectionist models was proposed by Tom Shultz (2003), who conducts simulations with a learning algorithm called cascade correlation. What makes the cascade correlation algorithm unique is that, in contrast to standard multilayer networks that have a fixed architecture, cascade correlation networks are able to generate new hidden units as they learn.

One of the tasks that Shultz has studied with the cascade correlation algorithm is the balance-scale task. This task was first investigated by Jean Piaget (1896–1980), who asked children to predict which side of the scale will tip when weights are hung on each side; Piaget discovered that children pass through four stages as they learn to master the balance scale. Shultz first simulated the task with a fixed 3-layer network and found that the network was only able to reach stage three. He then trained a second network with cascade correlation and

found that as new hidden units were generated, the network reached stage four on the balance scale task.

Shultz proposes that while networks with a fixed architecture learn by a process comparable to rote memorization, dynamic networks “grow” new units and connections and are thus able to actively reorganize what is being learned. Walter Schneider and David Graham (1992) suggest that traditional classroom learning can benefit from this research by exploiting both styles or modes: conventional memorization-based learning, balanced with self-directed or problem-based learning.

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Matthew Schlesinger

CONSTRUCTIVISM

This entry contains the following:

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Cynthia M. D'Angelo, Stephanie Touchman, Douglas B. Clark
- II. CASE BASED LEARNING
Angela M. O'Donnell
- III. DISCOVERY LEARNING
Richard E. Mayer
- IV. INQUIRY BASED LEARNING
David Dean, Jr.
- V. PROBLEM BASED LEARNING
Cindy E. Hmelo Silver
- VI. PROJECT BASED LEARNING
Cindy E. Hmelo Silver

OVERVIEW

The term constructivism has played a dominant role in educational literature for a number of decades. While educators generally agree on several core aspects of constructivism, significantly different interpretations, perspectives, and approaches exist regarding the details of constructivist learning and teaching. This section discusses (a) the historical roots of constructivism, (b) perspectives on constructivism as epistemological theory, learning theory, and pedagogy; (c) the continuum of constructivist perspectives from individual to social, (d) evidence for the efficacy and adoption of constructivism, (e) the key assumptions about constructivist learning and instruction, and (f) introductions to several instructional approaches involving constructivist designs.

HISTORICAL ROOTS OF CONSTRUCTIVISM

Constructivism, although relatively new in its current form, has deep historical roots. At their core, constructivist perspectives focus on how learners construct their own understanding. Some philosophers, such as Socrates, focused on helping students construct meanings on their own rather than having authority figures transmit information to them. Immanuel Kant (1724–1804) built upon this by recognizing that the way learners perceive stimuli from their environment shapes their understanding of the world. In the early 20th century, John Dewey (1859–1952) proposed that education should work with students' current understanding, taking into account their prior ideas and interests. Later, Jean Piaget (1896–1980) defined accommodation and assimilation as ways for new knowledge to build upon previous knowledge. The ideas of Lev Vygotsky (1896–1934) also influenced constructivism. He helped increase awareness of the interactions between the individual, interpersonal, and cultural historical factors that affect learning.

CONSTRUCTIVISM AS EPISTEMOLOGICAL THEORY, LEARNING THEORY, AND PEDAGOGY

The term constructivism can refer to one of many different but related concepts. More specifically, constructivist perspectives can focus on epistemological theory, learning theory, and pedagogy.

As an epistemological theory, constructivism focuses on how bodies of knowledge come to be. This perspective is important to note even though this view of constructivism is not discussed in the educational literature as frequently as other views. Constructivism as an epistemological theory holds that disciplines, such as history and mathematics, are constructed by human interactions

and decisions. For some disciplines, such as literature, this idea is fairly well accepted; there are certain books that most people agree are worth reading and others that are purposefully forgotten. For disciplines such as science and mathematics, however, the idea that people (and not nature) construct the bounds of the disciplines and the concepts within them remains contentious.

More commonly, educators view constructivism as a learning theory. Some educators use the term constructivist simply to indicate a non-behaviorist learning theory. While constructivist learning theories are non-behaviorist, constructivism involves much more than simple opposition to a previous learning theory. From the perspective of constructivism, learners construct knowledge based on what they already understand as they make connections between new information and old information. Students' prior ideas, experiences, and knowledge interact with new experiences and their interpretations of the environment around them. Research by Savery & Duffy (1995) suggests that learning how to use constructivist theories involves many interactions between the content, the context, the activity of the learner, and the goals of the learner.

Cognitive conflict drives this knowledge-building process. Cognitive conflict occurs for learners when they encounter and recognize discrepancies between what they already know and new persuasive information that brings their current understanding into question. These discrepancies cause cognitive tension requiring adjustment to reduce the discrepancies. When students resolve these discrepancies they actively figure out ways to reconcile their prior knowledge or understanding with the new information. Students may construct new knowledge from pieces of prior knowledge or restructure prior knowledge. Thus the resolution of cognitive conflict drives learning.

Finally, based on the core ideas of constructivist learning theory, constructivist pedagogy proposes that instruction must take students' prior ideas, experiences, and knowledge into account while providing opportunities for students to construct new understanding. Constructivist pedagogies are discussed in greater detail below, in the sections titled Assumptions about Constructivist Learning and Instruction, and Instructional approaches with constructivist designs.

CONSTRUCTIVIST PERSPECTIVES FROM INDIVIDUAL TO SOCIAL

While the general principles discussed above apply to most constructivist theories and pedagogies, significantly different interpretations have evolved regarding the details. One key distinction, discussed by Phillips (2000) and other educators, among constructivist perspectives involves the continuum of interpretations in terms of where the construction of knowledge takes place. Radical

constructivism anchors one end of this continuum and social constructivism anchors the other. Most educators' theoretical commitments fall somewhere between these two perspectives.

RADICAL CONSTRUCTIVISM

Radical constructivism proposes that the construction of knowledge takes place solely in the learner's mind and on an individual level. Ernst von Glasersfeld (1917) refined many of the core ideas of radical constructivism. McCarty and Schwandt (2000) explain that according to radical constructivism, concepts form through the learner's experiences with objects or events as the learner notes similarities and differences among the experiences and gradually builds up a concept relating to that object or event.

Radical constructivism is similar in many ways to Jean Piaget's perspectives on assimilation and accommodation and to theories of information processing. Both Piagetian and information processing theories view learning as a cognitive activity through which individuals actively incorporate new information and experiences into the information and understandings already stored in memory. Piaget explains these processes in terms of assimilation, in which learners add new information into their existing knowledge frameworks, and accommodation, in which the new information causes cognitive conflict that results in the reorganization of learners' knowledge frameworks. Information processing theory uses a computer metaphor to explain how knowledge construction works. The learner perceives various stimuli, encodes them into useful information, and then stores the information for later use. The learner is able to modify previous knowledge or strategies in order to help with current problem solving and develop more sophisticated knowledge. In alignment with radical constructivist perspectives, therefore, both perspectives focus on how the individual processes and relates new information to information already in the mind.

Radical constructivism holds serious implications for learning and teaching. Most importantly, from the perspective of radical constructivism, a person cannot ascertain that what other people have constructed in their minds is exactly the same as what he or she has constructed. In spite of this paradox, teachers must act "as if there were a world about which meanings were shared" (Howe & Berv, 2000, p. 33).

SOCIAL CONSTRUCTIVISM

Social constructivism represents the other end of the continuum. Social constructivism, heavily influenced by Vygotsky and sociocultural theory, proposes that learning takes place in the interaction between people and their

CONTROVERSY OVER THE EFFICACY OF CONSTRUCTIVISM

While significant evidence supports the efficacy of constructivist approaches, other evidence suggests that other forms of instruction offer important advantages depending on context. Research by Kirschner, Sweller, and Clark, for example, suggests that many constructivist based approaches do not work as well as direct instruction in changing long term memory. Part of their argument hinges on findings from cognitive science that limit the amount of information that can exist in working memory at one time. In addition, constructivist methods commonly involve problem solving situations where the learning is self directed, which unchecked can lead to potential misconceptions. Furthermore, research by Elby suggests that different theoretical views about what misconceptions are (either stable entities or cued responses based on context) lead to dramatically different student outcomes. Teachers who are able to recognize productive elements in students' intuitive understanding may be more successful in constructive pedagogies. A further issue limiting the efficacy of constructivist approaches involves the fact that many teachers have not received sufficient training to effectively support their students in constructivist learning activities. More research on the efficacy of constructivism would be useful and would help educators focus on specific pedagogical methods and the limitations and advantages of each.

environment. An extreme social constructivist view developed by Kenneth Gergen proposes no strict boundary between the mind and the environment or between language and reality. This view further proposes that a person's understanding of the world cannot be removed from the way he or she uses language to describe it, view it, and discuss it with others.

Less extreme social constructivist perspectives propose simply that students construct knowledge through an interaction with their surroundings rather than in isolation from them. Social interactions play an important part in knowledge construction because they support the introduction and resolution for the cognitive conflict at the heart of constructivist learning perspectives. Although moderate social perspectives acknowledge the

role of people's prior knowledge in the evolution of their understanding, moderate perspectives propose that knowledge structures evolve socially through observation and interaction with other people and the environment. Sociocultural theories and perspectives emphasize the importance of learners' interactions with their social environment in order to determine what should be learned and how it should be learned. Also, being able to discuss developing ideas with others helps learners determine how to modify their ideas.

Different flavors of social constructivism have different emphases for learning and instruction. Some emphasize cognitive skills and strategies for learning while others emphasize the big ideas or concepts in a discipline. Some social constructivists propose three fundamental commitments for teaching and learning: treat the discipline with respect, treat students' ideas with respect, and view the discipline as a "collective intellectual endeavor situated within a community" (Ball & Bass, 2000, p. 197). From this perspective, instruction should involve a democratic process in which students and the teacher discuss what represents publicly shared knowledge and what does not. Instruction should focus on this publicly shared knowledge in order to allow all the students to build upon what they know and to help the teacher understand what steps need to be taken in order to achieve certain goals.

EFFICACY AND ADOPTION OF CONSTRUCTIVISM

Constructivist teaching, introduced by Piaget in the early 1930s, has found increasingly wide acceptance by researchers and educators since the early 1980s. Although widely accepted, however, constructivism remains less widely practiced. A study by Moussiaux and Norman (1997) involving 49 schools and 289 teachers in Michigan found that only 28% to 50% of teachers claimed to use constructivist methods. Furthermore, as noted by Jones and Carter (2007), many teachers who believe they enact constructivist methods do not actually use methods in alignment with constructivist theories. Teachers should be aware of not just the instructional strategies they are implementing but also the theoretical reasons behind those strategies and how they can be used in different ways. Abbott and Fouts found that only 17% of 669 classrooms in 34 schools in Washington actually incorporated constructivism into instruction.

Barron and colleagues (1998) suggest that constructivist approaches remain underimplemented and underutilized because constructivist teaching practices are foreign to students and teachers, and difficult to apply. Many people in the general public remain suspicious when teaching methods differ from the forms of instruction they experienced in school. High-stakes testing represents

another obstacle to wider implementation of constructivist instruction. Although state education standards usually include constructivist goals, these standards and goals often do not align with the high-stakes tests or the preparation for those tests. A review by Jones and Carter (2007) suggested that wider implementation of constructivist approaches will require changes in teacher attitudes and beliefs in addition to educational reform.

While authentic constructivist pedagogies remain relatively uncommon in classrooms, many studies support the potential efficacy of constructivist approaches. Abbot and Fouts (2003), for example, found a significant correlation between constructivist teaching and higher achievement. Different constructivist approaches appear, however, to vary in their levels of efficacy. Research on guided discovery learning and pure discovery learning demonstrates that students engaging in guided discovery learning activities outperform students in pure discovery curricula (Shulman & Keisler (1966), Kittel (1957), and Mayer (2004)). In summary, studies have shown that constructivist approaches have great potential but require authentic implementation in order to achieve that potential.

ASSUMPTIONS ABOUT CONSTRUCTIVIST LEARNING AND INSTRUCTION

Although constructivist instruction can take many forms based on the instructor's theoretical commitments, constructivist teaching at its core focuses on students' active role in their own learning as they build and organize their knowledge. Constructivist instructional frameworks, such as those discussed by Lebow (1993), often focus on the following attributes: personal relevance, the opportunity to generate new knowledge, personal autonomy, active engagement, collaboration, the opportunity to reflect on learning, and pluralism. In addition, Langer and Applebee (1987) discuss how the core goals of constructivist teaching often include promoting democratic learning environments and student-centered instruction. As a result, "teachers are apt to feel comfortable in this role only if they view uncertainty and conflict as natural and potentially growth producing for members of the learning community" (Prawat & Floden, 1994, p. 40).

To create personal relevance, learners need to understand the benefits and importance of the curriculum for their own interests. Teachers can promote this relevance by incorporating real-life situations and experiences into their students' classroom learning. To give students an opportunity to be involved in creating knowledge, the learner should be involved not in activities in which the goal is to memorize facts but in problem-solving activities. For instructional design geared toward radical con-

structivism, students should be provided with personal autonomy in which individual work is part of the instructional framework. Also, students should be part of the process of designing the problem as well as dictating the process for working on that problem. Furthermore, to actively engage students, "the teacher's role should be to challenge the learner's thinking not to dictate or attempt to proceduralize that thinking" (Savery & Duffy, 2001, p. 5). For instruction geared toward social constructivism, collaboration provides opportunities for students to interact and teach one another in small group work.

INSTRUCTIONAL APPROACHES WITH CONSTRUCTIVIST DESIGNS

While many pedagogical approaches integrate key constructivist assumptions about learning and instruction discussed above, five approaches currently receive significant attention. These include (a) case-based learning, (b) discovery learning, (c) inquiry-based learning, (d) problem-based learning, and (e) project-based learning.

Case-based learning, as Herreid (1997) explains, uses real-life examples to build knowledge by resolving questions about a specific case. Usually these questions have no single right answer. Generally, case-based learning focuses on small groups and the interactions between the participants. The teacher facilitates the students' interactions while the students choose analysis techniques and work toward solutions of the open-ended problem. Under this pedagogical approach, students learn content while exposed to real-life issues. Students benefit from this type of instruction because they are given an opportunity for decision making as part of their learning process and because they experience and address different viewpoints.

Discovery learning engages learners in problem solving to make a discovery, as described by Mayer (2004). According to Seymour Papert, "The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge" (Papert, 1980). The instructional design of discovery learning provides students with a problem and the opportunity for exploration to formulate solutions to the problem. The teacher guides the development of problem-solving skills and the creativity of the students. Discovery learning works on the assumption that students are more likely to retain knowledge if they discover it on their own. Students benefit from this type of instruction because it fosters curiosity and creativity.

As discussed by Edelson, Gordin, and Pea (1999), inquiry-based learning places the responsibility for learning and understanding concepts on the student. In other words, inquiry learning requires students to determine the content, the learning process, and the assessment of

learning. Inquiry-based methods use questions to guide instruction rather than predetermined topics. Usually this instructional design begins with a general theme that serves as a starting point for learning. Then the instruction builds upon the responses and interactions of the students. Teachers monitor the students' learning process through interviews, journaling, and group discussions. Students benefit from this instructional approach because they develop meta-cognitive learning skills and research skills upon which they can build toward future educational experiences.

Similar to case-based learning, problem-based learning teaches students to think critically, analyze problems, and use appropriate resources to solve real-life problems. Through this process, students identify the nature of the problem and determine what resources they need to utilize to solve the problem, as described by Boud & Feletti (1997). The teacher offers scaffolding by providing examples of how to approach the problem. A study by Wood (1993) suggests that students benefit as they integrate analytical skills with content knowledge as a member of a team.

Project-based learning also harnesses the process of investigation to encourage understanding. This method, as described by Polman (2000), engages students in a long-term project based on a real-life problem. These activities typically involve a wide range of interdisciplinary skills, including math, language, art, geography, science, and technology. This instructional design has less structure than traditional instruction because the students organize their own work. Generally, this approach involves collaborative learning. The teacher provides guidelines (such as checklists) for the students as they progress toward the completion of their project. By providing students with an authentic problem, project-based learning offers students a meaningful experience that promotes the development of research skills.

SEE ALSO *Cognitive Development: Piaget's Theory; Information Processing Theory; Sociocultural Theory.*

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CASE-BASED LEARNING

Case-based instructional methods are used in a variety of disciplines, including medicine, law, business, and education. Cases provide analogs of personal experience; they include a representation of a situation, how the situation was dealt with, and what the consequences were of dealing with it in that way (Kolodner, 1997). Cases describe an interesting story that will generate alternative perspectives from learners. Cases should provoke alternative ideas and require decision making (Herreid, 2008). There are a variety of methods for using cases in the context of instruction. Collaborative discussions among students about the case are common. Students are expected to bring their knowledge and perspectives to the consideration of the case, engage in argumentation about the interpretation of the case with their peers, and deepen their understanding of the issues at hand. In doing so, students use their prior experiences and knowledge to construct new knowledge and understandings.

The various disciplines that use cases as part of their instruction vary in how they define cases. It is difficult to distinguish a case from an example or a problem. Cases are used in various disciplines for different functions. In law schools, students study cases from the past and learn to use them as examples of judicial reasoning (Herreid, 2008). In medicine, cases are examples of previous medical decision making. In both law and medicine, the consequences of the particular decisions made are clear. In education, cases are used in preservice teacher education to illustrate theoretical ideas or to practice decision making. However, the consequences of one set of actions rather than another are much less clear in education than in other domains.

The use of cases in teacher education has the potential to bridge the gap between the declarative knowledge acquired in coursework and the procedural and condi-

tional knowledge developed through practice. Many of the writings available about cases appeal to this potential (e.g., Doyle, 1990; Shulman, 1992). Because cases (e.g., a particular problem in a teacher's class) have face validity as representations of classrooms, teaching by using cases is often touted as a preferred teaching method (Silverman, Welty, & Clark, 1996). However, in 1996 K. K. Merseth noted: "the collective voice of its proponents [the use of cases] far outweighs the power of existing empirical work" (p. 722).

The use of cases for instruction also has the potential to provide a window on developing expertise. More and less experienced individuals can be expected to respond to cases in different ways, providing instructors with insight into how cases are understood. There is some evidence that the use of cases can result in the development of theoretical and practical knowledge (Lundeberg, Levin, & Harrington, 1999). Case discussions can promote reflection and metacognition (Harrington, 1995; Levin, 1995). Much of the research on the use of cases in teacher education has been conducted within the context of college classrooms, and the designs of such research are typically pre- and posttest designs within specific courses that show an increase in the number and kind of theoretical constructs included in the posttest case analysis. Although this kind of research has yielded useful and important information, it is unclear whether the effects are due to the case method *per se* or simply to the exposure to the content of the course. Lundeberg and colleagues (1999) and Levin (1995) call for more systematic research on the use of cases in teacher education.

Students vary in their responses to case-based instruction. In a small study of nine veterinary students, students who had high levels of self-regulatory skills perceived the format of the instruction to be relevant and effective, whereas those students with low self-regulatory skills did not (Ertmer, Newman, & MacDougall, 1996). The degree to which participants engage in discussions related to a case also influences the quality of their thinking about the case (Levin, 1995).

The research on the use of cases has not been programmatic nor are the results systematically organized. It is difficult to draw conclusions about the effectiveness of case-based instruction and learning when there are different criteria across disciplines for what constitutes a good case, how effectiveness is assessed, and how research is conceptualized.

SEE ALSO *Cognitive Apprenticeship; Scaffolding.*

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DISCOVERY LEARNING

Discovery learning is an instructional method in which students are free to work in a learning environment with little or no guidance. For example, discovery learning is the method of instruction when students are given a math problem and asked to come up with a solution on their own, when students are given a scientific problem and allowed to conduct experiments, or when students are allowed to learn how a computer program works by typing commands and seeing what happens on a computer screen. The early 21st-century interest in discovery learning has its roots in Jerome Bruner's (1961) eloquent call for discovery methods of instruction and is echoed in Seymour Papert's (1980) focus on discovery methods for teaching computer programming and Deanna Kuhn's (2005) focus on discovery methods for teaching scientific thinking.

Constructivism is a theory of learning in which learners build knowledge in their working memory by engaging in appropriate cognitive processing of mental representations during learning. Richard Mayer (2008) identified three major cognitive processes in this view of

learning as knowledge construction: (a) selecting, attending to relevant information that enters the cognitive system through the eyes and ears, (b) organizing, mentally arranging the selected material into coherent cognitive structures, and (c) integrating, mentally integrating the incoming material with prior knowledge activated from long-term memory. The role of active cognitive processing during learning has its roots in the constructivist theories of Frederick Bartlett (1932) and Jean Piaget (1970).

THE RELATIONSHIP BETWEEN CONSTRUCTIVISM AND DISCOVERY

What is the relation between constructivism as a theory of learning and discovery learning as a method of instruction? In a review of research in the learning sciences, John Bransford, Ann Brown, and Rodney Cocking (1999) showed how constructivism has become the dominant view of how people learn. Importantly, they noted that "the revolution in the study of the mind that has occurred in the last three or four decades has important implications for education" (Bransford, Brown, & Cocking, 1999, p. 3). Richard Mayer (2004) has shown how it might be tempting for educators to equate a constructivist vision of active learning (i.e., the idea that deep learning occurs when learners engage in active cognitive processing during learning) with a seemingly corresponding vision of active methods of instruction (i.e., instructional methods emphasizing learning by doing such as discovery learning). Mayer (2004, p. 15) refers to this confusion as the constructivist teaching fallacy, namely the idea that active learning requires active teaching. Instead, the goal of constructivist-inspired teaching methods is to prime appropriate cognitive activity during learning—a goal that does not necessarily require behavioral activity during learning. In short, Mayer (2004, p. 17) argues that "the formula *constructivism = hands-on activity* is a formula for educational disaster."

In educational research, it is customary to compare the effects of pure discovery methods (in which learners receive little or no guidance while working on an educational task), guided discovery methods (in which learners receive substantial guidance while working on an educational task), and direct instruction (in which learners are presented with the to-be-learned material). The overwhelming pattern of results shows that pure discovery methods result in poorer learning than guided discovery or direct instruction. In their landmark book, *Learning by Discovery: A Critical Appraisal*, Lee Shulman and Evan Keiser concluded that research conducted during the 1960s did not favor pure discovery as an effective method of instruction: "there is no evidence that supports the



Conducting experiments is one type of discovery learning. MAURO FERMARIELLO/PHOTO RESEARCHERS, INC.

proposition that having students encounter a series of examples ... and then having them induce the rule is superior to teaching the rule first and asking students to apply it" (1966, p. 191). More than 30 years later, John Sweller came to the same conclusion in comparing learning to solve math problems via worked examples versus via learning by doing: "worked examples proved superior to solving equivalent problems" (1999, p. ix).

DISCOVERY LEARNING

In a review of research on teaching children how to solve Piagetian conservation tasks conducted mainly in the 1970s, C. J. Brainerd (2003) reported that children learned better when given heavy amounts of specific guidance than when left to learn on their own through hands-on discovery. In *Teaching and Learning Computer Programming*, edited by Richard Mayer (1988), research-

ers working in the 1980s reported that students learned the LOGO programming language better through guided discovery or direct instruction than through pure discovery. Subsequently, Klahr and Nigam (2004) found that students who learned to test scientific hypotheses by being given guidance on how to carry out controlled comparisons learned to reason scientifically better than students who learned through using hands-on pure discovery.

In their provocative review, "Why Minimal Guidance During Instruction Does Not Work," Paul Kirschner, John Sweller, and Richard Clark (2006, p. 75) concluded: "although unguided or minimally guided instructional approaches are very popular and intuitively appealing ... these approaches ignore both the structures that constitute human cognitive architecture and evidence from empirical studies over the past century that consistently indicate that minimally guided instruction is

less effective than instructional approaches that place a strong emphasis on guidance of the student learning process.” Similarly, in “Should There Be a Three-Strikes Rule against Pure Discovery Learning?” Richard Mayer demonstrated that “there is sufficient research evidence to make any reasonable person skeptical about the benefits of discovery learning practiced under the guise of . . . constructivism as a preferred instructional method” (2004, p. 14). Overall, in the educational research conducted between 1965 and 2005 across many different learning tasks, discovery methods (i.e., methods of instruction that emphasize hands-on activity without adequate guidance) have consistently been shown to be less effective than more guided methods of instruction.

Theories of learning in the early 2000s provide the theoretical rationale for providing guidance during learning. Based on John Sweller’s (1999) cognitive load, Richard Mayer (2001) notes that discovery methods of instruction can encourage learners to engage in extraneous cognitive processing—cognitive processing that does not support the instructional goal. Because cognitive resources are limited, when a learner wastes precious cognitive capacity on extraneous processing, the learner has less capacity to support essential cognitive processing—to mentally represent the target material and generative cognitive processing—to mentally organize and integrate the material. Guidance in the form of scaffolding, coaching, modeling, or providing direct instruction is effective when it helps guide the learner’s essential and generative processing during learning while minimizing extraneous processing. In short, discovery learning is particularly ineffective when students do not naturally engage in appropriate cognitive processing during learning—a situation that characterizes most novice learners.

SEE ALSO *Cognitive Apprenticeship; Scaffolding.*

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Richard E. Mayer

INQUIRY-BASED LEARNING

Research in education and psychology that addresses the development of reasoning typically acknowledges the difficulty children (and adults) have in mastering this form of thinking. Constructivist teaching practice, particularly inquiry-based learning, seeks to mediate the learning process and make this kind of cognition an object of classroom instruction. Through inquiry learning, students play the role of scientists, a role that is familiar to researchers, as it is modeled on the authentic inquiry activities of professional scientists. Their tasks include formulating questions, designing informative investigations, analyzing patterns, drawing inferences, accessing evidence in responding to questions, formulating explanations from evidence, connecting explanations to knowledge, and communicating and justifying claims and explanations. The focus on inquiry learning originated with the work of Jean Piaget (1896–1980) on the development of adolescent reasoning skills, particularly his focus on the discontinuous, or abrupt, transition from concrete to formal operational thought during adolescence.

Piaget advanced an image of children at the early stages of development as intuitive scientists, actively engaged in understanding their environment and forming theories that they seek to support with evidence from their experience. The construction of these theories is driven by their exercise in informal experimentation, although this is not necessarily how people commonly understand experimentation in the work of professional scientists. Frequently, children’s theories are hampered by bias, specifically toward confirmation of their existing theories and flawed efforts to integrate new information

with existing knowledge, a limitation one would not characterize as typical of scientific reasoning. Although Piaget focused on the development of children's understanding, he emphasized that their strategies of knowledge acquisition exhibit developmental trajectories as well. Research since Piaget has demonstrated that the developmental path he envisioned as discrete stages is more continuous in nature. Abandoning inefficient strategies of knowledge acquisition actually overlaps with adoption of more efficient strategies. One of the primary difficulties students have in evaluating evidence is understanding that their theories exist and can (and most of the time should) be revised by new information. Without some form of intervention to support this development, many students will not achieve this sophisticated level of thinking, and their adult thinking will continue to be characterized by inconsistent, inefficient strategy use.

USE OF INQUIRY BASED LEARNING

Inquiry-based learning has come to be most frequently used in and associated with science instruction. Preeminent science educators in the United States identify inquiry as the preferred and prescribed method of teaching science. In fact, the first science teaching standard developed by the National Research Council requires science teachers to plan an inquiry-based science program for their students. The National Science Teachers Association (NSTA) has adopted these standards and proclaims itself an integral part of their dissemination and implementation. Typically, the procedure they advocate includes five distinct phases that reflect the scientific process:

- Phase 1: engagement with a scientific question, event, or phenomenon connected with their current knowledge, though at odds with their own ideas, which motivates them to learn more;
- Phase 2: exploration of ideas through hands-on experiences, formulating and testing hypotheses, problem-solving, and explaining observations;
- Phase 3: analysis and interpretation of data, idea synthesis, model building, and clarification of concepts and explanations with scientific knowledge sources (including teachers);
- Phase 4: extension of new understanding and abilities and application of learning to new situations (transfer);
- Phase 5: review and assessment of what they have learned and how they have learned it (metacognition).

Although receiving most attention in science, inquiry skills have been cited as integral to virtually all subjects

taught in K-12 schools. Professional organizations governing instruction in most subjects, from language arts to social studies to music education, include these skills in standards for their disciplines. According to these standards, then, students in K-12 schools can and should be expected to master the skills of inquiry in all areas.

PRINCIPLES OF INQUIRY BASED LEARNING

The most common components of comprehensive approaches to inquiry-based learning are characterized by close adherence to authentic scientific inquiry as modeled by researchers and scientists themselves. Inquiry-based learning can take multiple forms depending on the task at hand: open, guided, coupled, or structured inquiry. The goals of each approach are dependent upon whether the learning objective involves conceptual or procedural knowledge or some combination of the two. Whether engaging in open or structured inquiry, students may perform most, if not all, components of reasoning, including generating hypotheses, designing experiments, gathering and evaluating evidence, and drawing conclusions based on evidence. The tasks they complete may involve investigation of an actual physical system or of a computer simulated system, an increasingly common practice given its cost-effectiveness and the ubiquitous availability of classroom technological tools. Relations between variables in these systems typically include some that reflect a student's prior beliefs and some that do not. Performance measures in these tasks can be numerous, ideally addressing all components of the process and in multiple forms with feedback to further inform student learning.

Most empirical studies of scientific investigation show significant age differences in performance, with adults typically outperforming children. Researchers have suggested that the development of metacognitive reasoning accounts for these weaknesses, specifically with regard to understanding false beliefs, growing awareness of the sources of personal knowledge, and differentiating and coordinating theory and evidence. The effective use of inquiry requires meta-level understanding of why a particular strategy works, suggesting that the goal of reasoning instruction in general, and inquiry learning methods in particular, should take particular account of metacognition.

EVIDENCE SUPPORTING THE USE OF INQUIRY BASED LEARNING

Though not the only method of instruction, inquiry-based learning remains a clearly effective method for teaching the skills of inquiry and ensuring their long-term retention and transfer to new domains. Other instructional methods are appropriate complements to inquiry-based learning, particularly when the goals of

instruction are conceptual rather than procedural. There is a great deal more to learn in inquiry than just the control of variables strategy that has been the focus of research. Most research on scientific thinking, in fact, has been strictly focused on the control of variables strategy without consideration of the more complex metacognitive awareness required for its consistently successful use. This lack of concern with the meta-level of understanding has resulted in exclusive emphasis on the performance level, i.e., strategy execution. More critically, students must develop explicit models of inquiry procedures that include not just the reasoning process itself but also its value in acquiring knowledge.

SEE ALSO *Cognitive Apprenticeship; Scaffolding.*

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David Dean, Jr.

PROBLEM-BASED LEARNING

Problem-based Learning (PBL) is an approach to instruction that situates learning in guided experience solving complex problems, such as medical diagnosis, planning instruction, or designing a playground. Developed initially for use in medical schools it has expanded to other settings such as teacher education, business, engineering, and K-12 instruction (Barrows, 2000; Hmelo-Silver, 2004; Torp & Sage, 2002).

PBL is considered a constructivist approach to instruction because in PBL, students are actively engaged in learning content, strategies, and self-directed learning skills through collaboratively solving problems, reflecting on their experiences, and engaging in self-directed inquiry. The role of the teacher is to facilitate the students' learning by providing opportunities for learners to engage in constructive processing. The students take responsibility for their own learning and for the collective progress of their collaborative group.

PRINCIPLES OF PROBLEM BASED LEARNING

PBL was designed with five instructional goals (Barrows, 1985): to help students (1) construct flexible knowledge, (2) develop effective problem-solving skills, (3) develop self-directed learning skills, (4) become effective collaborators, and (5) become motivated to learn. Major factors in the effectiveness of PBL are having good problems that allow for extended engagement, a student-centered tutorial process, and a facilitator to help guide the learning process.

To foster learning and engagement, good PBL problems have several characteristics. They need to be complex, open-ended, and multiple solution paths; they must be realistic, connect with the learners' experiences, and allow free inquiry. Good problems require multidisciplinary solutions and provide feedback that allows students to evaluate the effectiveness of their knowledge, reasoning, and learning strategies. Problems should be rich enough to promote conjecture and discussion. They should motivate the students' need to learn and apply their new knowledge (Savery, 2006). As learners generate and support their ideas, they publicly express their current understanding, thus enhancing knowledge construction and preparing them for future learning.

Each problem requires a final product or performance that allows the learners to display their understanding. For example, in their 2000 study, Hmelo, Holton, and Kolodner used PBL to help middle-school students learn life science by designing artificial lungs. The students conducted experiments and used a variety of other resources to learn about breathing. Their final products were models of their designs. In teacher education, the final product might be a lesson design, whereas in medical education, it is often an explanation of underlying mechanisms that cause a patient problem.

The heart of PBL is the small group tutorial process. A PBL tutorial begins by presenting a group of students with some information about a complex problem. From the outset, students need to obtain additional problem information through engaging in inquiry. They may gather this information from problem simulations, for example from a patient record database in medical education or from a classroom video in teacher education (Derry, Hmelo-Silver, Nagarajan, Chernobilsky, & Beitzel, 2006); they may also gather facts by doing experiments or other research. At several points, students pause to reflect on the data they have collected so far, generate questions about that data, and ideas about solutions. Students identify concepts they need to learn more about to solve the problem. After considering the problem with their current knowledge, learners divide and independently research the learning issues identified. They then

come back together to share what they learned and re-evaluate their ideas. When completing the task, they reflect on the problem to consider the lessons learned, as well as how they performed as self-directed learners and collaborative problem solvers.

As part of the tutorial process, students use whiteboards to help guide their learning and problem solving. The whiteboard is divided into four columns that help structure their activity by reminding the learners of the problem-solving process. The whiteboard serves as a focus for group discussions. The *Facts* column holds information that the students obtain from the problem statement and from their inquiry into the details of the problems. The *Ideas* column serves to keep track of their evolving hypotheses about solutions, such as difficulty breathing might be caused by asthma, a common respiratory ailment. The students place their questions for further study into the *Learning Issues* column. They use the *Action Plan* column to keep track of plans for resolving the problem or obtaining additional information. It should be noted that although this is a typical whiteboard, some schools using PBL use only the first three columns. Other schools that use PBL use *KWL charts* in which students indicate what they *Know*, what they *Want* to learn, and what they *Learned*.

The facilitator is a key factor in an effective PBL tutorial. In PBL, facilitators (also called tutors or coaches) are expert learners, able to model good learning and reasoning strategies, rather than providing content expertise. The facilitator helps move students through the various stages of PBL and monitors group dynamics, ensuring that all students are involved and encouraging them both to articulate their own thinking and to comment on one another's thinking. The facilitator plays an important role in modeling the thinking skills needed when self-assessing reasoning and understanding. It is important to note that the facilitator's moves build on students' thinking to maintain a student-centered learning process. For example, the facilitator encourages students to explain and justify their thinking as they propose solutions to problems. Facilitators guide the tutorial largely through the use of open-ended questions. Their questions help model the use of particular reasoning strategies as they encourage students to connect their inquiry to hypotheses, explain their thinking, and realize the limits of their understanding. Facilitators progressively reduce their support as students become more experienced with PBL until the facilitators' questioning role is largely adopted by the students. However, the facilitators continue to actively monitor the group, making moment-to-moment decisions about how to facilitate the PBL process using a repertoire of different strategies (Hmelo-Silver & Barrows, 2006).

RESEARCH ON PROBLEM BASED LEARNING

Of the five goals for PBL, much of the research has focused on knowledge construction, problem-solving skills, and self-directed learning skills. There is less evidence about collaboration and motivation. The majority of the research has been conducted in the medical school context. In a 2003 analysis across many studies of PBL in medical education, Dochy and colleagues found that students in a PBL curriculum were better at applying their knowledge than students in a traditional curriculum and that there were no differences on fact-based measures. A few studies have been conducted outside the medical venue and these show some positive effects but there are too few studies to draw firm conclusions (see Hmelo-Silver, 2004 for a review).

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PROJECT-BASED LEARNING

The use of projects in learning has a long history, dating back to the 1918 work of William Heard Kilpatrick (1871-1965). In this initial formulation, project-based learning was the idea of "whole-hearted purposeful

activity proceeding in a social environment.” Thus, many elements of project-based approaches of the twenty-first century are present in this early conception. A goal of using projects is to provide opportunities for students to become engaged in their own learning as they create meaningful artifacts. These may include reports, physical models, computer models, exhibits, Web sites and other concrete products that provide opportunities for students to demonstrate their understanding. Project-based learning (PBL) is a constructivist approach to learning because students are involved in constructing deep understanding as they engage with the ideas needed for their projects.

University of Michigan researchers Krajcik and Blumenfeld (2006) have contributed to articulating the key features of designs for PBL:

1. Learners start with a driving question, such as “What’s in our water?”
2. They explore the driving question by engaging in inquiry. For example, they may study changes in water quality at a local stream. In this process, they learn to apply key disciplinary ideas.
3. Learners work collaboratively to address the driving question.
4. Learning technologies support the learners’ inquiry and allow them to participate in authentic activities that might otherwise be beyond their reach.
5. Learners create artifacts to address the driving question such as a computer model of a local water source.

The driving question helps learners see the relevance of what they are learning. This is important as learners are engaged in inquiry over a prolonged time period rather than the typical short-term laboratory experiences. Students need scaffolding for their inquiry, which is accomplished through teacher modeling and feedback as well as through technology-based scaffolding. A key feature of many PBL approaches is the use of technology as cognitive tools that support planning, collaboration, data collection and analysis, modeling, visualization, and information gathering. Examples of these approaches are found in the work of Linn and Slotta with the Web Integrated Science Environment (2006) and the Center for Learning Technology in Urban Schools (Krajcik & Blumenfeld, 2006). Although the research on the effectiveness of PBL overall is limited, according to Krajcik and Blumenfeld, there is growing evidence that project-based science is effective in improving student achievement and motivation.

PBL has similarities to problem-based learning and case-based learning as Savery has noted. All situate learning in real-situations that provide contexts for applying

ideas (Hmelo-Silver, 2004). In case-based learning, cases are used as illustrations with a variety of different instructional strategies. There is no signature student-centered pedagogy in case-based instruction though such approaches tend to be oriented toward promoting knowledge application and critical thinking skills. There is a fine line between problem- and project-based learning. Both may involve creating artifacts, but this is not necessarily the case in problem-based learning. In problem-based learning, the problem may be more complex than in project-based learning. There are also differences in the activity structures that are used. The role of the teacher is similar in both approaches because they both build on student thinking. In both approaches, the teacher builds on student thinking, but in a project-based approach, the teacher may also provide benchmark lessons and play a larger role in setting learning goals than in problem-based learning.

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CONCEPT-ORIENTED READING INSTRUCTION (CORI)

SEE *Learning and Teaching Reading*.

COOPERATIVE LEARNING

SEE *Collaborative Learning*.

CORI (CONCEPT-ORIENTED READING INSTRUCTION)

SEE *Learning and Teaching Reading*.

CORRELATIONAL RESEARCH

Correlational research is an important form of educational and psychological research. Some knowledge of correlational methods is important for both the consumption and conduct of research. The purpose of this entry is to (a) define quantitative research methods as a way of framing correlational research, (b) consider multivariate extensions of the bivariate correlation, including statistical methods for analyzing correlational research data, (c) provide some relevant examples of correlational research, (d) discuss the role of correlational research, and (e) mention some key issues associated with correlational research.

DEFINITIONS OF QUANTITATIVE METHODS OF RESEARCH

Research in education and psychology can be roughly divided into quantitative research, qualitative research, and historical research. Quantitative research methods can be categorized as descriptive research, correlational research, and experimental research.

Descriptive research describes the phenomena being studied. Data are gathered and descriptive statistics are then used to analyze such data. Thus descriptive research considers one variable at a time (i.e., univariate analysis), and is typically the entry-level type of research in a new area of inquiry. Descriptive research typically describes what appears to be happening and what the important variables seem to be.

The purpose of correlational research is to determine the relations among two or more variables. Data are gathered from multiple variables and correlational statistical techniques are then applied to the data. Thus correlational research is a bit more complicated than descriptive research; after the important variables have been identified, the relations among those variables are investigated. Correlational research investigates a range of factors, including the nature of the relationship between two or more variables and the theoretical model that might be developed and tested to explain these resultant correlations. Correlation does not imply causation. Thus correlational research can only enable the researcher to make weak causal inferences at best.

In experimental research, the researcher manipulates one or more independent or grouping variables (e.g., by comparing treatment conditions, such as an intervention group vs. a control group) and then observes the impact of that manipulation on one or more dependent or outcome variables (e.g., student achievement or motivation). The statistical method of analysis is typically some form of the analysis of variance. Experimental research includes (a) true experiments (in which individuals are randomly assigned to conditions or groups, such as method of instruction or counseling) and (b) quasi-experiments (in which individuals cannot be randomly assigned as they are already in a condition or group, such as gender, socioeconomic status, or classroom). The basic question to be posed in experimental research concerns what extent a particular intervention causes a particular outcome. Thus experimental studies are those in which strong causal inferences are most likely to be drawn.

MULTIVARIATE EXTENSIONS AND RELEVANT STATISTICAL TECHNIQUES

There are a number of different methods in which correlations can be considered. Each of these methods is directly tied to a particular statistical technique (with names and dates of their initial development). Thus these methods and statistical techniques can be considered together. At the most basic level is a bivariate correlation (contributions by Galton, 1888; Edgeworth, 1892; Pearson, 1900), which examines the correlation or relation between two variables (hence the terms co-relation and bivariate). In some cases one variable is known as an independent variable (or input variable) and the second variable as a dependent variable (or outcome variable). In other cases there are two variables without any such designation. Bivariate correlations provide information about both the strength of the relationship (from uncorrelated, when the correlation is zero, to perfectly correlated, when the correlation is positive or negative one), and the direction of the relationship (positive or negative). A bivariate correlation can only consider two variables at a time. However, there are a number of multivariate extensions to the bivariate correlation in which more than two variables can be simultaneously analyzed.

Regression analysis (1805) of Adrien-Marie Legendre (1752 1833) is a method for using one or more independent variables or predictors to predict a single dependent variable or outcome. The relations among the variables are used to develop a prediction model. Because only one dependent variable can be considered, regression analysis can only be used to test simple theoretical models. A related method, created by George Udny Yule (1871 1951), is that of the multiple correlation (1897);

it represents the correlation between multiple independent variables and a single dependent variable. The multiple correlation is a direct extension of the bivariate correlation for situations involving multiple independent variables. Path analysis (1918), created by Sewall Wright (1889–1988), is an extension of regression analysis for more than a single dependent or outcome variable. Here more complex theoretical models can be tested, as the relations among multiple independent variables and multiple dependent variables can be simultaneously considered.

Canonical correlation analysis (1935), created by Harold Hotelling (1895–1973) is used to determine the correlation between the linear combination of two sets of variables. Statistically this process is superior to examining a multitude of bivariate correlations (both within and across sets). For example, there may be one set of independent variables and a second set of dependent variables. This method takes the best linear combinations from each set of variables and generates a canonical correlation between the combinations of the two sets. Obviously this method represents an extension of the bivariate correlation and the multiple correlations for situations involving multiple independent variables and multiple dependent variables (or simply for two separate sets of variables).

The previously described methods examine the relations among what are known as observed variables. For example, the Stanford-Binet IQ measure is an instrument that produces an observed measured variable (or score) than can be used to infer intelligence. Latent variables (also known as constructs or factors) are variables that are not directly observed or measured but can be indirectly measured or inferred from a set of observed variables. The Stanford-Binet is one possible observed measure of the latent variable intelligence.

The following methods use both observed variables and latent variables. Factor analysis (Spearman, 1904; Thurstone, 1931) and principal component analysis (Pearson, 1901; Hotelling, 1933) are related multivariate correlational methods. Their purpose is to reduce a set of correlated variables into a smaller set of linear combinations of those variables, known as latent factors or components. For example, with a battery of intelligence tests, one can determine how many factors underlie the data (e.g., a single general intelligence factor, specific performance and verbal intelligence factors, etc.).

Structural equation modeling (Joreskog, 1973; Keesling, 1972; Wiley, 1973) combines factor analysis with path analysis to test theoretical relations among latent variables. Here models can range from simple to complex in nature in that any number of variables of any type can be involved (i.e., observed, latent, independent, and/or dependent variables). The incorporation of factor analysis

in structural equation modeling allows the researcher to use multiple measures of each latent variable instead of a single measure, thereby enabling better measurement conditions (i.e., reliability and validity) than with a single measure, for example, determining the relationship between an intelligence latent variable and an achievement latent variable, in which each latent variable is measured through multiple indicator variables.

EXAMPLES OF CORRELATIONAL RESEARCH

What follows are a few prototypical examples of correlational research that educational and psychological researchers have investigated. Bivariate correlations determined the relations between math anxiety measures and teacher confidence measures (Bursal & Paznokas, 2006). Their results indicated that low math-anxious pre-service teachers were more confident in teaching math and science than high math-anxious pre-service teachers. Regression analysis was used to predict student exam scores in statistics (dependent variable) from a series of collaborative learning group assignments (independent variables) (Delucchi, 2006). The results provided some support for collaborative learning groups improving statistics exam performance, although not for all tasks. Multiple correlations were computed between a nonverbal test of intelligence (dependent variable) and various ability tests (independent variables) (Domino & Morales, 2000). The nonverbal test was significantly correlated with grade point average and ability test scores for Mexican American students.

In a path analysis example, Walberg's theoretical model of educational productivity was tested for fifth-through eighth-grade students (Parkerson et al., 1984). The relations among the following variables were analyzed in a single model: home environment, peer group, media, ability, social environment, time on task, motivation, and instructional strategies. All of the hypothesized paths among those variables were shown to be statistically significant providing support for the educational productivity model. A canonical correlation analysis study examined battered women who killed their abusive male partners (Hattendorf, Ottens, & Lomax, 1999). There were two sets of variables: (1) frequency and severity of posttraumatic stress disorder (PTSD) symptoms, and (2) severity of types of abuses inflicted. The set of symptom variables were found to be highly related to the set of abuse variables, thus indicating a strong relationship between PTSD symptoms and severity of abuse. Another more general example involves the relation between a set of student personality variables and a set of student achievement variables.

In terms of factor analysis and principal component analysis, early examples considered the structure underlying different measures of intelligence (subsequently developed into theories of intelligence). Similar work has examined the dimensions of the Big Five personality assessments.

Finally, two examples of structural equation modeling involving both latent and observed variables can be given here. Kenny, Lomax, Brabeck, and Fife (1998) examined the influence of parental attachment on psychological well being for adolescents. In general, maternal attachment had a stronger effect on well being for girls, while paternal attachment had a stronger effect on well being for boys. Shumow and Lomax (2002) tested a theoretical model of parental efficacy for adolescent students. For the overall sample, neighborhood quality predicted parental efficacy, which predicted parental involvement and monitoring, both of which predicted academic and social-emotional adjustment.

ROLE OF CORRELATIONAL RESEARCH

Correlational research has played an important role in the history of educational and psychological research. Early on, the bivariate correlation was used in heredity research and then eventually expanded into all areas of educational and psychological inquiry. Subsequently more sophisticated multivariate extensions enabled researchers to examine multiple variables simultaneously. Correlational research has had and will continue to have an important role in quantitative research in terms of exploring the nature of the relations among a collection of variables. In part, unrelated variables can be eliminated from further consideration, thereby allowing the researcher to give more serious consideration to related variables.

Correlational research can also play an important role in the development and testing of theoretical models. Once the nature of bivariate relations has been determined, this information can then be used to develop theoretical models. The idea here is to attempt to explain the nature of the bivariate correlations rather than to simply report them. At this point, methods such as factor analysis, path analysis and structural equation modeling can come into play.

ISSUES IN CORRELATIONAL RESEARCH

When consuming or conducting correlational research, there are a number of issues to consider, with some issues being positive and others negative in nature. On the positive side, once descriptive research has helped to identify the important variables, correlational research can then be used to examine the relations among those

important variables. For example, researchers may be interested in determining which variables are most highly related to a particular outcome, such as student achievement. This can then lead into experimental research in which the causal relations among those key variables can be examined under more tightly controlled conditions. Here one independent variable can be manipulated by the researcher (e.g., method of instruction), with other related variables being controlled in some fashion (e.g., grade, level of school funding). This then leads to a determination of the impact of the independent variable on the outcome variable, allowing a test of strong causal inference.

On the negative side, a limitation of correlational research is that it does not allow tests of strong causal inference. For example, if researchers find a high bivariate correlation between amount of instructional time (X) and student achievement (Y), then they may ask if this correlation necessarily implies that more instructional time causes higher achievement. The answer is not necessarily. Two variables X and Y can be highly correlated for any of the following reasons and others: (a) X causes Y; (b) Y causes X; (c) Z causes both X and Y, but X and Y are not causally related; (d) X and Y both cause Z, but X and Y are not causally related; and (e) many other variables might be involved. In addition, for a causal relationship X must occur before Y. Thus a bivariate correlation coefficient gives information about the nature of the relations between two variables, but not why they are related. Theoretical models of educational and psychological phenomena tend to be rather complex, certainly involving more than simply two variables. More sophisticated correlational methods, such as factor analysis, path analysis, or structural equation modeling, have the ability to examine the underlying relations among many variables and can, therefore, be used as a basis to argue for causal inference.

Another limitation of correlational methods is they commonly suggest that the variables are linearly related to one another. For example, variables X and Y can be shown to have a linear relationship if the data can be nicely fitted by a straight line. When variables are not linearly related, correlational methods will reduce the strength of the relationship (in other words, the linear relation will be closer to zero). Therefore, nonlinear relationships will result in smaller linear correlations, possibly misleading the researcher and the field of inquiry. Outliers, observations that are quite a bit different from the remaining observations, will also reduce the strength of the relationship. It is wise for researchers to examine their data to see if (a) variables are linearly related (e.g., by the use of scatterplots), and (b) there are any influential observations (i.e., outliers).

A final limitation of correlational research occurs when a researcher seeks to consider the relations among every possible variable. The idea is if researchers examine the relations among enough variables, then certainly some variables will be significantly related. While there is an exploratory consideration here, in terms of seeing which variables are related, there is a statistical consideration as well. That is, if researchers examine enough bivariate correlations, they will find some variables that are significantly related by chance alone. For example, if they examine 100 correlations at the .05 level of significance, then they expect to find five correlations that appear to be significantly different from zero, even though these correlations are not truly different from zero. In this case, the more sophisticated multivariate correlational methods can be useful in that fewer tests of significance tend to be done than in the bivariate case.

Correlational methods of inquiry have been popular in educational and psychological research for quite some time in part because they are foundational in nature in terms of their ability to examine the relations among a number of variables. Also, correlational methods can be used to develop and test theoretical models (e.g., factor analysis, path analysis, structural equation modeling). Despite the limitations of correlational research described here, these methods will continue to be used. Additional information on correlational methods can be found in Grimm and Yarnold (1995, 2000), Lomax (2007), and Schumacker and Lomax (2004).

SEE ALSO *Experimental Research; Research Methods: An Overview.*

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CREATIVITY

Creativity, of particular interest in Europe and North America, has been defined in many ways over time, reflecting era and culture. Most definitions frame creativity as involving shaping novel possibilities using imagination, recognizing the originality and value of outcomes that are thus generated.

A clear historical evolution of distinctive approaches researching creativity can be documented (Ryhammar & Brodin, 1999; Sternberg, 2003), many earlier approaches being clearly visible even in 2007, as, in common perhaps with many fields of study, intellectual fragmentation of discourse occurs.

HISTORICAL EXPLANATIONS FOR CREATIVITY

The idea of creativity as inspiration produced by a higher power is found far back in Greek, Judaic, Christian, and Muslim traditions, the driving idea being that creativity comes from a mysterious, even divine source. Such ideas are still found in the early 2000s in attempts to understand the mystery of intuition, particularly in the arts (Bannerman et al., 2006; Ghiselin, 1985).

The Romantic era in mid-19th century Europe spawned a very different view, with creativity seen as emerging from human creative capacity for genius expressed as originality, insight, and feeling. Inspiration was seen during this period as being expressed artistically, with a core role given to the subjectivity of feeling. Subsequently many disciplines have contributed to the study of creativity, including psychology, which grew, by the end of the 19th century, to be perhaps the most dominant.

EARLY PSYCHOLOGICAL PERSPECTIVES ON CREATIVITY

From the late 19th century, and rooted in the Romantic conceptions of creativity, psychological explorations focused initially on genius, with the first systematic study

undertaken in 1869 by Sir Francis Galton (1822–1911), leading to around a hundred studies well into the 1920s, exploring creativity as achievement acknowledged in the wider public arena.

Approaches from the early 1900s through the first half of the 20th century were characterized by a broadly deductive, philosophical approach within psychology, dominant threads being psychoanalytic, cognitive, and humanistic traditions.

The psychodynamic tradition in the early twentieth century saw the unconscious as playing a significant role in behavior and subjective experience. The work of Sigmund Freud (1856–1939) (1908, 1910) offered insights born of his therapeutic practice-derived psychoanalytic theory, that great creators are driven to do what they do to satisfy unconscious desires. Others, such as Donald Woods Winnicott (1896–1971), followed, with psychodynamic theories of creativity as fundamental and intrinsic to human nature, as closely linked to play and necessary to development.

By the mid-20th century, creativity was seen as associated with science as well as with art; pragmatic approaches were also increasingly adopted as a global economy based on knowledge increasingly required creativity as a core capability (Haste, 2008). Also emerging from therapeutic practice, humanistic approaches to creativity in the later 20th century saw creativity as self-realization, or self-actualization (Rogers, 1954, 1961; Maslow, 1971).

COGNITIVE APPROACHES TO CREATIVITY

But by far the most influential tradition has been the cognitive one, searching both conceptually and empirically, for models to describe creative behavior. This tradition generated many models, including seminal work by Graham Wallas (1926) of the creative process (preparation, incubation, illumination, verification), Mednick's 1962 associative process model, Finke's 1995 exploration of generative to exploratory thought, and Hudson's recognition (1968) that both divergent and convergent thought are involved in creativity.

From the 1950s, building from the cognitive tradition and launched by Guilford's 1950 work on limitations of intelligence testing, came perhaps more deductive, empirically based approaches than hitherto. Some focused on pragmatic strategies to increase individual and collective creativity. These included de Bono's 1993 creative thinking strategies, Buzan's mind mapping techniques (e.g., Buzan, 2006), and Osborn-Parnes' "creative problem solving," triggered by Osborn's early work (1953). Others emphasized psychometric testing (e.g., Torrance, 1969, 1974). Studies proliferated exploring individual and social traits of creative persons and groups, with a

remarkable degree of correlation (Brolin, 1992), leading to perspectives on creativity as inherently collaborative (John-Steiner, 2000). Researchers in Europe and North America sought to contribute to developing the creative organization (e.g., Amabile, 1988; Ekvall, 1996; Isaksen & Lauer, 2002).

Evolutionary approaches to creativity (e.g., Campbell, 1960; Perkins, 1995; Simonton, 1999) also developed, seeking to understand evolution in ideas and identifying two basic steps: first, blind variation (generativity), then, selective retention (novelty judged as valuable), the most creative possibilities surviving.

As the twentieth century drew to a close, many studying creativity began to recognize that multiple components must converge in a confluence approach. These include Amabile's work (1982, 1996, 1999) on intertwining intrinsic motivation, domain knowledge, and creativity skills, also the evolving-systems model generated by Gruber (1981, 1989) integrating knowledge, purpose, and affect, as well as documenting "networks of enterprise" surrounding creative practitioners. Mihaly Csikszentmihályi (1988, 1996), too, proposed a systems approach, comprising dynamic interaction between individual, domain, and field.

The late 20th century saw a shift from measuring to characterizing, from simple to complex, from individual to collective, from universalized to situated (Jeffrey & Craft, 2001). Researchers began to see creativity as life-wide and domain-wide (Craft, 2005; Claxton, 2006), and as democratic (NACCCE, 1999).

Since the mid-1990s, creativity in applied contexts has experienced unprecedented resurgence globally as an area of scholarship, policymaking and practice, in the classroom, the workplace and personal life. Embedded is the assumption of everyday creativity as necessary and feasible, life-wide and lifelong, a distinctly different perspective to previous ones, which had emphasized the extraordinary, *big c* or high creativity.

The resurgence spans Northern, Central, and Southern Europe, the Middle and Far East and Australasia and North America, expanding the research discourse pool well beyond the earlier North-American community. Such international re-engagement with creativity reflects the relationship perceived at policy level between fostering everyday creativity within education, and economic competitiveness (Jeffrey and Craft, 2001; Craft, 2005). Research methodology shifted, from positivist, large-scale studies aiming to measure creativity, toward ethnographic, qualitative research (Jeffrey & Craft, 2001). Early 21st century studies of creativity in education increasingly emphasize cultural dimensions of creativity, in particular discontinuities between universalized and marketized North American creativity discourse and Asian perspectives

(Craft, Cremin, & Burnard, 2008; Craft, Gardner, & Claxton, 2008).

In the first decade of the 21st century conceptual work examined the ethical dimension of creativity (Craft, 2005; Craft, Gardner, & Claxton, 2008), asking how creativity engages with wisdom and trusteeship, in a world facing unprecedented global problems (Craft, Gardner, & Claxton, 2008).

Approaches to fostering creativity reflect the perspectives discussed earlier. Creativity in education is increasingly linked both to the economy, and, in England in particular, to cultural development, reflecting several rhetorics (Banaji & Burn, 2006). Pedagogical developments include working in partnership with those beyond the classroom, initially recommended by the National Advisory Committee on Creative and Cultural Education (NACCCE, 1999) and then by later government reviews (e.g. Roberts, 2006; Department for Culture, Media and Sport, 2006).

How organizations and societies handle the spectrum of creative and cultural development in the learning age is a contested area spanning psychological, social, and economic theory. Richard Florida (2002) offers such a theory, suggesting, controversially, that urban and economic regeneration correlate with growth in “the creative class” (high-tech workers, artists, musicians, gay men, and bohemians), generating open, dynamic professional and personal activity. While critiqued (Malanga, 2004), the theory remains influential.

MEASURING CREATIVITY

Knotty problems yet to be adequately tackled, include how creativity is assessed. Challenge exists in acknowledging how creativity is recognized and valued in different cultures, particularly where Eastern and Western perspectives are concerned (Craft, 2005; Ng & Smith, 2004). Such is the case because ways in which creativity is assessed imply an underpinning model of creativity.

Some of the most influential and widely used tests of creativity (Torrance, 1969, 1974) can be seen as being based on a temporally located Westernized model of creativity as individualized and involving the generating of a product-outcome. The Torrance Tests of Creativity (TTCT) drew directly on Guilford’s 1967 characteristics of divergent production, that is, fluidity, flexibility, originality, and elaboration. Torrance saw creativity as an ability to notice omissions or gaps, to propose solutions to problems, to produce original ideas, to recombine these, and to be able to detect novel relationships between ideas. His figural and verbal tests of creativity imply creativity involves producing outcomes, triggered by challenges focused on exploring consequences of questions, improving ideas, considering unusual uses for artifacts, and imagining

what might be, as well as involving figural invention, elaboration, and departure from structure. Responses to the tests are judged to be creative in terms of the following features:

- fluency (number) of appropriate or relevant responses
- flexibility in types of responses
- originality in terms of novelty of responses
- elaboration in terms of details that embellish or extend responses.

The Torrance tests, however, take no account of context or of how judgments are made. Amabile’s Consensual Assessment Technique, or CAT, (1982, 1996) addresses this by recognizing creativity is embedded in its cultural context, thus a product may be considered to be creative when appropriate judges (familiar with the field) agree that it is so.

Amabile’s CAT contrasts with Torrance’s in being contextually dependent but also because the field of judges may include those who have generated the creative products. The CAT process involves judges rating products in a random order by level of creativity a five-point scale, from very uncreative to very creative. Amabile’s work with Hennessey (Hennessey & Amabile, 1999) suggests it is not only tangible products that may be assessed using CAT, but any open task that has multiple potential outcomes, leading to what might be seen as a relativist perspective on what constitutes creativity and one which is culturally sensitive (Cheng, 2008).

Attempts to explore assessment of creativity in a learning context include those acknowledging teacher stance in relation to learner stance (Craft, Cremin, Burnard, & Chappell, 2008).

SEE ALSO *Gifted Education.*

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Anna Craft

CRITERION-REFERENCED TESTS

A *criterion-referenced test* is a test that provides a basis for determining a candidate's level of knowledge and skills in relation to a well-defined domain of content. Often one

or more performance standards are set on the test score scale to aid in test score interpretation. Criterion-referenced tests, a type of test introduced by Glaser (1962) and Popham and Husek (1969), are also known as domain-referenced tests, competency tests, basic skills tests, mastery tests, performance tests or assessments, authentic assessments, objective-referenced tests, standards-based tests, credentialing exams, and more. What all of these tests have in common is that they attempt to determine a candidate's level of performance in relation to a well-defined domain of content. This can be contrasted with *norm-referenced tests*, which determine a candidate's level of the construct measured by a test in relation to a well-defined reference group of candidates, referred to as the norm group. So it might be said that criterion-referenced tests permit a candidate's score to be interpreted in relation to a domain of content, and norm-referenced tests permit a candidate's score to be interpreted in relation to a group of examinees. The first interpretation is content-centered, and the second interpretation is examinee-centered.

CRITERION REFERENCED TESTS AND NORM REFERENCED TESTS

Because these two types of tests have fundamentally different purposes, it is not surprising that they are constructed differently and evaluated differently. Criterion-referenced tests place a primary focus on the content and what is being measured. Norm-referenced tests are also concerned about what is being measured but the degree of concern is less since the domain of content is not the primary focus for score interpretation. In norm-referenced test development, item selection, beyond the requirement that items meet the content specifications, is driven by item statistics. Items are needed that are not too difficult or too easy, and that are highly discriminating. These are the types of items that contribute most to score spread, and enhance test score reliability and validity. With criterion-referenced test development, extensive efforts go into insuring content validity. Item statistics play less a role in item selection though highly discriminating items are still greatly valued, and sometimes item statistics are used to select items that maximize the discriminating power of a test at the performance standards of interest on the test score scale.

Some scholars have argued that there is little difference between norm-referenced tests and criterion-referenced tests, but this is not true. A good norm-referenced test is one that will result in a wide distribution of scores on the construct being measured by the test. Without score variability, reliable and valid comparisons of candidates cannot be made. A good criterion-referenced test will permit content-referenced interpretations and this means that the content domains to

which scores are referenced must be very clearly defined. Each type of test can serve the other main purpose (norm-referenced versus criterion-referenced interpretations), but this secondary use will never be optimal. For example, since criterion-referenced tests are not constructed to maximize score variability, their use in comparing candidates may be far from optimal if the test scores that are produced from the test administration are relatively similar (see Hambleton & Zenisky, 2003).

RELIABILITY AND VALIDITY ASSESSMENT

Because the purpose of a criterion-referenced test is quite different from that of a norm-referenced test, it should not be surprising to find that the approaches used for reliability and validity assessment are different too. With criterion-referenced tests, scores are often used to sort candidates into performance categories. Consistency of scores over parallel administrations becomes less central than consistency of classifications of candidates to performance categories over parallel administrations. Variation in candidate scores is not so important if candidates are still assigned to the same performance category. Therefore, it has been common to define reliability for a criterion-referenced test as the extent to which performance classifications are consistent over parallel-form administrations. For example, it might be determined that 80% of the candidates are classified in the same way by parallel forms of a criterion-referenced test administered with little or no instruction in between test administrations. This is similar to parallel form reliability for a norm-referenced test except the focus with criterion-referenced tests is on the decisions rather than the scores. Because parallel form administrations of criterion-referenced tests are rarely practical, over the years methods have been developed to obtain single administration estimates of decision consistency (see, for example, Livingston & Lewis, 1995) that are analogous to the use of the corrected split-half reliability estimates with norm-referenced tests.

With criterion-referenced tests, the focus of validity investigations is on (1) the match between the content of the test items and the knowledge or skills that they are intended to measure, and (2) the match between the collection of test items and what they measure and the domain of content that the tests are expected to measure. The "alignment" of the content of the test to the domain of content that is to be assessed is called *content validity evidence*. This term is well known in testing practices.

Many criterion-referenced tests are constructed to assess higher-level thinking and writing skills, such as problem solving and critical reasoning. Demonstrating

that the tasks in a test are actually assessing the intended higher-level skills is important, and this involves judgments and the collection of empirical evidence. So, construct validity evidence too becomes crucial in the process of evaluating a criterion-referenced test.

SETTING PERFORMANCE STANDARDS

Probably the most difficult and controversial part of criterion-referenced testing is setting the performance standards, i.e., determining the points on the score scale for separating candidates into performance categories such as “passers” and “failers.” The challenges are great because with criterion-referenced tests in education, it is common on state and national assessments to separate candidates into not just two performance categories, but more commonly, three, four, or even five performance categories. With four performance categories, these categories are often called *failing*, *basic*, *proficient*, and *advanced*.

What makes the setting of performance standards on criterion-referenced tests controversial is that the process itself is highly judgmental, and the implications are far-reaching. Candidates who fail the test may be denied a high school diploma or a license to practice in the profession they trained for. Teachers and administrators can lose their jobs if student test performance does not meet the performance standards. Perceptions of the quality of education in a state can be affected by large percentages of students being assigned to the failing or basic performance categories. With international assessments such as Trends in Mathematics and Science Study (TIMSS), the educational reputations of countries are based on criterion-referenced test performance.

The process of setting performance standards proceeds through many steps (see Cizek, 2001; Hambleton & Pitoniak, 2006). First, it is common to set a policy about the composition of the panel that will set the performance standards. Here, decisions about the demographic make-up of the panel, such as gender, ethnicity, years of experience, geographical distribution, role (e.g., teachers, administrators, curriculum specialists, parents), are usually considered, as well as other factors. Then a plan is put in place to draw a representative panel to meet the specifications.

Another big decision concerns the choice of standard-setting method. There are probably 10 to 20 major methods, and large numbers of variations of each. The methods include Angoff, Ebel, Nedelsky, contrasting groups, borderline groups, direct consensus, item cluster, booklet selection, extended Angoff, bookmark, and more.

Prior to the meeting of the panel to set the performance standards it is common for a different panel to

prepare performance category descriptions. These descriptions lay out for the standard-setting panel what it means to be a failing student, a basic student, and so on. The descriptions provide a basis for the standard-setting panel to carry out its work of determining just how well candidates must perform on the test to demonstrate basic, proficient, and advanced level performance. The descriptions are also helpful in communicating what the expectations are for students in the performance categories, and at the time of score reporting.

Next, the panel is brought together and the chosen method is applied to produce performance standards. A typical panel meeting often begins with discussion of the purpose of the test and exposure to the performance category descriptions. Having the panelists take a portion or even the entire test is another activity that is included as part of the training. Then the method is introduced, and practice is given prior to the panel starting on its task of setting the standards.

The meeting continues, and often two to three days are needed for the panelists to work through the method and related discussions until a final recommended set of performance standards is produced. Validity evidence is compiled about the process and the panelists' impressions of it, a technical manual is often written, and then all of the information is forwarded to a board for setting the final performance standards for the criterion-referenced test. If multiple tests are involved (e.g., mathematics, reading, and science tests at several grade levels), the task of making the complete set of performance standards across subjects and grades consistent or coherent is especially challenging.

USES

Criterion-referenced tests are used in many ways. Classroom teachers use them to monitor student performance in their day-to-day activities. States find them useful for evaluating student performance and generating educational accountability information at the classroom, school, district, and state levels. The tests are based on the curricula, and the results provide a basis for determining how much is being learned by students and how well the educational system is producing desired results. Criterion-referenced tests are also used in training programs to assess learning. Typically pretest-posttest designs with parallel forms of criterion-referenced tests are used. Finally, criterion-referenced tests are used in the credentialing field to determine persons qualified to receive a license or certificate. There are hundreds of credentialing agencies in the United States that are using criterion-referenced tests to make pass-fail credentialing decisions.

SEE ALSO *Classroom Assessment.*

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Ronald K. Hambleton

CRITICAL THINKING

One of the most challenging and yet rewarding experiences in teaching any college course occurs when the professor is faced with dispelling a popular myth or misconception that students hold in their belief system. It is challenging because beliefs are part of an entire system of understanding, and the process of changing a belief typically requires considerable effort by both professor and students. Ideally, beliefs are based on solid reasoning and good data, so changing a belief may mean changing the way someone reasons and the data that are accepted as valid. In changing a belief, educators need to understand how students explain events. For example, if someone is thinking about a friend and the friend calls him moments later, is this evidence of chance or a premonition? It is not easy to get most people to consider all of the people they think about everyday and realize that, just by chance, sometimes they will get a phone call from the very person who occupied their thoughts in the last few minutes.

The reward for the professor occurs when students can understand faulty reasoning patterns and distinguish good data from poor data. The deconstruction and rebuilding of a belief system requires critical thinking. The term critical thinking refers to the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is purposeful, reasoned, and goal directed. It is the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions. When people think critically, they are evaluating the outcomes of their

thought processes—how good a decision is or how well a problem is solved. Critical thinking also involves evaluating the thinking process—the reasoning that went into the conclusion arrived at or the kinds of factors considered in making a decision.

Professors who teach introductory courses (e.g., introduction to psychology, critical thinking, and life span and human development) are often faced with common misconceptions. Examples of misconceptions include the credibility and use of astrological readings, belief in the power of healing crystals, and reliance on shoddy research to justify a belief in products such as the use of shark oil to cure cancer or copper bracelets to relieve the pain of arthritis. Students must engage with new information in a conscious and critical manner for these misconceptions to be replaced with a new belief system.

CRITICAL THINKING

Critical thinking is one type of thinking. Other types are the use of random methods to arrive at a conclusion, rote memorization, day and night dreaming, and sloppy thinking. Critical thinking is not a new idea. The philosopher John Dewey, who wrote about this topic at the turn of the 20th century, advocated for teaching skepticism, reflective inquiry, and tolerance for ambiguity, while working to reduce uncertainty. Students must be taught to consider evidence, from multiple sources, in order to solve problems. What is now thought of as critical thinking had a place in Dewey's basic writings. For Dewey, schools act as a repair organ for society, and it is through education that students can learn to think critically so that society can work toward self-improvement.

Diane Halpern (2003) notes that different types of information can be held or processed by different cognitive processes. For example, information in the form of speech is processed differently than visual information. In fact, these are examples of the two preferred modes of thought; silent speech and imagery. Based on these two types of processing information, different cognitive strategies are used during the critical thinking process.

The notion of different cognitive processes dealing with different information is related to the definition of critical thinking. Halpern defines the term as follows:

Critical thinking is the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is used to describe thinking that is purposeful, reasoned, and goal directed—the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions, when the

thinker is using skills that are thoughtful and effective for the particular context and type of thinking task (2003, p. 6).

The student who believes in astrological readings may focus on those outcomes that confirm the predictions made in the readings, which are always vague enough that almost anyone can find confirmation for the predictions. Another key element to critical thinking is an awareness of one's own thinking. Metacognition, or knowledge about what a person knows and how the person thinks is a key concept in the critical thinking literature because students need to have an awareness of the process and outcome of their thinking in order to consciously improve how they think.

A MODEL OF INTELLECTUAL DEVELOPMENT

Critical thinking is a developmental process that can begin at an early age. When thinking about critical thinking, people need to keep their definitions developmentally appropriate so that what constitutes critical thinking in the elementary school grades will differ from what is expected of an adult. William Perry conducted a survey of the thinking processes of students at Harvard University and Radcliffe College in 1953. Perry later (1968) devised an intellectual development model based on his analysis of survey responses. Although Perry's model was not designed to describe the development of critical thinking, it does describe many of the characteristics of a critical thinker such as open-mindedness, flexibility, willingness to self-correct, and pursuit of consensus (Halpern, 2003). The authors have broken Perry's model into four stages, with progression through the stages in a linear fashion. Perry's model can help educators understand how important aspects of critical thinking develop.

The first stage of Perry's (1968) model is called basic duality. This type of thinking is best illustrated by someone who believes there is only one truth and the authority of the truth is not to be questioned. Students who are functioning at this level will strictly memorize material with little critical thinking about the material. Some students in this stage will begin to question authority figures but will only identify those whom they believe are frauds. They will start to perceive information as limited truths. The second stage is called multiplicity pre-legitimate. A student's thinking about information changes from the notion that there is an absolute truth with correct/incorrect information to the notion that the truth remains to be known. At this stage, students' thinking processes change in that they understand that work is needed to provide evidence for opinions, including their own, for what may be the truth and that there may be multiple truths in the world.

- How to make abstract information meaningful.
 - How you can use over-learning, cognitive interviewing techniques and memory triggers to recall and organize information.
 - How to develop an awareness of biases in memory.
 - How to understand and use questioning and listening strategies.
 - How to recognize and defend against the use of inappropriate, emotional language.
 - How to choose and use graphic organizers.
 - How to discriminate between deductive and inductive reasoning.
 - How to understand the differences between truth and validity.
 - How to properly use quantifiers in reasoning.
 - How to diagram the structure of an argument.
 - How to examine the credibility of an information source.
 - How to judge your own arguments.
 - How to understand the limits of correlational reasoning.
 - How to isolate and control variables in order to make strong casual claims.
 - How to know when casual claims can and can not be made.
 - How to use probability judgments to improve decision making.
 - How to compute expected values in situations with known probabilities.
 - How to avoid overconfidence in uncertain situations.
 - How to reframe decisions to consider alternatives.
 - How to prepare a decision-making worksheet.
 - How to understand the distinction between the quality of a decision and its outcome.
 - How to plan and monitor a strategy for finding a solution.
 - How to use graphs, diagrams, hierarchical trees, matrices and models as solution aides.
 - How to select appropriate problem-solving strategies.
 - How to visualize the problem.
 - How to brainstorm productively and create alternatives.
 - How to gather additional information.
- SOURCE: Abstracted from Halpern (2007).

List of Critical Thinking Skills ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

The third stage is called relativism correlate, competing or diffuse. In this stage of development, students begin to understand that truth is contextual. Furthermore, they see that validity is an important issue that must be addressed in accepting that all knowledge may be relative but not equally valid. Another important aspect of the thinking process is the realization that theories are more like metaphors for the real world and are not to be accepted as absolute truths. With the realization of information being relative and the idea of validating information, students can become disoriented and starts to question the self. There is a realization that decisions need to be made in an uncertain world, a difficult process to go through. The final stage of Perry's model is called commitment foreseen. The students who reach this stage have come to the conclusion that commitments for how knowledge is obtained, used, and created needs to be made carefully.

The commitments made in the final stage influence personal values and career decisions. More importantly, students realize a balance must be made in assessing and accepting new information. Students become more

flexible in respecting others' values and are aware that they must be open-minded and ready to learn new information while still maintaining their own values. The key element to this stage of thinking is that the student realizes that the process of acquiring, analyzing, and making a decision about new information is an iterative process. It is a process that requires much knowledge about one's own thinking while allowing for acquiring new information. This process has come to be known as metacognition.

METACOGNITION

Metacognitive processes are central to understanding critical thinking. John Flavell (1979) introduced four basic components to self-knowledge: metacognitive knowledge, metacognitive experiences, goals, and strategies. They are often referred to as ease of learning judgments. The ease of learning judgment is an initial assessment by the student of how easy or difficult it will be to acquire the new information. In making these judgments, critical thinkers will devise a plan for the best way to obtain new information. Critical thinkers also recognize the potential cognitive strategies and skills that may be required. The quality of learning judgment is a monitor of how well the information is being learned. Critical thinkers assess if any changes in their learning process need to be changed by using different cognitive strategies or skills. The feeling of knowing judgment is a check on how well information is known. During this time in the thinking process, critical thinkers will seek consensus to determine if information has been conceptualized correctly. If the information turns out to be false, critical thinkers are willing to self-correct.

The degree of confidence judgment is a monitor for how confident the student is in giving an answer. Many errors can occur in the process of making this judgment. Asher Koriat, Sarah Lichtenstein, and Baruch Fischhoff (1980) found that people are susceptible to ignoring evidence that contradicts their answers and tend to favor positive evidence when compared to negative evidence. It is crucial that students are willing to self-correct while judging how confident they are in a belief. Metacognition is an important component in the critical thinking process in that people need to be aware of their own knowledge in the cognitive strategies and skills that are at their disposal. It is during the process of thinking about their own thinking that students assess the quality of the data or other evidence that supports their conclusion and how closely related the data are to the conclusion.

COGNITIVE STRATEGIES AND SKILLS

The instruction of critical thinking has been transitioning from teaching students to critically think in a content driven course to courses designed exclusively to teach critical thinking. The latter approach allows the students to become explicitly aware of their thinking by providing them with both academic and real-world examples in demonstrating the cognitive strategies and skills associated with critical thinking. Halpern's taxonomy of critical thinking allows students to develop a critical thinker attitude by engaging in real-world, practical examples as opposed to the more traditional approach of dialectical reasoning.

Halpern's critical thinking taxonomy is designed from a skills based approach. The skills are broken down into ten primary categories as follows: critical thinking framework, memory, language and thought, reasoning, analyzing arguments, hypothesis testing, likelihood and uncertainty, decision making, problem solving skills, and creativity. The skills taught are geared toward the student becoming accustomed to thinking at the highest levels of Bloom's taxonomy, which include evaluating, designing, and creating knowledge.

The critical thinking framework includes the skills for framing the problem and recognizing the goal. Skills in memory include mnemonics and the recognition that memory is a mediator of thought. The relationship between language and thought is important for students to understand, and they need to gain skills in recognizing emotional language, the use of vagueness, ambiguity, and reification. Other basic skills include recognizing anchoring and framing effects, thinking in terms of probability and likelihood, and working backwards to find a solution to a problem.

Understanding arguments and the concept of hypothesis testing are both important for people to be effective critical thinkers. The skills that come in understanding arguments include recognizing the components of an argument and recognizing typical fallacies that people use in arguments. For hypothesis testing, the necessary skills include being able to distinguish between inductive and deductive reasoning, knowing the difference between an independent variable and dependent variable, and the importance of random assignment.

The accumulation and combination of these skills, along with many others, are what create a critical thinker. Critical thinking is not a single skill that can be used over and over in a rote fashion; this sort of conceptualization is antithetical to the very idea of a critical thinker. A critical thinker has the ability to use any and all strategies as appropriate and maybe even to create some new strategies in developing a solution to a problem.

CRITICAL THINKING ASSESSMENT

There are two primary critical thinking assessments. The first assessment, the Watson-Glaser Critical Thinking Appraisal (WGCTA), is designed to evaluate a critical thinker's ability to solve problems, reason deductively, evaluate arguments, make inferences, and conduct interpretations. The second is the Halpern Critical Thinking Assessment (HCTA). Similar to Halpern's taxonomy, this assessment is designed to test students' critical thinking skills within the context of real-world situations. For example, test takers might be asked to evaluate an argument that if the Immigration Office changes one country's immigration quota, then it will have to change the immigration quota for all other countries. The objective of this particular example is to see if the person recognizes the slippery slope fallacy being used by the Immigration Office.

Critical thinking is a process that requires the conscious awareness of a person's ability to recognize the cognitive strategies and skills that he or she can use appropriately. Metacognition is the monitoring of one's own cognition and capabilities. In explicitly teaching students critical thinking strategies through a skills-based approach, they will be directed through the developmental stages of intellectual development. The result is a critically conscious citizen whose decisions will have a higher probability rate of being informed and judicious.

SEE ALSO *Cognitive Strategies; Reasoning.*

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CRONBACH, LEE
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1916–2001

Lee Joseph Cronbach was born in 1916 in Fresno, California. He graduated from high school at the age of 14 and from college at the age of 18. He earned a Bachelor of Arts degree from Fresno State's teacher's college, and a master's degree from the University of California.

After a fast-paced doctoral training in educational psychology at the University of Chicago, he joined the psychology faculty at Washington State College in 1940, where he taught his first courses in evaluation and measurement, and wrote the first edition of *Essentials of Psychological Testing* (1949). During World War II he worked as a research psychologist at the U.S. Navy's sonar school in San Diego. In 1948 he accepted a joint appointment in education and psychology at the University of Illinois, Urbana. He returned to California in 1964 to join the faculty of Stanford's School of Education, where he remained until his retirement in 1980. He died on October 1, 2001, at the age of 85.

Cronbach was president of the American Educational Research Association, the American Psychological Association, and the Psychometric Society. He was a member of the National Academy of Sciences, the National Academy of Education, the American Philosophical Society, and the American Academy of Arts and Sciences. He received many honorary degrees.

ISSUES IN MEASUREMENT

Cronbach's early work on measurement led to the "Coefficient Alpha" paper (Cronbach, 1951), which provided a widely used formula for estimating the reliability of test scores. Later he developed generalizability theory (Cronbach, Gleser, Rajaratnam, & Nanda, 1972) that examined systematic variations in test performance, and provided techniques for assessing the relative influences of various aspects or facets of the testing procedure. The theory provided important guidance for test developers on matters such as the number of items or the optimal allocation of raters.

Cronbach and Meehl's 1955 study established the centrality of validity considerations in testing, and "construct validity" as a unifying theme for interpreting test scores. Whereas traditional approaches to test validity were limited to examining test content or simple correlations with other variables, construct validation was to build a firm, rigorous theoretical basis for score interpretation. Cronbach also drew attention to the plurality of points of view, values, and beliefs for test developers, users, and policy-makers as essential ingredients in the process of test validation.

THE INTERACTIONIST APPROACH

Cronbach (1957, 1975) argued that the rift between experimental and correlational psychologies artificially separated the learner from the learning environment. He maintained that aptitudes—individual differences in response to educational treatments—were as important to understanding and improving educational programs as the typical response or average program effect. In earlier work (Cronbach & Gleser, 1957) on personnel-decision theory he and his colleague concluded that optimal placements must acknowledge the interaction of personal characteristics and job demands. His work on aptitude-treatment interactions (ATI) sought to demonstrate the potential benefits of matching the right type of instruction to students' abilities, motivations, and interests (Cronbach & Snow, 1977; Corno, et al., 2002). His efforts to discover general propositions about who would benefit from alternative methods of teaching and how learning environments could be designed to maximize benefits for all students, led him almost two decades later to suggest a radical shift in the goals of social science research toward a more contextualized inquiry (Cronbach, 1975). He sharpened the sensitivity of educational researchers to the ways different learners cope with the demands and affordances imbedded in different learning environments, and he advocated the use of intensive local studies and field methods that produced rich narratives of teaching and learning.

PROGRAM EVALUATION

Cronbach built on the ideas of Ralph W. Tyler (1902–1994), about how teachers should fashion their instruction to fit their students' needs, to pioneer the movement of “formative evaluation”—the idea that assessment is not a yardstick against which students should be measured and ranked but a feedback tool to stimulate teachers' efforts to improve instruction. He saw the evaluator as an educator informed by empirical studies rather than as an impartial observer submitting a verdict and drafting a correctional order. For him, evaluation was a pluralist, inclusive, and open-ended inquiry, sensitive to unexpected issues or unforeseeable events, even if such real-time adjustments spoiled the scientific elegance of the study.

Cronbach led the Stanford Evaluation Consortium, a multidisciplinary group whose work was summarized in a volume published in 1980 (Cronbach and associates, 1980). Two years later, Cronbach published his own book on program evaluation (Cronbach, 1982), in which he argued that the academic study of human affairs is not an exercise in abstraction. Research programs, he claimed, are valuable to the extent they serve the purpose of improving some aspect of the social reality.

SEE ALSO *Reliability*.

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Haggai Kupermintz

CROSS-SECTIONAL RESEARCH DESIGNS

When psychologists want to investigate age differences between groups of children, they frequently use a cross-sectional design (Creasey, 2006; Miller, 2006). In a cross-sectional design different children at different ages are assessed at the same time. For instance, if one were interested in the development of arithmetic abilities, different groups of children at ages 4, 5, 6, and 7 could be given tests that assess addition and the strategies children use to arrive at their answers. In a very brief time the test giver would have an idea of how this important skill changes with age. (If the researcher used a longitudinal design, in which the same children were tested repeatedly over time, it would take them four years to get the same information.) The intent of a cross-sectional design is to allow psychologists to efficiently describe change over time and to identify the various mechanisms associated with those changes.

Cognitive strategies—the deliberate plans children use to organize their problem solving—have been studied extensively in developmental psychology using cross-sectional designs (Bjorklund, 2005). For example, Jane Gaultney (1998) investigated the use of memory

strategies in third-, fourth-, and fifth-grade students with and without learning disabilities. Specifically, she examined the degree to which children organized their recall of related items (e.g., sorting and later recalling together items from the same semantic category) and the extent to which such strategy use benefited their memory performance. She found that typically developing children benefited more from the use of strategies than children with learning disabilities. This difference increased with age and was due to the lack of progress by older children with learning disabilities. Her research also showed that children with learning disabilities experienced more benefit when they used strategies to study items for later recall, whereas typically developing children benefited most from strategies when actually recalling the items. Such an approach identifies potentially important age differences in children quickly and provides some insights into the specific problems children of different ages and abilities have.

CONDUCTING RESEARCH FROM A DEVELOPMENTAL PERSPECTIVE

The use of cross-sectional designs in education implicitly involves a concern for age differences, and this awareness implies an interest in development. A developmental-psychological perspective is concerned with age-related changes and the factors associated with those changes. The deeper issues of how, when, and ultimately why psychological change takes place shape the formulation of research questions, which in turn influence the methods chosen to answer these questions.

While the importance of measuring age-related change should not be underestimated, it is often the normative, or perhaps even more critical, non-normative influences associated with change that most interest developmental and educational psychologists. A broad holistic view of development leads to questions about children's thinking in both social and academic environments that can lead to techniques for enhancing education (Teti, 2006; Bergman et al., 2000).

FACTORS INVOLVED IN CONDUCTING CROSS SECTIONAL STUDIES

Several factors must be taken into account in conducting a study using a cross-sectional design. For instance, if researchers are interested in the development of scientific reasoning in school-age children, they can design a study in which groups of children are given problems to solve requiring reasoning associated with (a) developing an hypothesis, (b) deciding how to test the hypothesis, (c) collecting data, and (d) evaluating the hypothesis. Questions immediately surface regarding how they might go

about conducting such a study and what pitfalls they must avoid in order to make sure the results of their study are interpretable.

In such a study researchers must ensure that each age and experimental group is balanced in terms of important demographic characteristics. For example, in the study of scientific reasoning, they may give children in grades 3 through 8 different types of science instruction or different textbooks to read. They would need to balance the age and instruction groups for gender. They would need to consider if children from different age groups are from different schools, and if so if the schools differ in any important way, such as socio-economic status (SES) or quality of instruction. Also, they would consider if the children in the various grades or instruction groups differ in academic abilities, motivation, or previous knowledge of the subject matter in any systematic way. Academic and developmental differences are often associated with gender, SES, motivation, and a host of other factors. Researchers may be interested in how these factors affect scientific reasoning, but in order to interpret unambiguously any age or instruction differences they may find in their study, they have to insure that their groups are balanced, as much as reasonably possible, in terms of demographic and related factors.

Another consideration when doing cross-sectional research is the tasks children in each group perform. These tasks should be age-appropriate, so they are not too difficult for the youngest children or too easy for the oldest. Researchers must check that the wording of the problems is comprehensible to children of all ages to be tested. Once they have decided what tasks they are going to give children, they have to decide how to administer them. Children in each group should be tested in a similar fashion. However, because of differences in the social, emotional, and particularly cognitive abilities of children of different ages, it may not be possible to use the identical procedures with all children. What is important is that children of all ages understand the task and what they are supposed to do. As a result, testing procedures may have to be varied to ensure that both younger and older children understand the tasks, but not varied so much as to make the tasks qualitatively different for children of different ages. For example, it is possible to read or rephrase directions, or even use pictorial representations of the directions, to help younger children understand the expectations of the task. Robust results from research are predicated on ensuring that attention is given not only to the design of the study, but also to the manner in which the research design is implemented.

USING CROSS SECTIONAL DESIGNS AND OTHER RESEARCH METHODS

Cross-sectional designs can be used in conjunction with both experimental and correlational studies. Experimental research is the gold standard for answering questions about cause-and-effect relationships. Experimental studies involve the manipulation of one or more factors, or variables, and observation of how these manipulations change the behavior under investigation. For example, Schwenck, Bjorklund, and Schneider (2007) were interested in factors that influence memory strategy development in groups of first- and third-grade children. To assess these factors, they gave some children instruction in strategy use on some trials, whereas others received no such instruction. They also varied the type of materials that children were asked to remember, including items that were either typical of their category (e.g., shirt, dress, pants for clothes) or atypical of their category (e.g., socks, tie, belt for clothes). They found age differences not only in how well children of different ages remember, but also in children's abilities to benefit from strategy training. For instance, older compared to younger children required less explicit prompting to use a strategy, were more likely to use a strategy when atypical category items served as stimuli, and generalized a strategy to new sets of words. They also identified differences in children's tendencies to use a strategy but not to experience any benefit in recall, termed a utilization deficiency, something important to educators concerned with teaching strategies in the classroom.

In correlational studies researchers make comparisons between two or more variables. Keep in mind that identifying a relationship between two variables does not imply causation, but if a relationship does exist, further understanding may be gained by pinpointing the nature of the relationship and then conducting experimental studies. Cross-sectional designs have been used in correlational studies leading to understanding about different developmental trends in the use of reading strategies for children with different levels or styles of learning aptitudes (see Gaultney, 1998). For example, in one study (Siegel & Ryan, 1988), researchers compared the phonological processing (specifically, reading pronounceable pseudowords such as *blurt*) of 7- to 14-year-old children with and without reading disabilities. Both groups of children showed marked improvement in pseudoword reading with age, although at each age tested, children with reading disabilities performed significantly worse than typically developing children. In fact, the pseudoword reading of 13- to 14-year-old reading-disabled children was comparable to that of their 7- to 8-year-old typically developing peers.

CONTRIBUTIONS TO TEACHER PRACTICE USING CROSS SECTIONAL DESIGNS

A prominent myth exists that practitioners, most notably teachers, have no need for an understanding of research. The poor transfer of scientific research findings to application in the classroom creates a void between empirical inquiry and classroom-based practices. In short, teachers must be able to understand the meaning of research findings and how to incorporate the results into pedagogical practices. This transfer of knowledge poses a challenge for many teachers who may need more than simple exposure to the research literature in order to make fundamental change. The challenge to teach essential knowledge and foster skill development in children is the primary responsibility of the classroom teacher. It is critical that teachers be able to pose and ultimately answer questions about important aspects of the teaching and learning process. Evaluating the outcomes of schooling based solely on students' abilities to engage in particular skills is clearly an inadequate approach to gain an understanding of the entire schooling process. There is no paucity of variables one must take into account when investigating why and how children make academic and social progress, and equally as important are the factors that account for failure to make adequate progress. A holistic view of the full teaching and learning process is necessary to account for the mechanisms underlying learning, and this often involves an ability to interpret the findings of developmental/educational research and sometimes to perform simple studies.

Research is not the enemy of teachers, and it is possible to structure research that can help answer some of the most salient questions about teaching and learning. There is common ground between researchers and teachers. Each group desires to answer questions about children's ability to learn content and develop skills. For many teachers, the daily grind of classroom instruction is reason enough to shy away from any sort of formal inquiry into the teaching and learning process, but it is exactly these daily routines that provide a rich source of potential issues from which to gain further insight. The cross-sectional design is a relatively accessible approach that can be used in the classroom to answer questions about how children change with age in regard to a particular ability or process and how children of different ages respond to different types of instruction. The following paragraphs provide an example of a cross-sectional study that a classroom teacher could conceivably implement, beginning with the formulation of a research question to the execution of the project.

EXAMPLE OF A CROSS SECTIONAL STUDY

Formal inquiry begins with the generation of questions about instruction and student learning. From here, the challenge is to isolate a particular aspect of the process that warrants attention. Research is most easily facilitated with a clear focus. For example, a teacher may wonder about how students benefit from the use of reading-comprehension strategies to recall information from a science textbook. Perhaps there are age differences in children's ability to benefit from using reading-comprehension strategies that can be traced using a cross-sectional design.

After formulating the research question, it is then necessary to identify groups of children to participate in the study and to determine what, if any, experimental groups teachers want to include. They may decide based on the science curriculum at their school that children much below grade 3 would be too young and children much beyond middle school would be too old for the questions they wish to ask. In the present example, they may include at each grade tested an experimental group that gets special reading-comprehension strategy instruction, as well as a control group that gets standard classroom instruction or perhaps some extra time with the teacher to balance for the amount of teacher-time children in both groups receive. (They may also want to test special groups of children, such as those with learning disabilities, slow readers, or those from less-advantaged homes, and compare them to typically developing children, but the design can be kept simple for this example.) When identifying groups of participants, it is important to recruit approximately equal numbers of boys and girls and to ensure that the different ages and instructional groups are balanced for other factors that may influence children's performance, such as academic achievement and SES.

The next step is to determine the measurement for the study. In this case, the teachers would need to develop or identify a reading-comprehension strategy that they could teach to their participants (likely obtained from the research literature) and a measure to identify whether using such a strategy works, that is, enhances recall of science-text content. They may be able to use tasks already used in the classroom, for instance, questions taken from the science text or teacher-made questions. They want to make sure that the questions are age-appropriate and that the testing methods are similar across ages.

Based on such an experiment, they may find that whereas third-grade children can implement the reading-comprehension strategy, the students tend not to generalize it to new texts and perhaps experience only minimal improvement in recall from its use. In contrast, older children not only use the strategy but also generalize it to new texts and experience substantial recall benefits from

its use. Such findings would help in the development of different types of instruction for children of different ages and perhaps cause teachers to ask more questions about what it is about the reading-comprehension instruction that works (or does not work) for children of different ages. Of course, there are a number of possible outcomes from such a study, but the point here is that one is able to get an idea of how strategy use is developed and then make a determination of which strategies to use and when.

Cross-sectional designs permit researchers or teachers to collect quickly information about age changes in some ability. However, in order to assess true developmental change, longitudinal approaches, which test the same children over time, are necessary. Such studies are not out of the question for classroom teachers. For example, the assessment of reading-comprehension strategy instruction on children's recall of science information could be performed once in November and again in May to see if individual children make improvements over the course of the school year.

Research has not always been held in high regard or maintained a prominent place in the typical classroom. This does not have to be the case if research studies are designed to be easily understood and implemented in the classroom. Teachers typically reflect on the teaching and learning process, and the use of research designs simply allows these questions to be tested and better understood.

SEE ALSO *Longitudinal Research; Research Methods: An Overview.*

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SEE *Classical Test Theory*.

CULTURAL BIAS IN TEACHING

Cultural bias in teaching can be described as teachers and administrators holding the belief that the dominant or mainstream (presumably European and North American) cultural ways of learning and knowing are superior to ways of learning and knowing that do not reflect such a culture. Historically, the research on cultural bias in teaching and learning can be traced back to the research of Lev Vygotsky (1896–1934) and Alexander Luria (1902–1977). Both psychologists launched research programs determining the cultural bias inherent in evaluators' critique of young children's problem-solving strategies.

Throughout their work, it was uncovered that many mainstream evaluators would render impoverished Soviet children's responses to cognitive tasks incorrect (Vygotsky, 1978). However, according to Vygotsky and Luria, this evaluation oftentimes reflected the evaluator's cultural frame of reference. That is, the evaluation of the correct response was found to be a) biased towards a set of culturally aligned ways of thinking, knowing, and problem-solving, and b) biased against alternative, cultural ways of thinking, knowing, and problem-solving. Work in the late 1990s and early 2000s has shown that cultural bias continues to inform the ways individuals evaluate student performance (Baker, 2005; Ndura, 2004).

PREVALENCE OF CULTURAL BIAS IN EDUCATION

For many education researchers, cultural bias in teaching is evidenced within various academic texts and modules across multiple academic domains (Baker, 2005; Loewen, 2007). Particularly in the United States, several researchers agree that most contributions to academic subject matter (i.e., history and social and natural sciences) are made by members of the majority race or culture (American Psychological Association, 2003; Gay, 2000; Rogoff, 2003) and much of the text throughout this

subject matter is used to reinforce the superiority of this group (Loewen, 2007). Loewen (2007), for example, offers that most elementary and secondary U.S. history textbooks offer a romanticized view of the Europeans' experience in the United States whereas most of the experiences of Native Americans and/or Africans in these same lands are either misrepresented or underrepresented. He and others have also noted that many of these texts have continued to marginalize the achievements and significant traditions of many ethnic minority populations living in the United States (Howard, 1999; Loewen, 2007). Other works have shown that additional academic domains such as the natural sciences and English also promote a U.S./European ideological focus (e.g., Solano-Flores & Nelson-Barber, 2001).

In addition to cultural bias found throughout public school curricula and standardized testing, cultural bias is believed to be salient throughout the instructional practices promoted and executed by school teachers and administrators (Boykin, Tyler, & Miller, 2005; Gay, 2000; Nieto, 2001). Here, cultural bias beliefs sanction as appropriate certain forms of classroom behavior, including the manner in which a student is to perform and learn during class time. An example of cultural bias in classroom practices is reflected in the belief that learning must occur in a controlled environment, where students are seated independently and working quietly on a singular task and are only to interact and correspond to the instructor (Gay, 2000). For many, these activities reflect a mainstream cultural perspective (Gay, 2000; Howard, 1999; Nieto, 2001).

These same works have also claimed these learning behaviors and activities are inconsistent with the varied and cultural-laden learning experiences many ethnic minority students have outside the classroom. Some of these experiences reflect communalism or interdependence along with verve or the presence of and adherence to multiple and simultaneous activities (Boykin, Tyler, Watkins-Lewis, & Kizzie, 2006; Gay, 2000). Despite the salience of these learning activities that display an alternative cultural worldview, many classroom teachers continue to promote learning and instructional practices that reveal an adherence to a mainstream ideology or worldview (Boykin, Tyler, Watkins-Lewis, & Kizzie, 2006; Tyler, Boykin, & Walton, 2006).

Thus, cultural bias in teaching occurs when classroom instruction, learning activities, materials, and lessons largely reflect the contributions and/or cultural values and perspectives of the majority race or culture. In the United States, that race is White, Caucasian, or European American, and the culture is largely mainstream oriented (Strickland, 2000). In most classrooms with predominantly ethnically and culturally diverse

students, cultural bias is also presented as an inherent promotion of the perceived superiority and effectiveness of mainstream cultural modes of learning, thinking, and performing (APA, 2003).

An explicit example of cultural bias in classroom learning and thinking is found in the work of Perry and Delpit (1998). The researchers report a study in which African American students' responses to test items were evaluated. One test item showed a man standing, wearing a suit and carrying a briefcase. Students in the study were asked about the destination of the man in the picture. Perry and Delpit (1998) reported that the test writers concurred that the correct answer was that he was going to his place of work or business. It was reported, however, that many of the African American children thought the man was going to church.

Perry and Delpit (1998) argued that the African American students' response reflected aspects of their cultural background. Specifically, within their communities, men dressed in suits and carrying briefcases are typically going to church. Yet, from a mainstream cultural perspective, this response is deemed incorrect. Students were to observe that the suited man carrying a brief case is going to work and not church. For Perry and Delpit (1998), however, marking the African American students' responses incorrect reveals bias toward a knowledge base rooted in a North American or mainstream cultural value system. It also shows bias against knowledge emerging from an alternative, albeit equal cultural value system. Other works support these claims (Baker, 2005).

CULTURAL DISCONTINUITY

What results from these culturally biased beliefs is an in-school cultural socialization process in which ethnically and culturally diverse students are exposed to instructional practices and learning activities that do not reflect their cultural-laden modes of learning and knowing. In fact, their adherence to more mainstream culture-based classroom practices is oftentimes, imposed and coerced. Some evidence exists to support each of these claims (Tyler, Boykin, Miller, & Hurley, 2006; Boykin, Tyler, Watkins-Lewis, & Kizzie, 2006; Tyler, Boykin, & Walton, 2006). The result of this in-school socialization process is cultural discontinuity.

Cultural discontinuity is defined here as a school-based behavioral process in which teachers and administrators are a) active in promoting adherence to classroom curricula and classroom learning and instruction that reflect mainstream or European and/or North American cultural values, and b) active in diminishing preferences for and practices of learning modes and practices that reflect the indigenous cultures of ethnically and culturally diverse students. While Ogbu (1982) charged that all

students experience home-school discontinuities throughout their schooling experiences, such discrepancies are considered more pronounced for ethnically and culturally diverse students (Gay, 2000; Nieto, 2001). For these students, home-school cultural discontinuity emerges from cultural bias in teaching.

In particular, the values and behavioral preferences of many ethnically and culturally diverse students are discontinued in classrooms because of a) the bias held for mainstream cultural norms and values in public school classrooms, and b) the bias held against those cultural norms and values brought to such classrooms by ethnically and culturally diverse students. Specifically, it has been suggested that most ethnic minority students emerge from households that maintain several culturally aligned practices and behaviors that do not reflect a mainstream ideology, but rather aspects of their indigenous cultures (Gay, 2000; Howard, 1999; Nieto, 2001; Vygotsky, 1978). For these students, it is often difficult and undesirable to abide by a set of behaviors that do not reflect their indigenous culture or cultures (Boykin et al., 2006).

Yet due to cultural bias in teaching, where there is an apparent adherence to mainstream forms of thinking, learning, and behaving (Howard, 1999; Loewen, 2007), ethnically and culturally diverse students often have to discontinue learning behaviors and activities that reflect aspects of their home or indigenous culture. In fact, they are often told to replace these indigenous cultural value-laden behaviors with classroom practices and behaviors reflective of mainstream cultural values. Not doing so often leads to misperceptions of students' learning abilities and in some cases, recommendations for in-school remediation and/or psychological services (Baker, 2005).

RESEARCH ON CULTURAL BIAS AND CULTURAL DISCONTINUITY

Some research corroborates the claims that cultural bias beliefs and cultural discontinuity practices are part of the classroom realities for ethnically and culturally diverse students (Gay, 2000; Nieto, 2001). Regarding low-income African American students, research conducted by Wade Boykin and associates has determined that many classroom teachers are biased toward mainstream ways of learning and instruction. For example, in one study, classroom teachers were asked to respond to a questionnaire assessing their endorsement of mainstream and alternative ethnocultural classroom practices. Teachers reported significantly higher reports of classroom practices that reflected mainstream cultural values (i.e., competition and individualism) than those practices that reflected students' alternative ethnocultural values such as communalism and *verve* (Boykin, Tyler, Watkins-Lewis, & Kizzie, 2006).

Another study asked teachers to report their perceptions of the academic motivation and achievement of hypothetical students displaying either mainstream or alternative ethnocultural classroom practices. Teachers read a scenario depicting a student engaged in classroom learning in one of four culturally aligned ways. Teachers then completed a scale assessing their perceptions of the student's motivation and academic performance. Motivation and achievement ratings were significantly higher for hypothetical students displaying mainstream cultural classroom practices than those students displaying alternative ethnocultural classroom practices (Tyler, Boykin, & Walton, 2006). Together, these two studies show that many teachers of low-income African American students hold biases for mainstream cultural practices in the classroom. Moreover, the findings indicate that such biases also inform how teachers perceive and evaluate students displaying alternative ethnocultural values.

In addition to research illuminating the presence of cultural bias towards mainstream cultural values and practices, other work has determined that many ethnically and culturally diverse students experience cultural discontinuity throughout their schooling experiences (Gay, 2000; Nieto, 2001; Rogoff, 2003). Some evidence suggests that low-income African American students actually prefer classroom learning in ways that reflect their indigenous cultural values (Tyler, Boykin, Miller, & Hurley, 2006). Other works have determined, however, that these students are not allowed to carry out academic tasks in these culturally specific ways.

For example, in one qualitative study, 21 classroom teachers maintained classroom practices and instructional styles that largely reflected mainstream cultural values. Observations of classroom practices reflecting alternative ethnocultural values were marginal (Boykin, Tyler, & Miller, 2005). In another study, African American students reported that they would be disciplined at school for displaying classroom behaviors reflecting alternative ethnocultural values. The cultural values in question were communalism or interdependence and verve or simultaneity. These same behaviors and values, though not allowed in school, were permissible in their households (i.e., working in groups or listening to music while working). Moreover, the participants indicated that they would not be disciplined at school for displaying classroom behaviors reflective of mainstream cultural values. These students did, however, indicate that they would get in trouble for displaying mainstream cultural values at home (Tyler, Boykin, Miller, & Hurley, 2006). Together, these and other works corroborate the claim that cultural discontinuity is part of the classroom learning experiences of many ethnically and culturally diverse students, particularly African

American students (Gay, 2000; Nieto, 2001; Rogoff, 2003)

REDUCING CULTURAL BIAS IN TEACHING AND CULTURAL DISCONTINUITY

Although the specific effects of cultural bias and cultural discontinuity on student outcomes have not been studied empirically, the literature is replete with examples of ways to reduce cultural bias and cultural discontinuity. To begin, a reduction of cultural bias and cultural discontinuity requires teachers to establish and maintain classroom environments in which the emotional, social, cognitive and cultural needs of all students are met (Brown, 2004). The term *culturally responsive teaching* is commonly used by researchers to describe an environment in which teachers respond appropriately to the diverse learning experiences and culturally situated behavioral preferences of learners in their classroom (Brown, 2004).

One of the major factors emphasized in achieving a culturally responsive classroom is that teachers and administrators examine their own biases regarding what is and is not appropriate classroom behavior. Prior to acknowledging and using the cultural values and belief systems of ethnically and culturally diverse students, teachers may profitably engage in self-reflection in order to gain understanding of their own cultural biases in teaching (APA, 2003). Also integral to this reflective process is the teachers' understanding of how these biases towards mainstream culture may impact the type of instruction they engage in, the classroom learning activities they sanction, and the evaluation of their students.

For many, reducing cultural bias in teaching requires teachers to become more aware of themselves as cultural beings (APA, 2003). Teachers must be more cognizant of their own biases towards specific cultural values before they begin to acknowledge and use the cultural values of others. Such self-reflection aids in the development of positive attitudes towards the cultural values and learning styles of ethnically and culturally diverse students. These positive attitudes, then, become the precursor to aligning curricula and classroom activities with the cultural values and behaviors of ethnically and culturally diverse students. For example, Phuntsog (2001) found that teacher attitudes toward cultural value diversity were important factors in their willingness to create culturally responsive classrooms. Indeed, self-reflection of the culturally based teaching practices and beliefs is considered an essential first step toward establishing a culturally responsive learning environment and reducing cultural bias in teaching (Gay, 2000).

TEACHER CARING

In addition to self-reflection as a way to reduce cultural bias in teaching, some researchers have suggested more interactive practices that can help teachers respond more appropriately to culturally and ethnically diverse students. One such practice is *teacher caring*, a term that refers to a set of teacher-initiated practices that promote strong interpersonal bonds between teachers and their students (Rogers & Webb, 1991). Research has shown that students' reports of teacher caring contribute to perceptions of teacher effectiveness, academic effort, and academic success (Perez, 2000; Ware, 2006). In a study of classroom management strategies and culturally responsive teaching, Brown (2004) identified a caring attitude as a major teacher-centered characteristic that facilitated the interaction with ethnically and culturally diverse students. For many, a teacher who cares about students will not display biases against the students' distinct cultural values. Instead, the teacher finds ways to use these cultural values throughout classroom practice (APA, 2003; Gay, 2000; Nieto, 2001; Rogoff, 2003).

One way that teacher caring is demonstrated with ethnically and culturally diverse students is through the adoption of warm demander pedagogical styles. A teacher who is a warm demander maintains a classroom environment in which students feel respected and are respectful of the instructor's directions and rules. That is, the teacher cares about the students and does so in a manner that maintains the teacher's position in the classroom as the authority figure (Ware, 2006). Warm demander characteristics displayed in the classroom have been shown to enhance the social and academic experiences of ethnically and culturally diverse students, particularly low-income African American students (Gay, 2000). These characteristics also reflect the typical caretaker-child dynamic many ethnically and culturally diverse students are exposed to during their out-of-school socialization (Brown, 2004). Regarding African American students, promoting warm demander pedagogy has been shown to enhance their schooling experiences, particularly by reducing their exposure to classroom-based cultural discontinuity practices (Ware, 2006).

In addition to teacher-based characteristics and activities that can reduce cultural bias and cultural discontinuity at school, some research has shown that incorporating aspects of ethnically and culturally diverse students' cultural values into academic tasks and lessons actually facilitates their performance (Serpell, Boykin, Madhere, & Nasim, 2006). Other works have shown that utilizing these cultural values can foster greater communication in the classroom, greater task engagement, increased responsiveness to teacher expectations and instruction, and enhanced academic performance (Gay, 2000; Nieto, 2001; Rogoff, 2003).

In all, these studies provide practical suggestions that teachers can use to reduce cultural bias and cultural discontinuity in their classrooms. For instance, constructing classroom lessons and activities that build upon the cultural values of ethnically and culturally diverse students reduces cultural discontinuity as students are no longer asked to forego their culturally aligned learning practices and preferences. Many of the cited research studies have indicated that these culturally aligned practices enhance student performance outcomes. Thus, classroom teachers can use these in an effort to reduce cultural discontinuity and promote optimal performance among ethnically and culturally diverse students.

Moreover, the demonstrated effectiveness of these culturally situated practices aids in the reduction of cultural bias in teaching. Specifically, classroom teachers using culturally responsive pedagogical practices are exposed to instructional practices and learning activities that do not solely reflect a mainstream cultural value system. Rather, many of these practices reflect the cultural values and customs of many ethnically and culturally diverse students. The fact that these practices and activities have proven to be beneficial to these students gives teachers alternative instructional practices to consider in class. Using them can result in the broadening of classroom teachers' understanding of what works best for this student population. Considering alternative instructional practices and knowledge sources also reduces cultural bias in teaching.

SEE ALSO *Cultural Bias in Testing; Culturally Relevant Pedagogy; Vygotsky, Lev Semenovich.*

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CULTURAL BIAS IN TESTING

Any book that focuses on psychology is incomplete without a discussion of testing, including the topic of test bias. Psychologists, more than professionals in other disciplines, are the primary administrators of intelligence tests,

with schools being the primary user. In the high-stakes testing of the early 2000s, employment opportunities, high school graduation, grade promotion, college admission, gifted education placement, and special education placement rely extensively on test results. Thus, the discussion of how tests impact the decisions of test users and the opportunities of those tested is by no means insignificant. Stated another way, "an intelligence test is a neutral, inconsequential tool until someone assigns significance to the results derived from it. Once meaning is attached to a person's score, that individual will experience many repercussions, ranging from superficial to life changing. These repercussions will be fair or prejudiced, helpful or harmful, appropriate or misguided depending on the meaning attached to the test score" (Gregory, 2004, p. 240).

Regarding intelligence tests, this entry presents an overview of issues surrounding test bias primarily related to African Americans. It defines bias, gives examples of test bias, and recommends ways to reduce bias. Two caveats are in order. First, clearly test bias is not unique to African Americans, but the bulk of research and discussions focus on this group. Thus, the focus here on African Americans is not a slight to other culturally and linguistically diverse (CLD) groups. Second, different types of tests exist beyond intelligence tests—aptitude, achievement, career/vocational—and they are not exempt from discussions about bias. However, the focus here is specifically on bias regarding intelligence tests, as this is the most controversial type of test. One complication is that intelligence tests and the meaning attached to the word *intelligence* carry more significance than those associated with achievement tests. Intelligence tests (also called cognitive ability and ability tests) are often associated with genetic endowment and capacity, while achievement tests are more often associated with learning opportunities and educational experiences—the environment and their effect on test performance. As Gregory (2004) noted, beyond a doubt, no practice in modern psychology has been more assailed than psychological testing. Commentators reserve a special and often vehement condemnation for ability testing in particular. Additionally, Jensen (1980) contended that test bias is the most common rallying point for critics.

The test bias controversy and debate has its origins in the observed differences in average IQ scores between various racial groups (Blacks) and ethnic groups (immigrants) in the early 1900s (Cole & Zieky, 2001). Specifically, several studies indicate that African Americans score, on average, 15 points lower than their White counterparts on traditional intelligence tests—tests with high linguistic/verbal and cultural loadings (Flanagan & Ortiz, 2001). This finding of differential group test score performance in intelligence heightened the controversy

over test bias (Gregory, 2004). Under scrutiny have been all versions and editions of traditional intelligence tests, including the Wechsler tests (e.g., WISC-IV, WAIS, WPPSI), the Binet tests (e.g., Stanford-Binet, Binet-IV), Otis Lennon School Aptitude Test, and Peabody Picture Vocabulary Test. Non-verbal intelligence tests have also been examined for bias (e.g., Ravens Progressive Matrices; Naglieri Non-Verbal Intelligence Test) (e.g., Bracken & Naglieri, 2003).

In addition to coming under professional scrutiny, intelligence tests have been challenged legally. One of the most famous cases is *Larry P. v. Wilson Riles* (1979) in which 9th U.S. District Judge Robert F. Peckham in California ruled that intelligence tests used for the assessment of Black children for special education classes for the educable mentally retarded are culturally biased. One year later, Judge John F. Grady in Illinois ruled in *Parents in Action in Special Education v. Joseph P. Hannon* that intelligence tests are not racially biased; they do not discriminate against Black children. Set one year apart, the opposing positions of these two cases helped to create or sustain the debates that continued into the early 2000s.

POSITION 1: INTELLIGENCE TESTS ARE BIASED

Opponents of using intelligence tests with Black and other CLD groups often focus on the social and educational consequences—fairness and disparate impact. The primary argument and belief is that persons from backgrounds other than the culture in which the test was developed will always be penalized; they will likely score lower on the test and, thus, have their opportunities limited and face misinterpretations about their worth and potential (academically, as students, as employees, etc.). They argue that too few intelligence tests have been normed with representative numbers (not just percentages) of CLD populations. Therefore, the test scores are not valid and reliable for them, rendering the test inappropriate to use. This argument or position also applies to topics other than race and ethnicity. For example, if few in the norming group are low income or linguistically diverse, then the test is viewed as inappropriate and potentially useless and harmful to that group. Further, if few gifted students or students with learning disabilities were in the norming group, the test's usefulness for them is questionable (Ford, 2004, 2007).

Recognizing that Black students in particular were and are negatively affected by their test performance or scores, the Association of Black Psychologists (Williams, 1970) charged that Black students were/are subsequently denied many educational opportunities; they charged that intelligence tests are not valid measures for Black students and that they are more harmful than helpful.

This notion of tests being harmful goes against the principles of fair and equitable testing, a key feature of professional testing standards (e.g., American Psychological Association, American Educational Research Association, National Council on Measurement in Education, 1999). Simply put, tests should be used to help not harm; they should benefit the test taker.

POSITION 2: INTELLIGENCE TESTS ARE NOT BIASED

Proponents of intelligence tests maintain that tests are valid and reliable tools for all groups. According to Armour-Thomas and Gopaul-McNicol (1998), support for this position falls into at least three categories or assumptions: (1) tests are culturally fair and items do not favor a particular cultural group; (2) the tasks assess the cognitive abilities underlying intellectual behavior for all groups; and (3) the tests accurately predict performance for all groups.

It is also important to note that test construction is grounded in the assumption of homogeneity and equal opportunity to learn and acquire knowledge and experiences (Armour-Thomas & Gopaul-McNicol, 1998; Flanagan & Ortiz, 2001), meaning that (a) the test items measure the everyday experiences of populations and (b) everyone has had an equal opportunity to learn and be exposed to the tasks in the tests and its format (Ford, 2004). Essentially, it is believed that tests are not discriminatory.

TEST BIAS DEFINITIONS: TECHNICAL AND SOCIAL DEFINITIONS

It is important to keep in mind that tests are often viewed as being biased against Black and other culturally and linguistically diverse groups, and against low-income students, but biased in favor of White and middle class students. Gregory (2004) defined test bias as “objective statistical indices that examine the patterning of test scores for relevant subpopulations” (p. 242). He adds that consensus exists about the statistical criteria that indicate when a test is biased. A review of definitions indicates that test bias can be categorized in two ways: technically and socially. Technically, test bias refers to differential validity for definable, relevant subgroups of persons (Sattler, 1992, p. 616). Hence, a test would be considered biased if the scores from subpopulations did not fall upon the same regression line or a relevant criterion.

Bias is present when a test score has meanings or implications for a relevant, definable subgroup of test takers that are different from the meanings or implications for the remainder of test takers. Thus, bias is the differential validity of a given interpretation of a test

score for any definable, relevant subgroup of test takers (Cole & Moss, 1998, cited in Gregory, 2004, p. 242). When a test is biased, from a social or social values viewpoint, the concern relates to denial of opportunity and the false negative hypothesis. Two other terms or concepts are relevant to discussions regarding testing CLD groups. It can be argued that while a test might not be biased technically, it can still be unfair (see Cole & Zieky, 2001). Test fairness is fundamentally about the social consequences of test results (Gregory, 2004, p. 249; Hunter & Schmidt, 1976). Test fairness is the extent to which the social consequences of test usage are considered fair or unfair to relevant subgroups; test fairness is especially important to consider when used for selection or placement decisions. From a legal point of view, this is related to the notion of disparate impact (see *Griggs v. Duke Power*, 1971). If a test negatively affects opportunities for a group to participate in, for example, gifted education, then it has a disparate impact and should not be used. Out of *Griggs v. Duke Power* came the fundamental question: "If a group consistently performs poorly on a test, why do we continue to use it?"

TYPES OF BIAS

Fundamentally, all concerns about bias relate to differential performance between and among groups. Why does one group perform differently than another group (Black /CLD or White, female or male, high income or low income) on a consistent basis? Attempts to account for differential performance target the individual characteristics of examinees, the testing environment, and/or characteristics of the test or test items (Scheuneman, 1985). Four types of bias are often discussed.

Bias in Construct Validity. Bias in construct validity is present when a test is shown to measure different hypothetical constructs or traits for one group than another; this type of bias also exists when the test measures the same trait for groups but with differing degrees of accuracy. Statistics regarding factor structure are often employed here. Specifically, a biased test will show different factor structures across subgroups. There will be a lower degree of similarity for the factor structure and the rank or item difficulty across groups (Sattler, 1992). The basic question here is: Does the item or test measure what it is intended to measure? A key illustration relates to language. Testing a student in English who has yet to become proficient in English is problematic. An intelligence test then becomes a language test. Certain students or groups may have the knowledge and experiences needed to answer the item correctly but cannot do so if they do not understand the question due to language barriers.

Bias in Content Validity. Bias in content validity is present when an item or subscale is relatively more difficult for members of one groups than another after the general ability level of the two is held constant. For example, if asked the question, "How are soccer and football alike?" a student or group who has never played or watched or had discussions about soccer is at a disadvantage. Lack of exposure and experience place them at a disadvantage. Reynolds (1998) defined content bias in this way: "an item or subscale of a test is considered biased when it is demonstrated to be relatively more difficult for members of one group than another when the general ability of both groups is held constant and no reasonable theoretical rationale exists to explain group differences on the item or subscale in question" (cited in Gregory, 2004, p. 243). Reynolds (1998) lists three examples of content bias:

The items ask for information that minority persons have not had equal opportunity to learn;

The scoring of the item is inappropriate, because the test author/developer had arbitrarily decided on the only correct answer and minority groups are inappropriately penalized for given answers that would be correct in their own culture;

The wording of questions is unfamiliar, and minority groups who may know the answer may not be able to respond because they do not understand the question(s) and/or are unfamiliar with the test format.

Bias in item Selection. Bias in item selection is present when the items and tasks selected are based on the learning experiences and language of the dominant group. This bias is closely related to content validity, but addresses more directly concerns regarding the appropriateness of individual items. While the overall test may not be biased statistically, a few items in them can be. Essentially, this issue concerns how an item gets included in a test but another item does not.

Bias in Predictive or Criterion-Related Validity. Bias in predictive or criterion-related validity is present when the inference drawn from the test score is not made with the smallest feasible random error or when there is constant error in an inference or prediction as a function of membership in a particular group. The overarching question here is: "Does the test scores accurately predict how the student or group will perform on a task in the future?" It is often presumed that a high intelligence score predicts a high grade point average and success in college and on the job, and so much more. A concern of opponents is that intelligence tests are given too much power, and if a student or group scores low on an intelligence test, there is a high

probability that they will be denied an opportunity to access a program or service because expectations for them are low. In other words, a test is considered “unbiased if the results for all relevant subpopulations cluster equally well around a single regression line . . . an unbiased test predicts performance equally for all groups, even though their means may be different” (Gregory, 2004, p. 244).

**NON DISCRIMINATORY
ASSESSMENT: SOME
RECOMMENDATIONS FOR
REDUCING BIAS**

In newer editions of intelligence test, most producers endeavor to ensure that their tests are low in bias, and their manuals address such efforts. No matter how diligent these efforts are, there is no such thing as a bias-free test; nonetheless, we must aim for bias-reduced tests. Some suggestions for achieving this goal are as follows:

- Translate tests into the language of the examinee;
- Use interpreters to translate test items for examinees;
- Examine all test items/tasks to see if groups perform differently and eliminate those items/tasks;
- Eliminate items that are offensive to examinees;
- When interpreting test scores, always consider the examinee’s background experience;
- Do not support the assumption of homogeneous experience or equal opportunity to learn; groups have different backgrounds and experiences that affect their test performance;
- Never base decisions on one test and/or one score. One piece of information or lone score cannot possibly be useful in making effective and appropriate decisions;
- Do not interpret test scores in isolation; collect multiple data and use this comprehensive method to make decisions;
- When an individual or group scores low, consider that the test may be the problem; it may be inappropriate and should be eliminated;
- If a group consistently performs poorly on an intelligence test, explore contributing factors and the extent to which it is useful/helpful for that group (Griggs Principle);
- Always consider the technical and social merits of tests. A test can be technically unbiased and simultaneously unfair (i.e., have a disparate impact);
- Review norming data and sample sizes; while diverse groups can be proportionately represented in the

standardization sample, their actual numbers may be too small to be representative, which hinders generalizability;

Include culture-fair or culture-reduced tests in the assessment or decision making process; these tests are designed to minimize irrelevant influences of cultural learning and social climate and, thereby, produce a clearer separation of ability or performance from learning opportunities; non-verbal intelligence tests fall into this category, with their reduced cultural and linguistic loadings (see Bracken & Naglieri, 2003; Flanagan & Ortiz, 2001);

Always use and interpret test scores with testing principles and standards in mind, such as those published by the American Psychological Association and others (1999), which address professional responsibility and ethics, as well as working effectively with culturally diverse populations (Ford & Whiting, 2006; Whiting & Ford, 2006).

As of 2004, culturally diverse students comprised some 43% of the U.S. public school population, and demographers predicted that this percentage would increase. Given the rapid changes in school demographics and the ever-increasing reliance on tests for decision-making purposes, the discussion of test bias was anticipated to continue. Testing is here to stay, and high-stakes testing is on the rise as of the early 2000s. Thus, the power of tests to open or close doors is increasing and of increasing concern.

While test developers increasingly work to decrease biases in their tests and, in effect, to increase the usefulness of their measures, controversy continues. It has been argued that tests in and of themselves are harmless tools, a philosophical viewpoint that often fails to hold true in actual practice. “Unfortunately, the tendency to imbue intelligence test scores with inaccurate and unwarranted connotations is rampant . . . Test results are variously over-interpreted or under-interpreted, viewed by some as a divination of personal worth but devalued by others as trivial and unfair” (Gregory, 2004, p. 240). While not intended for this purpose, in practice, tests do serve as gatekeepers, often resulting in closed doors and limited options for Black and other diverse groups (Ford & Joseph, 2006). Moreover, if misuse and misinterpretation were not problematic, there would be no need for task forces and standards to hold educators accountable (see works by Association of Black Psychologists, and the joint testing standards of APA, AERA, and NCME, 1999).

Despite the best intentions to develop tests that are low or reduced in bias, human error stereotypes and

Cultural Deficit Model

prejudice undermine test administration, interpretation, and use. More often than not, African American and other culturally diverse students are the recipients of this inequity.

SEE ALSO *Ability Grouping; Culturally Relevant Pedagogy.*

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CULTURAL DEFICIT MODEL

In attempting to explain the widespread underachievement among students of color and students from lower socioeconomic strata in schools, many teachers, administrators, school agents and others locate the problem within the students, their families and communities. This cultural deficit model attributes students' lack of educational success to characteristics often rooted in their cultures and communities. That is, research grounded in a deficit perspective blames the victims of institutional oppression for their own victimization by referring to negative stereotypes and assumptions regarding certain groups or communities. This perspective overlooks the root causes of oppression by localizing the issue within individuals and/or their communities. Because this model frames the problem as one of students and families, the remedies informed by deficit perspectives created to ameliorate student underachievement and failure often fail meaningfully to address problems within schools or society at large that combine to depress the performance of certain groups of students. Under the cultural deficit model, schools are, at least in part, absolved from their responsibilities to educate all students appropriately, and this charge is shifted almost entirely to students and their families.

CHARACTERISTICS OF THE CULTURAL DEFICIT MODEL

The cultural deficit model stems from negative beliefs and assumptions regarding the ability, aspirations, and work ethic of systematically marginalized peoples. It asserts that students of color and low-income students often fail to do well in school because of perceived "cultural deprivation" or lack of exposure to cultural models more obviously congruent with school success. Consequently, according to this perspective students of color and poor students often enter school with a lack of "cultural capital" (Bourdieu, 1997), cultural assets that are affirmed by schools and often shared by school agents and therefore considered valuable. In addition, there is a popular assumption that the families of students of color and socioeconomically disadvantaged students do not value education in the same ways that their middle- and upper-class White counterparts do. Conversely, upper-

and middle-class students, according to the theory, are more likely to do well in school because they possess more cultural capital. Much of the deficit-centered literature also suggests that a lack of involvement among families living in poverty is in part responsible for the educational outcomes of this community.

Deeply embedded in the fabric of schools, the deficit perspective is often disseminated through educational research and within teacher training programs (Trueba 1988; Valencia, 1997; González, 2005). For example, Ruby Payne's 2001 *Framework for Understanding Poverty*, a widely disseminated text with significant popularity within school districts, has been critiqued for promoting classist, deficit-centered theories to explain the underachievement of youth in poverty (Gorski, 2006). The results of the deficit perspective can be devastating and are manifested in multiple forms, making school a "subtractive" experience for many youth (Valenzuela, 1999). One of the most deleterious impacts is supported by research which suggests that students of color continue to be overrepresented in special education and in the less academically rigorous, non college-prep tracks of their schools (Russo & Talbert-Johnson, 1997; Patton, 1998; Coutinho & Oswald, 2000; Noguera, 2001; Oakes, 2005; Conchas, 2006). The negative impact of deficit perspectives is also evidenced by disproportionately high drop out or "push out" rates among students of color and poor students. Moreover, the negative beliefs regarding students of color and poor students can also result in stereotype threat (Steele, 1997), resulting in depressed academic performance.

ALTERNATIVES TO DEFICIT PERSPECTIVE

In spite of its pervasive influence, deficit perspective research has been discredited by an emerging body of literature. One area of critique notes that deficit perspectives fail to consider the fact that traditional avenues for parental participation in schools are closed off to many low income families and families of color. In a 2001 ethnographic study of Latino/a families, Concha Delgado-Gaitán (2001) found that almost all the teachers in her study believed parental involvement was extremely important, yet they also asserted that the majority of Latino/a parents were not sufficiently involved in their children's education. Nitza Hidalgo (1997, 2000) explored the contributions Latino/a parents make to the educational experiences of their children. The findings from her study suggest that Latino/a parents, and the extended familial social networks that they develop, contribute to the educational experiences of their children in meaningful ways that often remain unrecognized by schools. In their study of academically successful Puerto Rican students in the mid-

western United States, René Antrop-Gonzalez, William Vélez and Tomás Garrett (2005) found that students' families, and particularly their mothers, played a large role in fostering academic success, helping their children with schoolwork, locating resources to help support their learning, serving as mentors, and guiding them through the learning process. Similarly, research examining the role of parental involvement among African Americans demonstrates that parents have high participation in school programs when program themes emphasize empowerment, outreach, and valuing community resources (Abdul-Adil & Farmer, 2006).

Also contributing to debunking the myth that low-income families and families of racially and ethnically diverse backgrounds are apathetic about education, Gerardo Lopez's 2001 study cogently argues that the Latino low-income family in his study was highly involved in what he refers to as the "transmission of sociocultural values" (p. 430). That is, the family taught their children the value of hard work and underscored the importance of getting an education in part by taking their children with them to do physically demanding agricultural work, explicitly "giving their children the 'choice' to work hard at school or work hard in the fields" (p. 420).

By locating the causes for student underachievement within students and communities, the cultural deficit model fails to examine institutional barriers (i.e., school funding, racial and ethnic segregation) that can also potentially influence student achievement. It also fails to acknowledge the relationships between school practices, the sociopolitical factors that shape these efforts, and student outcomes. Much of the deficit-centered literature fails to explain or account for students who come from families and communities with the same alleged limitations yet succeed in school. The 2006 work of Gilberto Conchas highlights the voices of successful students of color in urban schools and examines the support structures that facilitated their success. In an effort to counter deficit perspectives and "RicanStruct" the discourse regarding urban Latino students, research by Jason Iri-zarry and René Antrop-González (2007) critically examines the characteristics of a group of exemplary teachers and academically successful students and puts forward a theory for culturally responsive pedagogy for this group. Similarly, Katie Haycock summarizes research that documents how entire schools that serve so-called culturally deprived students are as successful as many high-achieving schools in more affluent communities (Haycock, 2001).

This growing body of research urges schools to acknowledge the social and cultural capital present in communities of color and poor communities (Moll & Greenberg, 1990; Gonzalez, 2005; Yosso, 2005). Tara

Yosso (2005), for example, critiques static notions of cultural capital that fail to recognize what she refers to as “community cultural wealth” characteristics, such as resiliency, that students of color and poor students often bring to school that should be recognized and built upon. Similar research by Wenfan Yan (1999) suggests that academically successful African American students bring unique forms of social capital with them into the classroom that are distinct from white, middle-class cultural models and that African American parents tended to contact their children’s schools regarding their teens’ future career aspirations and experiences in schools more than White parents. As this body of research continues to develop, schools and school agents may abandon deficit perspectives, affirm the cultural richness present in these communities, and implement more culturally responsive approaches aimed at improving the educational experiences and outcomes for students of color and students from lower socioeconomic strata.

SEE ALSO *Cultural Bias in Teaching; Cultural Bias in Testing; Culturally Relevant Pedagogy; Stereotype Threat.*

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CULTURALLY RELEVANT PEDAGOGY

During the last three decades of the 20th century, teacher preparation addressed diversity as a critical component in effective teacher interaction with students in an increasingly multicultural population. In 1972 the American

Association of Colleges and Teacher Education published “No One Model American,” the aim of which was to “build an effective and humane society through the betterment of teacher education” (“No one model”, 1972). The resulting Commission on Multicultural Education endorsed three premises: (1) Cultural diversity is a valuable resource, (2) multicultural education preserves and extends the resource of culture diversity rather than merely tolerating it or making it “melt away,” and (3) a commitment to cultural pluralism should permeate all aspects of teacher preparation programs (Cochran-Smith, 2008, p. xv).

This commitment to multiculturalism expanded in 1976, when teacher preparation institutions had to provide evidence that their candidates had received adequate opportunities to interact with issues concerning teaching diverse populations (Gollnick, 1992). However, in spite of the ever-increasing terminology to encompass the changing faces of students in the classroom—multicultural, diverse, culturally responsive, diversity in race, ethnicity, gender, sexual orientation, socio-economic, linguistic, disability—Eurocentric attitudes often persisted. Nonetheless, effective teachers strive to acknowledge the kaleidoscope of background experiences students bring to the classroom and to ensure the materials and methods are representative of this ever-growing diversity. They aim to provide students with opportunities to connect their learning experiences to their own lives.

In 2002, No Child Left Behind (NCLB) emphasized that high-quality teachers were essential for student success. However, Ardila-Rey points out that NCLB’s “definition of what it means to be a highly qualified teacher . . . does not provide any provisions on . . . cultural requirements. . . . Only a handful of states have developed policies or standards for teacher preparation and credentialing that address issues to diverse populations” (Ardila-Rey, 2008, p. 341). This is cause for concern because teacher preparation institutions and other entities involved with ongoing professional development are responsible to “prepare educators who have the competencies and dispositions to work effectively with diverse students” (Anstrom, 2004, p. viii), address issues of theories and practices for effective learning, to include “experiences, knowledge, skills, and attitudes to successfully promote the educational success of all children” (Nevárez-La Torre, Sanford-DeShields, Soundy, Leonard, & Woysner, 2008, p. 270), and include competencies in which teachers “learn, reflect, introspect and incorporate . . . new ideas into pre-service and in-service teachers’ actions in their classrooms” (p. 277). With these goals in mind, teacher preparation and professional programs are being restructured so that candidates acquire the competencies to meet the challenges of educating a diverse student population (Phuntsog, 1999). However, despite con-

tinuing efforts to attract a balanced representation of teachers from various cultures, there is minimal diversity among teachers and the numbers who do exist are dwindling. According to Gay (2003):

It is increasingly a cross cultural phenomenon, in that teachers are frequently not of the same race, ethnicity, class, and language dominance as their students. This demographic and cultural divide is becoming even more apparent as the number of individuals in teacher preparation and active classroom teaching dwindle. (p.1)

PREPARING TEACHERS FOR CULTURALLY RELEVANT PEDAGOGY

Culture has been defined as “The system of values, beliefs, and ways of knowing that guide communities of people in their daily lives” (Trumbull, 2005, p. 35). Effective teacher preparation addresses the need for teachers to acknowledge students’ diversity and incorporate their pluralistic backgrounds and experiences into the learning experiences and classroom environment. In “culturally relevant pedagogy” (Ladson-Billings, 2001), “culturally responsive teaching” (Gay, 2000) (and other similar terms) teachers “develop the knowledge, skills, and predispositions to teach children from diverse racial, ethnic, language, and social class backgrounds” (Weinstein, Curran, & Tomlinson-Clarke, 2003, p. 270). Kirkland (2003) commented that “good multicultural teaching honors our diverse cultural and ethnic experiences, contributions and identities” (p. 131) and emphasized that teachers need to “understand the experiences and perspectives [students] bring to educational settings and be responsive to the cultures of different groups in designing curriculum, learning activities, classroom climate, instructional materials and techniques, and assessment procedures” (p. 134).

According to Hackett, teachers need to develop a “strong cultural identity [so as to be] responsible for teaching the whole child by teaching values, skills, knowledge for school success and participation in society, linking classroom teaching to out-of-school personal experiences and community situations” (Hackett, 2003, p. 329). Ambrosio emphasizes the importance of multiculturalism for the teacher:

Teaching is learning—a process of slowly integrating knowledge into practice. . . . The most important aspect of teaching is developing the mental habit of reflecting on your instructional practice and of altering your practice according to what you discover about how students learn best. Knowledge of multicultural theory and practice will give you the reflective space, the necessary

reservoir of cultural insight, to intelligently address pedagogical issues as they arise in your everyday practice. (Ambrosio, 2003, p. 37)

Gay (2006) echoed one recurring response to the need to ensure high-quality teacher preparation:

U.S. society is becoming increasingly diverse, and that diversity is reflected in its classrooms. Creating a respectful, productive classroom environment is always a challenge; this challenge is even greater when students and teachers come from different cultural backgrounds, or when students differ in terms of race, ethnicity, socioeconomic status, cultural and linguistic background, sexual orientation, ableness, and academic aptitude. Unless teachers have the knowledge, skills, and disposition to effectively guide diverse groups of children, they are likely to face classes characterized by disrespect and alienation, name calling and bullying, disorder and chaos. (pp. 365-366)

Moreover, Gay advised that “teachers must be multicultural themselves before they can effectively and authentically teach students to be multicultural” (Gay, 2003, p. 4) and proposed that “culturally responsive teachers . . . validate, facilitate, liberate and empower ethnically diverse students by simultaneously cultivating their cultural integrity, individual abilities, and academic success” (Gay, 2000, pp. 43-44).

Culturally relevant pedagogy aims to ensure that educators acknowledge and honor the diverse viewpoints of their student population and refrain from promoting homogeneous perspectives as universal beliefs. Glanzer (2008) referenced Hunter (2000) in that “the unspoken imperative of all moral education is to teach only those virtues, principles, and other moral teachings about which there is no disagreement in American society” (p. 525). Glanzer proposed that “schools should show fairness to diverse visions of the good life and not merely replace them with neutered and safe substitutes” (p. 526). Dingus (2003) further emphasized the importance of this perspective: “No student should have to sacrifice cultural heritage, ethnic identity, and social networks in order to obtain an education” (p. 99).

CHARACTERISTICS OF A CULTURALLY RESPONSIVE CLASSROOM

For more than five decades, teachers have developed strategies to comply with the responsibility to accommodate diverse students in an inclusive classroom; these challenges are compounded by the increasing diversity among the student population. Although teachers must be competent in the subject area they are assigned to teach (“Highly qualified teachers,” 2006), the main focus in teaching has

switched from the “What” that is, content in the curriculum to the “Who”:- who is the learner in the classroom. Teachers are responsible for teaching their students and for ensuring they all learn. It is critical that educators use their knowledge of students’ background and incorporate what they know about these learners into quality learning experiences. Culturally responsive teaching involves incorporating into learning experiences components of what is known about students’ knowledge of their cultures, their prior experiences both in their countries of origin and their current living situations, as well as the learning styles of diverse students, to make learning more appropriate and effective for them (Gay, 2000). “Culture is central to learning. It plays a role not only in communicating and receiving information, but also in shaping the thinking process of groups and individuals. A pedagogy that acknowledges, responds to, and celebrates fundamental cultures offers full, equitable access to education for students from all cultures” (“Culturally Responsive Teaching,” 1994).

Ambrosio (2003) referred to Freire’s (1970) premise that “Rather than seeing students as empty vessels, to be filled with the expert knowledge of teachers . . . students must make their own meanings; they must be producers of knowledge themselves” (p. 31). Moreover, he advised that teachers consider “students as creators rather than consumers of knowledge, as makers of meaning rather than passive recipients of socially sanctioned truths” (p.34). Ambrosio advocated a “pedagogy that uses the personal knowledge and experiences of students to reflect critically on issues presented from a variety of perspectives” (p. 34), advising that teachers should commit themselves to developing classrooms based on a “cultural democracy, to creating learning experiences and opportunities that allow students from diverse cultural groups to see themselves in . . . curriculum, instructional practices, and classroom climate” (p. 34). Pratt (2008) supported a student-centered curriculum, which “appreciates diverse abilities and interests and adapting teaching to allow for these differences” (p. 517). Students succeed when academic tasks include themes representative of their own culture (Boykin, Tyler, & Miller, 2005). Ironically, practices that give students choices about what they learn and how they learn are misaligned with standards-based curriculum and accountability through testing.

Culturally relevant pedagogy is a component in the foundation of competencies effective teachers require. Ladson-Billings (Summer, 1995) commented about this concept:

But that’s just good teaching! Instead of some “magic bullet” or intricate formula and steps for instruction, some members of my audience are shocked to hear what seems to them like some

routine teaching strategies that are a part of good teaching. (p. 159)

These “routine strategies for good teaching” are the criteria for effective teaching and learning. It is with this repertoire of theories, skills, and practices that effective teachers are able to create environments conducive to achieving the goal of education. That goal is to facilitate the development of intelligent, life-long learners who possess the strategies and metacognitive processes to make meaningful connections with their knowledge basis and transfer their skills to (and beyond) the challenges they encounter in their daily life. Teachers are obligated to “prepare students to become effective and critical participants in the world” (Nieto, 1999, p. 143). Effective educators are cognizant of the components necessary for learning to occur and are able to delve into their “toolbox” of theories and practices, strategies and perceptions, to ensure that all of their students will succeed. This is the more critical as the information and skills students learn will often be outdated by the time they exit the school environment.

Gay (2003) acknowledged, “much is said about the necessity and value of variety in teaching styles or using multiple means to achieve common learning outcomes” (p.2). When teachers plan for successful learning, they make a concerted effort to deliberately plan for classroom experiences in which all learners can be reached at multiple points throughout the learning experiences. Teachers who plan deliberately for an environment conducive to learning for all students ensure differentiation by incorporating various learning styles, multiple intelligences, cooperative learning, and “the diversity of learning styles, histories, cultures, and experiences that ethnically different students bring to the classroom” (p. 2).

Ambrosio (2003) emphasized that “multicultural education places a high value on critical thinking, on the personal truth making that enables students to challenge the moral and intellectual authority of the dominant culture” (p. 36).

Cooperative Learning. When a classroom incorporates the tenets of Cooperative Learning, the environment promotes maximal learning (Kagan, 2001). Ladson-Billings’ (1994) notion of culturally relevant classrooms provided Craviotto and Heras (1999) with the concept that when a classroom is designed around culturally relevant principles, there is significant interaction between students as well as between students and the teacher. They explained that, “Classroom dialogue is a fundamental aspect of classroom discourse. . . . [and the] classrooms are framed as an inviting space for exploration, learning, and dialogue among peers, students, and adults” (np). Rothstein-Fisch and Trumbull (2008) referenced Mar-

zano (2003) to promote classrooms where expectations include actions based on mutual respect. They support their premise with Slavin’s (2006) endorsement that an advantage of cooperative learning situations reinforces students’ responsibility for their own learning.

Classroom Management from a Cultural Perspective. The competencies for effective teaching include creating an environment conducive to learning. Effective classroom techniques are critical for each and every student to receive the learning experiences to which they are entitled (Weinstein et al., 2003). Culturally responsive pedagogy helps teachers achieve the goal of culturally responsive classroom management (CRCM) when they develop their management plan with an awareness of the diversity in their classrooms. Weinstein and colleagues (2003) outlined three premises by which to achieve the goal of CRCM:

1. *Recognize that we are all cultural beings, with our own beliefs, biases, and assumptions about human behavior.* At the same time, as it is incumbent that the educator incorporate the values “implicit in the western, White, middle-class orientation of U.S. schools, such as the emphasis on individual achievement, independence, and efficiency. . . . By bringing cultural biases to a conscious level, we are less likely to misinterpret the behaviors of our culturally different students and treat them inequitably;
2. *Acknowledge the cultural, racial, ethnic, and class differences that exist among people.* People must acquire “cultural content knowledge.” They must learn, for example, about their students’ family backgrounds, their previous educational experiences, their culture’s norms for interpersonal relationships, their parents’ expectations for discipline, and the ways their cultures treat time and space, and use acquired cultural knowledge as a way of demonstrating an openness and willingness to learn about the aspects of culture that are important to students and their families;
3. *Understand the ways that schools reflect and perpetuate discriminatory practices of the larger society.* This involves an understanding of how differences in race, social class, gender, language background, and sexual orientation are linked to power (p. 270).

Weinstein and colleagues proposed that, “Culturally responsive classroom managers work to create a sense of community. This means anticipating the cultural conflicts that are likely to arise and promoting positive relationships among students” (p. 273).

Rothstein-Fisch and Trumbull (2008) emphasized that teachers be trained in techniques of classroom management from a cultural perspective in that “cultural

values and beliefs are at the core of all classroom organization and management decisions” (p.xiii). They acknowledged the continuing concern that “School culture is relatively consistent across the United States and reflects the individualistic values of the dominant, European American culture” (p.xiii).

Cultivating Caring, Respectful Relationships. The ultimate goal of an effective teacher preparation program is to develop and hone the skills educators require to create learning environments that acknowledge, respect and are representative of the social world of all students (Noddings, 1992). “When teachers and students come from different cultural backgrounds, planned efforts to cross social borders and develop caring, respectful relationships are essential” (Weinstein et al., 2003, p. 272). When teachers create an environment which is based on caring and concern, and in which each student is valued, the result is that students become more motivated and learn more (Stipek, 2002).

Pratt (2008) identified “caring” as a central dimension of effective teaching. He advised:

Sometimes it is important to put aside the research journals, political commentaries, and popular news about the state of education and stop long enough to listen to the voice of a 9 year old. . . . You can learn a lot about classrooms just by listening to the kids who inhabit them. (p. 515)

Teacher Reflection as a Standard of Effective Teaching. In the standards for effective teaching, reflective practice is a criterion for all teachers—pre-service, novice, and veteran. Teachers’ ability to reflect on student achievement is a critical component in teacher preparation as well as in continuing professional development. Teachers who reflect on their own teaching ensure students are successful in their learning (Hoffman-Kipp, 2003; Ladson-Billings, 1995, 1999). Howard (2003) recommended teacher reflection as a means of incorporating issues of equity and social justice into teaching thinking and practice.

THE INFLUENCE OF THE TEACHER IN THE CLASSROOM: A THOUGHT FOR EDUCATORS

Diversity in the classroom encompasses many categories, among them ethnicity, culture, learning needs, and other issues. For all of these, educators have to hone their pedagogical skills to differentiate instructional practices to meet the varying needs of the population in the general classroom. The significant shift in the balance of diverse students—the multicultural panorama of 21st-century school environment—is no longer an exception to the world outside of the classroom, but a direct reflection of

it. Effective educators incorporate culturally relevant pedagogy to ensure that all students succeed. Sroka (2006) summarized the essential qualities of effective teachers in the criteria that teachers be nonjudgmental—that students’ opinions are welcomed and respected and that teachers have a passion for the content they teach.

Ginott (1995) made a powerful statement when he described the overpowering influence the teacher has in the classroom:

I have come to a frightening conclusion. I am the decisive element in the classroom. It is my personal approach that creates the climate. It is my daily mood that makes the weather. As a teacher I possess tremendous power to make a child’s life miserable or joyous. I can be a tool of torture or an instrument of inspiration. I can humiliate or humor, hurt or heal. In all situations, it is my response that decides whether a crisis will be escalated or de-escalated, and a child humanized or de-humanized. (p.302)

A KALEIDOSCOPE EFFECT

Effective teachers are equipped with a repertoire of teaching strategies designed to meet the educational needs of all students in the classroom. The components of their repertoire can be likened to a kaleidoscope that contains a multitude of prisms, which are dynamic and ever changing. Just as the kaleidoscope creates images using the diversity of color, shape, and sizes from the composite of the prisms, so, too, do successful educators develop an environment for optimal learning for the diverse student population.

SEE ALSO *Cultural Bias in Teaching; Cultural Bias in Testing; Cultural Deficit Model; Multicultural Education.*

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Gilda Oran

D

DEAF AND HARD OF HEARING

Hearing loss is common, and its incidence increases with age. For the most part hearing loss is mild and has no serious effect on the development of spoken language and communication. The number of children for whom hearing loss has implications for the classroom and for general communication is relatively small, and profound hearing loss, or deafness, constitutes a low-incidence condition. In general, two categories are used to describe hearing loss: hard of hearing and deaf, with no clear demarcation between the two. Roughly, hard of hearing children are characterized as having incomplete or limited access to the spoken word, either with or without augmented hearing. Deaf children have no functional access to the spoken word, either with or without augmented hearing. The hard of hearing category may be subdivided into two categories, mild and moderate, and deafness into another two, severe and profound. Numbers decrease with the severity of the hearing loss, with one school-age child in 2,000 exhibiting a profound hearing loss (Gallaudet Research Institute, 2005). Approximately 80,000 deaf and hard of hearing children in the United States have been identified as receiving education services (Mitchell, 2004).

ASSESSMENT OF HEARING

The most significant development in assessment of hearing has been the spread of neonatal hearing screening. Close to 95% of newborn children are screened in the hospital. Until the implementation of neonatal screening, the average age of identification of hearing loss was 2 1/2 years. The two most common types of tests used are

Automatic Auditory Brainstem Response (AABR) and Transient Evoked Otoacoustic Emissions (TEOAE) (Wrightstone, 2007). In the AABR test electrodes are placed on the forehead, mastoid, and nape of the neck of the infant, and the infant is fitted with a disposable earphone. The stimulus is a click or series of clicks. In the TEOAE test a microphone is placed in the external ear and a series of clicks tests the infant's response. In both cases, in order to reduce the number of false positives, a follow-up test is recommended for infants who do not pass the first screening.

Hearing testing, or audiometric assessment, can be accomplished in a variety of ways. Most frequently it is done by a trained audiologist using an audiometer, a device that emits tones at various frequencies and at different levels of loudness. The testing usually is conducted in a soundproof room. The person being tested wears a set of headphones or a headband and each ear is tested separately. The results are shown on an audiogram, a graph that represents hearing levels from low to high frequencies. The hearing is measured in units called decibels. Normal speech patterns are around 30 to 50 decibels. Hard of hearing individuals would have difficulty with much of spoken language and deaf individuals would have no access to it through audition.

CHARACTERISTICS OF DEAF AND HARD OF HEARING CHILDREN

Deaf and hard of hearing children, with some exceptions, reflect the general American school-age population. The exceptions are due to factors such as heredity, etiology, extent of hearing loss, and age of onset of a hearing loss.



Deaf students talking in the computer lab at Gallaudet University on November 3, 2006 in Washington, DC. ANDY NELSON/THE CHRISTIAN SCIENCE MONITOR/GETTY IMAGES.

For approximately half of American deaf and hard of hearing children, the hearing loss is caused by genetic factors (Moore, 2001).

Predominantly, genetic hearing loss is of a recessive nature, typically meaning that both parents, although they are able to hear, carry a gene for hearing loss. In a smaller number of cases, one parent may be deaf or hard of hearing and pass the gene along to the child in 50% of the cases. There are a small number of incidences of sex-linked hearing loss in which the hearing mother may pass the gene along to male children. This is possibly a partial explanation of why males constitute slightly more than half of the school age deaf and hard of hearing population. With a few exceptions, children with a genetic etiology do not possess disabilities; they are normal intellectually, physically, and emotionally.

Non-genetic factors play a decreasing but still important role. For generations, and perhaps for hundreds of years, worldwide maternal Rubella would double the number of deaf children born in particular periods of time. For large numbers of children, the results would include hearing loss, visual impairment, heart conditions, neurological disorders and physical

frailness. The development of a Rubella vaccine has eliminated Rubella as a cause of hearing loss. Mother-child blood incompatibility is another cause of hearing loss that has been brought under control, at least in developed countries. Childhood meningitis, however, presents a somewhat different picture. In the past a very young child who contracted meningitis might die, whereas an older child might survive but with profound hearing loss. In the 21st century it is more likely that the older child would be cured without any hearing loss and the younger child survive but with multiple disabilities. Hearing loss may also occur as a consequence of premature birth, with the possibility of additional disabilities. Again, medical advances can lead to survival, but with concomitant conditions. Miller (2006) has argued that there are essentially two distinguishable categories of children with hearing loss: those who are normal intellectually and physically and those with overlays of disability.

There are some differences in the racial/ethnic make up of the school age deaf and hard of hearing population as compared to the hearing population. According to information compiled by the Gallaudet Research

Institute (2005), 50% of the deaf and hard of hearing school-age population is classified as White, 15% as Black/African American, and 25% as Hispanic/Latino, with the remaining 10% being classified as Asian/Pacific, American Indian, Other, or Multi-ethnic. The disparity is with the Hispanic/Latino category. A larger percentage of Hispanic/Latino children are in programs for deaf and hard of hearing children than in the general school population. The reasons for this are not clear.

CURRENT EDUCATIONAL AND INSTRUCTIONAL PRACTICES

Historically, there have been three interrelated major points of contention concerning the education of deaf and hard of hearing children and educational practices: Where should the children be taught, what should the children be taught, and how should the children be taught? (Moore & Martin, 2006). Complex sets of demographic changes, medical developments, societal expectations, and federal legislation have had major impacts on each of these questions.

Traditionally, deaf and hard of hearing children were taught either in residential school or in separate day-school programs in large cities. The situation began to change after World War II, due to the baby boom and population explosion. State legislatures were not willing to commit extra money for the construction of new residential facilities, and increasing numbers of deaf and hard of hearing children attended public schools, often in separate classes in schools with a majority of hearing children. The trend continued with the last major Rubella epidemic in the 1960s, at a time when the baby boom was over and there were empty rooms in the schools. The passage in 1975 of the Education of all Handicapped Children Act, which has undergone extensive amendment over time, including the Individuals with Disabilities Education Improvement Act Amendments (IDEA) of 2004, was the impetus for the acceleration of the movement of special education children to mainstream or integrated settings. The law requires a Free Appropriate Public Education (FAPE) for all disabled children, with each child receiving an Individualized Education Plan (IEP). Children are to be educated in the Least Restrictive Environment (LRE), and placement with non-disabled children is viewed as desirable. The concept of integration has been replaced with that of inclusion, by which modifications of instruction are expected to adapt to the needs of the child rather than placing the onus on the child. This is the expectation in theory, but it is not necessarily realized.

Amendments of IDEA lowered the age at which disabled children could be served until services are available at birth. For very young children there is an empha-

sis on serving the family as a whole system; instead of an individual education plan for the child, a family plan is developed. Coupled with universal neonatal screening there has been an increase of programs for children from birth to 3 years of age. Unfortunately, many states have not developed effective systems for follow-up once a hearing loss is identified, so there is often a lack of appropriate response.

Approximately half of deaf and hard of hearing children are placed in a regular classroom setting with hearing children, and may be served, depending on the IEP, by an itinerant teacher of the deaf or other professional. An estimated 40% of deaf and hard of hearing children in regular class settings receive sign interpreting services (Gallaudet Research Institute, 2005).

The question of what deaf and hard of hearing children should be taught has been influenced by changes in school placement and by federal legislation. The curricula for deaf and hard of hearing children used to emphasized speech training, speech recognition, and English, with relatively little attention devoted to content areas such as math, science, and social studies. However, as more and more children were educated in regular classrooms the regular education curriculum of the particular school district took precedence.

The enactment of the No Child Left Behind (NCLB) legislation in 2001 brought education of deaf and hard of hearing children into even more close alignment with regular education. Among other things, the law mandates that each state must establish high standards of learning for each grade and that the states develop rigorous, grade-level assessments to document student progress. Results are reported at school, school district, and state levels. Results are also reported at each level for all students and disaggregated by race/ethnicity, speakers of languages other than English, poverty (as demonstrated by free or reduced lunch eligibility), and disability. Annual goals are established for each category, and schools, school districts, and states must show annual yearly progress (AYP). Any achievement gaps among racial/ethnic, income, language, or disability groups must be closed so that by 2014 100% of American children will demonstrate academic proficiency, as measured by grade-level standardized state-administered tests. Only a small number of profoundly impaired children are exempt. All others, including deaf and hard of hearing students, must take the tests and, by 2014, have a 100% pass rate.

This poses an enormous challenge. Deaf and hard of hearing children in regular classrooms are already being exposed to the curricula of their home school districts, and most day and residential programs have adopted or adapted general education curricula. However, many, if

not most, deaf and hard of hearing children start school, even after early intervention and preschool experiences, without the English skills and word knowledge that most children have acquired before the start of formal schooling. They are therefore unable to use English fluency as a tool to acquire academic knowledge and skills. For many deaf and hard of hearing children English is a barrier to learning that must be overcome. The curriculum must be modified to help deaf and hard of hearing children develop some of the skills that hearing children already have at the start of their education. Only a small percentage of high school-age deaf children achieve at grade level at the same level as their hearing peers (Moore & Martin, 2006) and the goal of 100 percent success in demonstrated academic proficiency will not be achieved by 2014.

The third issue, how to teach deaf children, deals with the oral-manual controversy, which has been raging for more than a century. In the first American schools for the deaf, which enrolled a substantial number of late deafened and hard of hearing students, instruction was through either a natural sign language, the precursor of American Sign Language (ASL), or through a system of signs modified by means of the American manual alphabet to represent English and presented in English word order. This method predated English-based signed systems that may be presented in coordination with spoken English. Oral-only education was introduced in the last third of the nineteenth century and quickly became dominant in the large city day schools and in some private residential schools. In the state residential schools a system evolved in which children up to around age 12 were taught orally and then tracked into either oral or manual classes (Winzer, 1993).

The situation began to change in the 1960s because of dissatisfaction with results of oral-only early intervention programs. A philosophy called Total Communication quickly grew in popularity. Theoretically, it involved the use of any means of communication to meet individual needs: speech, ASL, English-based signing, writing, gesture, or speech-reading. In reality it usually involved English-based signing in coordination with speech, and was known as simultaneous communication (Sim Com). During the 1990s a movement developed to employ ASL as the main mode of classroom instruction, with an additional concentration on written English. The approach was labeled Bi-BI, or bilingual-bicultural. Early 21st-century data indicates that 50% of deaf and hard of hearing children are taught through oral-only communication, 40% through sign and speech, and 10% through sign-only communication (Gallaudet Research Institute, 2005).

There has been growing interest in multichannel cochlear implants for deaf and hard of hearing children. The surgical procedure involves removing part of the mastoid bone and inserting a permanent electrode array into the cochlear. The procedure has been more common

in Australia (Lloyd & Uniacke, 2007) and Western European countries such as Sweden (Preisler, 2007), where as many as 80% of young deaf and hard of hearing children have received implants. Implantation has increased in the United States and in some areas approaches 50% of the deaf and hard of hearing population. Cochlear implants are designed to bring a more clear representation of the spoken word to deaf and hard of hearing children. There have been anecdotal reports of dramatic improvements in hearing in some children, but systematic reports of the extent to which it helps children with different characteristics are not available.

ASSESSMENT AND INSTRUCTION

It is important to keep in mind that the purposes of assessment for each child can include facilitating educational placement decisions, evaluating progress, determining educational approaches to be used, improving educational and intervention strategies, monitoring progress for individualized education plans, or family education plans (Miller, 2006). Although the situation is improving, attempts to provide meaningful and valid assessments for deaf and hard of hearing children have met with limited success. Miller points out that there is difficulty getting agreement in the field about which tests require “deaf norms” and which tests should use “hearing norms.” When separate norms are desired there is the additional question of who should be included in the normative sample— all deaf children, deaf children without disabilities, deaf and hard of hearing children, children with disabilities, and so forth.

Miller states that in establishing an assessment framework assessment specialists must keep in mind the normal course of development of a typical deaf or hard of hearing child who has no disabilities and who has been in a linguistically enriched environment from birth. Other deaf and hard of hearing children should be compared to this ideal prototype or model of development and measured in ways that can estimate their similarities to or differences from the ideal. The template of developmental norms for deaf and hard of hearing children should be the model for all deaf and hard of hearing children even if such children comprise a minority of the population under consideration. Some of the key variables to be considered include age of onset of the hearing loss, age of identification and beginning of educational services, home and school linguistic environment, presence or absence of disabling conditions, use of and benefit from auditory amplification, and consistency of the communication approach over the years.

Considering these variables, the assessment specialist should be able to identify those children with hearing loss only, those with disabilities who have received excellent

programming from an early age, and those who have received little or inappropriate educational services. The need is for assessment specialists to redouble efforts to develop meaningful, relevant, and linguistically and culturally appropriate assessment batteries that make the most sense in practical terms for deaf and hard of hearing children and their families.

SEE ALSO *Special Education*.

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DECISION MAKING

Researchers generally assume that people engage in a small set of cognitive processes when they make decisions. These processes include (a) evaluating a set of options that could be implemented to attain a goal and (b) choosing one of these options. For example, a student who wants to do well on a test (a goal) may decide to study for it by making flash cards (option 1) instead of rereading relevant textbook chapters (option 2) or reviewing notes (option 3). Decision-making processes are instigated whenever an individual wants to accomplish something and realizes that there are several different ways to accomplish this goal. Defined in this way, it should be clear that people make numerous decisions every day (e.g., when to wake up in the morning; what

to wear; what to eat for breakfast). The definition suggests that decision processes are not involved when only one option is possible; similarly, they are not involved when people decide to pursue a particular goal always the same way and never attempt to consider alternatives.

Given the pervasiveness of choices in daily life and the fact that some of these choices are rather important (e.g., choice of spouse; which job offer to accept; whether to have surgery; whether to purchase a new house; whether to drink and drive), decision-making should be of interest in its own right as a focus of research. In reality, however, most of the psychological studies of decision-making have generated interest because of their implications regarding the limits of human reasoning and the extent to which adults routinely violate the norms of rationality.

In particular, philosophers have argued that some of the hallmarks of rational behavior include the tendencies to (a) take full account of all options that may be available in a given situation, (b) act in accordance with one's beliefs and values, and (c) maintain a rank-ordering of evaluated options across situations (e.g., if option 1 is rated higher than option 2 at a given time, the former should always be selected over the latter in all other situations as well). These and other characteristics comprise the so-called *normative model of decision-making* because they describe what people should do rather than what they actually do. Beginning in the 1950s, psychological researchers conducted carefully controlled laboratory experiments on decision making and began to discover that adults often fail to demonstrate one or more of these presumed characteristics of rationality. In response to such findings, researchers began to wonder if people are fundamentally irrational, a question that generated considerable interest and controversy in the field of psychology. The arguments on either side of this issue have filled entire volumes and special issues of scholarly journals. In addition, the frequent deviations from the normative model prompted theorists to devise theoretical models that capture what decision-makers actually do, rather than what they should do. These so-called *behavioral decision theories* contrasted with the normative models.

LEADING FIGURES IN THE FIELD

Herbert Simon (1916-2001), who was associated with Carnegie Mellon University, was one of the first to point out the limits of human reasoning as it relates to decision-making. He argued against the normative model using the tenets of Information Processing theory and proposed the construct of *bounded rationality*, which specifies that the human mind is incapable of processing all aspects of all possible options in a given situation. Instead, the mind must simplify the process by reducing

the number of options that are considered (e.g., five or less) and the number of attributes of these options (e.g., just the price, gas mileage, and color of potential cars to buy). He argued further that decision makers have a tendency to engage in “satisficing” when they think about their options; that is, instead of waiting to choose an option until all options have been carefully and exhaustively considered, decision makers consider options one by one in sequence until they reach one that is good enough. Once this good enough option is encountered, none of the remaining options is examined. This tendency to satisfice runs against the prescriptions of the normative model because it is possible that the best option that should have been selected was among those that were not yet evaluated. The notion of bounded rationality was extremely influential because of its applicability across disciplines. Scholars in the field of economics were particularly enamored with this notion and eventually nominated Simon for the Nobel Prize in economics (which he subsequently was awarded).

Simon’s application of Information Processing theory to decision making influenced several generations of decision theorists that came along in the 1970s and 1980s. The idea that decision makers engage in *cognitive shortcuts* soon became pervasive in the literature. In some of the seminal studies in this area, Daniel Kahneman of Princeton University and the late Amos Tversky of Stanford University proposed a series of cognitive heuristics that people use when they process information relevant to decisions. These heuristics, in turn, produce systematic biases to respond in particular ways, and these biases affect their choices. For example, the so-called representativeness heuristic is operative whenever people are presented with a category of things (e.g., cars) or events (e.g., random sequences). All categories have prototypical instances that are assumed to be highly representative of the categories (e.g., the sequence 3, 19, 26, 29, 34, 40 in a lottery drawing for random events), as well as instances that are assumed to be less representative (e.g., the sequence 1, 2, 3, 4, 5, 6; in reality, both sequences are equally probable). Incorrect or not, the assumption that an instance is representative prompts people to think it is more likely to occur than the less representative instance. In the case of random number sequences, the representativeness heuristic may make gamblers decide to place a large bet right after observing the occurrence of a less representative sequence because the occurrence of the less probable sequence makes them think that the more probable sequence will occur next.

Kahneman and Tversky also gained prominence for discovering the fact that people will make different choices regarding the same information depending on how it is *framed* (e.g., “400 out of 1000 people will be saved by a drug” versus “600 will die”) and for their Prospect Theory. Other prominent scholars who have

examined the prevalence and consequences of these and other reasoning biases on decision making are Baruch Fischhoff of Carnegie Mellon, Paul Slovic of Decision Research in Oregon, Jonathan Baron of the University of Pennsylvania, Hal Arkes of Ohio State University, Valerie Reyna of Cornell University, and Keith Stanovich of the Ontario Institute for Studies in Education.

In addition to stressing constructs such as memory limitations and cognitive shortcuts, the Information Processing (IP) approach also emphasizes other important aspects of performance that have a bearing on decisions such as cognitive strategies and metacognition. To illustrate one of these further applications, John Payne and James Bettman of Duke University examined the systematic strategies people use when they examine a number of options that are placed before them (e.g., 20 possible apartments that could be rented). The IP approach eventually developed a natural affinity to the idea that many aspects of human cognition (including cognitive shortcuts) were selected via evolutionary processes because of their adaptive value. Thus, the field took a 180-degree turn away from the original assumption that deviations from the normative model were a bad thing to the subsequent claim that these deviations were actually adaptive and likely to lead to environmental success.

Scholars such as Gerd Gigerenzer argued that in many situations, processing too many things could lead to serious negative consequences. For example, emergency room (ER) doctors could look for quite a number of symptoms when a cardiac patient enters the ER, but three particular signs are highly diagnostic of a heart attack. Spending time collecting data on the other less diagnostic symptoms would surely lead to an increase in ER deaths. Gigerenzer argued further that the most useful cognitive processes that people engage in during decisions operate at an unconscious level. Engaging in the conscious, systematic consideration of options would either be a waste of time or lead to lower levels of goal attainment, according to Gigerenzer.

Between the 1960s and 1990s, researchers who studied decision making in adults frequently were confronted with the criticisms that (a) much of the experimental work in decision making utilizes laboratory tasks that have little relevance to the real world, and (b) the IP inspired approaches seem to neglect the potentially important role of motivational or emotional factors in decision making. Perhaps in response to these criticisms, many of the most prominent figures in the field refocused their energies on explaining real world phenomena (e.g., actual home buyers assessing the risk of living near a nuclear reactor), and several also developed new theoretical models that give a more prominent role to emotions. Examples include Fischhoff, Slovic, Baron, and Arkes.

The portrait that has emerged since the 1990s is that of an adult decision maker who relies on cognitive shortcuts and emotional processing to make many ordinary decisions in ways that often lead to goal attainment. These same shortcuts and emotional responses can, however, lead to poor decisions in some circumstances. For example, there are times when it is a good idea to consider options more fully and not be distracted or misled by transient emotional states.

THE DEVELOPMENT OF DECISION MAKING

There are far fewer studies of the development of decision making in children and adolescents than studies of decision making in adults. Nevertheless, it is possible to draw some tentative conclusions about age changes that have the potential to affect the quality of decisions made by children and adolescents. Before doing so, however, it is important to note that developmentalists have not been concerned with age changes in the extent to which children make decisions (i.e., all children make many decisions per day at all ages), but rather, with age changes in the quality of children's decisions. Charting age changes in quality, of course, requires that one have a working model of what decision making competence entails.

Because of important shortcomings in the aforementioned normative model, some scholars have shifted from using the normative model as a guide to evaluating decision quality and moved towards defining decision competence in terms of environmental success. In particular, these scholars argue that a skilled decision maker is someone who knows the difference between options that are likely to lead to goal attainment (good options) and options that are unlikely to lead to goal attainment (not-so-good options). If so, the question then becomes one of identifying characteristics of decision makers that help them recognize or discover good options in a particular situation.

Some of the characteristics that have been proposed are (a) knowledge and experience (i.e., more knowledgeable individuals are likely to correctly predict the consequences of particular actions), (b) the tendency to seek advice from the right people when personal knowledge is lacking, (c) the tendency to pursue adaptive goals that are likely to promote physical health, emotional health, or financial well-being, (d) the tendency to prefer options that satisfy multiple goals as opposed to options that satisfy only a single goal (e.g., find a car that is attractive, relatively inexpensive, and reliable), (e) the tendency to learn from decision-making successes and failures, (f) the tendency to engage in effortful and thorough examination of options and consequences for important decisions, but not expend considerable effort considering

options for unimportant decisions, and (g) the ability to regulate one's emotional and impulsive tendencies in ways that keep these tendencies from interfering with appropriate consideration of options and consequences.

Although, as of the early 2000s, the evidence was still emerging regarding age differences in such characteristics, some studies suggested that older adolescents and adults are more likely than younger adolescents and children to (a) understand the difference between options likely to satisfy multiple goals and options likely to satisfy only a single goal, (b) anticipate a wider array of consequences of their actions, (c) evaluate their options in systematic ways and apply effortful strategies only for important decisions, and (d) learn from their decision-making successes and failures. Unfortunately, adolescents have also been found to seek advice less often from knowledgeable individuals than children, and they are more likely to pursue goals that could negatively affect their physical health, emotional health, or financial well-being (e.g., smoking cigarettes; drinking and driving).

MODERATING FACTORS

Earlier in this entry, it was noted that emotionality and impulsivity could have negative effects on decision-making. Some scholars argue that these tendencies should be considered moderating factors because people tend to make better decisions when they are calm and reflective than when they are emotionally aroused and impulsive. Generally speaking, these tendencies cause problems whenever they keep decision makers from fully considering the consequences of their actions and discovering better options than those that they implemented. Scholars such as Lawrence Steinberg and Ronald Dahl argue that adolescents are particularly vulnerable to the influences of emotions and impulsivity, and they argue that this vulnerability has a neural basis in their brain. As the brain continues to mature into adulthood, Steinberg and Dahl argue that decision makers gain the capacity to regulate their emotions and impulsivity. As with most other developmental claims regarding decision-making competence, however, the evidence supporting this view is relatively sparse and open to multiple interpretations. More research is needed to substantiate all of the age trends reported here.

INSTRUCTIONAL APPROACHES TO IMPROVE DECISION MAKING

In light of the rise in problem behaviors during adolescence (e.g., cigarette smoking, alcohol use, etc.), university researchers and policy makers in school systems have implemented a number of interventions to improve the quality of decision making in adolescents. Some of these interventions focus on general characteristics of good decision-making (e.g., seek advice from knowledgeable

individuals when you do not know what to do) while others specifically target particular problem behaviors (e.g., illicit drug use). Those who implement the general approaches hope that students will apply the principles to all decisions, including those related to problem behaviors. The standard by which a program should be judged to be effective is that it both alters the manner in which decisions are made and reduces the incidence of problem behaviors. Proving the latter requires the application of rigorous methodological approaches such as randomly assigning teens to intervention and control conditions, measuring decision making and problem behaviors before and after the intervention, and using valid measures of decision making and problem behaviors. Reviews of the literature reveal that few studies meet these standards of quality. Many studies show that teens can learn the content of a program, but few show that their actual decision-making changed as a result. The studies that do meet the standards have been found to be more effective when (a) they are more comprehensive (i.e., they target multiple causes of the problem behavior), (b) the teens themselves learn the information in an active rather than passive manner, and (c) the participants engage in peer-to-peer instruction.

SEE ALSO *Impulsive Decision Making; Problem Solving; Reasoning.*

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James P. Byrnes

DESIGN EXPERIMENT

Improving classroom teaching and learning is the primary goal of research in education, educational psychology, and the learning sciences. However, a common complaint about traditional research using experimental and quasi-experimental design points at the gap between

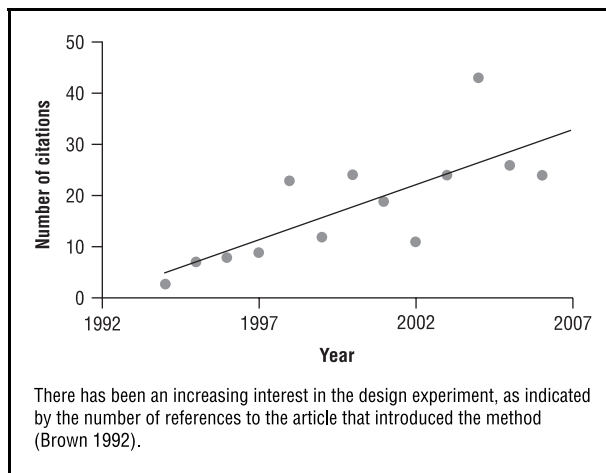


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

educational research and educational practice. Introduced in 1992 to address the theoretical and methodological challenges in creating complex interventions in classrooms (Brown 1992), design experiment, an initially unorthodox method, was eventually adopted quite widely as the method of choice for studying teaching and learning in the classroom setting. Between 1992 and the early 2000s, there was increasing interest in this research method, as shown by the increasing number of citations to Brown’s article listed in Thompson’s ISI Web of Knowledge (Figure 1). The success likely derives from the fact that the design experiment combined two existing functions of educational psychology: explanation and guidance of practice (Solomon 1996). Although Ann L. Brown and others credit Allan Collins for coining the term, it is through Brown’s work generally and through her introductory article in the *Journal of the Learning Sciences* specifically that learning scientists have come to know about this method. There has been an increasing interest in the design experiment, as indicated by the number of references to the article that introduced the method (Brown 1992).

DEFINITION

The term *design experiment* was modeled on the design sciences aeronautics and artificial intelligence, in which research and development are combined. It refers to interventions in which educational environments are engineered and where experimental studies of those innovations are conducted simultaneously. Design experiments differ from classical laboratory experiments and quasi-experiments in that the intervention itself is changed in response to problems that the ongoing (interpretative,

qualitative, ethnographic) research reveals. Design experimenters focus on understanding teaching and learning in complex, designed settings rather than reduce them to their constituent building blocks: The ultimate purpose of a design experiment is to bring about a lasting instructional change, which it can only achieve, as experience has shown, when the intervention is adapted to the contingencies of each setting. Thus, design experiments aim at arriving both at (a) the best possible form of the intervention in each setting, that is, instruction and learning, and (b) theoretical articulations that delineate why an intervention works across settings and thus makes it consistently repeatable.

USERS

An analysis of ISI Web of Science focusing on the authors and journals that cite Brown's article on the design experiment shows that the method is particularly of interest to learning scientists (*Journal of the Learning Sciences*, *Cognition and Instruction*, and *Educational Psychologist* account for over 20% of the citations) and science educators (three science education journals) and educational technology/instructional science account for another 16% and 7% of the citations, respectively. The common allegiance of the researchers is to the idea of research and development as design rather than to a particular epistemology, though a quick survey of articles citing Brown (1992) shows that the most common commitments are to social constructivist (constructionist), sociocultural, and cultural-historical theories of knowing and learning. This common allegiance may explain the large proportion of designers of (computing) technology-based learning environments with their cultural-historical practices of design, testing, and revising alpha, beta, and gamma versions of their artifacts among those who employ the design experiment as method.

DESIGN VERSUS CLASSICAL EXPERIMENTS

Structure of Experimental and Quasi-Experimental Designs. Design experiments are useful for moving instructional design through all the phases of development and implementation and especially in the final, gamma phase of designing instructional reform, that is, the widespread use with minimal support, which is a measure of reform longevity. Despite the increasing interest and use of design experiments, there continues to exist a lack of clarity concerning its methodological and epistemological features (Bell, 2004).

Classical laboratory experiments test hypotheses about relations that causally link independent and dependent variables. Causation can be established only when the variance between treatment and control group (different

or no treatment [placebo]) is reliably attributable to the treatment. Random assignment to treatment and control conditions has the function of drawing participant samples that (a) are representative of the target population and (b) are comparable, both within the limits of sampling error (Cook & Campbell, 1979). Whereas random assignment is possible in psychological laboratory experiments, which often have the problem that their results do not translate into real settings, educational research in real classroom settings, though more realistically addressing the context of learning, generally cannot randomly assign students to treatments and control. A common quasi-experimental design has the following structure

O_1	X	O_2
O_1		O_2

where the O_1 refers to observations (e.g., literal observations, written tests, or responses in computer presented tasks) and X refers to the treatment (e.g., "using computers" or "using peer teaching"). In other words, there are two groups (one above, one below the dotted line), which are observed/tested at one point in time (O_1). One group receives treatment ("X") the other does not. After the treatment has ended, both groups are observed again (O_2). Everything else being equal, any post-treatment differences can be attributed to the treatment. This structure addresses the comparability of non-equivalent control groups by collecting relevant information (e.g., pre-tests) that allows researchers to statistically adjust for the possible non-equivalence of experimental and control groups that may exist at the outset of the research. Although different quasi-experimental designs differ in their weaknesses and strengths, a creative mixture of designs within the same study may significantly increase confidence in the causes underlying the phenomena under study.

Structure of Design Experiments. Design experiments differ substantially from traditional psychological experiments and quasi-experiments because these systematically vary the interventions, using each iteration as an experiment that assists in evolving and testing theory in a naturalistic setting. Rather than having a previously specified constant treatment, design experiments change the intervention on the basis of emergent understandings so that the X (treatment) in the structure of the experiment no longer is the same from the beginning to the end of the intervention. It is therefore no longer possible to establish causal relations between, for example, particular interventions for example, Brown's reciprocal teaching with other interventions. This does not

prevent design researchers from conducting experimental (laboratory) studies within their design experiments to test hypotheses about causal relations. Design researchers frequently choose to deepen the study of emergent aspects by means of formal laboratory studies or classroom studies with random assignment of students to conditions (treatments). Such studies, then, allow the establishment of cause and effect but always relative to the theoretically interesting features that emerge in the course of the larger study.

This feature of design experiments is associated, for many psychologists, with substantial drawbacks (weaknesses) because it substantially alters the conception of what constitutes relevant knowledge and how it is derived. However, the design experiment can be understood through the analogy with an interrupted time series design because researchers go through considerable efforts in documenting learning prior to, during, and following the changes in instructional design. Design experiments therefore are characterized by the structure

$O_1 \quad O_2 \quad X \quad O_3 \quad O_4 \quad X' \quad O_5 \quad X'' \quad O_6 \quad O_7 \quad O_8 \quad \dots$

where each “O” represents an observation and each “X” an intervention. Note that the treatment changes in the course of the experiment (X becomes X’ becomes X’’ and so on) based on the information collected during the observations. However, in contrast to interrupted time series in which treatment episodes follow non-treatment episodes (to verify that the treatment rather than something else makes the difference), design research does not withdraw treatment but continually seeks to improve teaching (i.e., the treatment) and therefore learning. This structure of the design experiment, however, provides opportunities for a Bayesian approach. In a Bayesian approach, the already-generated quantitative and qualitative information is combined between the phases of the implementation to generate adjusted estimates of the success of the intervention in the future (Gorard, Roberts, & Taylor, 2004). These adjusted predictions are better estimates for the impact of future interventions because they explicitly take into account previous findings. Clearly, design experiments play into the hands of those interested in optimizing the learning environment by acting upon contingently emerging problems and understandings.

Criticisms and Responses. Even critics recognize that the strengths of design experiments lie in their ability to generate and test theories in situ, to cross the theory-practice gap by adaptively changing the intervention of interest. But the data generated before and during the

intervention generate immense datasets, which frequently leads authors to use narrative forms that do not and cannot provide the kinds of warrants required for establishing the veracity of claims made (Shavelson, Phillips, Towne, & Feuer, 2003). Here Brown’s introductory article countered some common objections to design experiments. For example, the very specificity of learning predictable in design experiments makes them immune to false claims due to the Hawthorne effect (positive effects merely because of attention researchers pay to research participants rather than because of treatment in and of itself). More so, addressing what Brown called the reality principle (the continued positive effects [shelf life] of an intervention), design experiments tend to achieve longevity and widespread adoption with minimal additional intervention. Such interventions that are the products of good design experiences are adaptive and fit the contingencies of the different settings. Design experiments, much more than other inventions of the past, have lasting and widespread effect because of the close collaboration of participants and researchers.

TWO PROTOTYPICAL EXAMPLES

By their very nature, design experiments require researchers to become familiar with and understand the setting, encouraging them to become ethnographers interested in how particular cultures make sense. Students tend to become researchers responsible for defining relevant expertise, and teachers tend to become researchers. It is not surprising that (a) teachers become design experimenters, (b) researchers become teachers to ascertain that a best-case scenario is studied, or (c) university-based design researchers become interested in the social agendas of students and teachers that their designs support. Two prototypical examples of design research are provided below that illustrate the first and third types of design research.

Teachers as Design Researchers. In the learning sciences literature, there are numerous examples of design experiments that involve researchers who not only observe but also teach during the intervention; there are also examples in which teachers themselves legitimately conduct design research. The present example is of the second kind, involving two science teachers investigating the implementation of an open-inquiry science curriculum (e.g., Roth & Bowen, 1995) that used the same guiding principles that also motivated the design work of Brown and Collins during the late 1980s and early 1990s that is, cognitive apprenticeship and community of learners. Students are provided opportunities to enact cognitive practices that have a high degree of family resemblance with the practices of professionals. With respect to the sciences, this means that students learn to pose research questions, collect data for answering them, and use

mathematical representations for analyzing the data and for representing the data in reports to substantiate research claims. In this model, the two teachers, both with graduate degrees in the natural sciences, were experts who scaffolded students' efforts. They did so on a need-to-know and just-in-time basis, that is, precisely when knowing something significantly would advance students in their work (Pea, 1997).

The two teachers set out to study (a) problem posing and solution finding, (b) mathematization and other representational practices of science, (c) the relationship between culture, practices, and cognitive resources, and (d) differences in mathematical practices arising from open inquiry versus school tasks. They planned a cognitive anthropological study in which mathematical representations and mathematical practices oriented data collection. They videotaped all lessons in one eighth-grade class and collected all students' field notebooks, laboratory reports, unit tests, end of semester test, and final examination in both participating classes. A third eighth-grade class taught differently served as the control group. The researchers collected student responses to standard instruments such as the Constructivist Learning Environment Scale; and they interviewed, using open-ended and structured protocols, about 25% of the participating students concerning different aspects of the intervention. Their substantial database allowed the researchers to evaluate knowing and learning in quantitative and qualitative ways and correlate achievement with other measures collected as part of the research.

The researchers transcribed all videotapes in an ongoing manner with less than 48-hour delays between recording tapes and conducting initial analyses. This allowed them to (a) design particular curricular strategies when problems became evident and (b) frame tentative hypotheses, which subsequently were tested experimentally. For example, the researchers framed the hypothesis that students' choice of mathematical representations was a function of the data set: Students were more likely using graphs to find trends in large data sets, whereas they were more likely to seek trends by visual inspection of the raw data. The researchers designed three forms of a task and randomly assigned pairs of students to one of the three conditions. Based on this experiment, the researchers rejected the hypothesis. A second part of the experiment, which compared the degree of mathematization that the eighth-grade students achieved to teachers in training with at least a BSc revealed statistically reliable differences: The eighth-grade participants in open-inquiry used more-abstract representations with a reliably higher frequency than the future science teachers (Roth, McGinn, & Bowen, 1998). The experiment also proved valuable because the researchers videotaped students during their work on the assigned, textbook-like tasks. As a

result, the researchers were able to study the differences between eighth-grade students' solving data analyses practices when students designed their own problems versus when the teacher-researchers set the problems.

This study shows the adaptive nature of design research both with respect to the intervention and research, thereby bettering the intervention and getting better data for understanding how students learn in an open-inquiry learning environment.

Critical Design and Social Change. Instead of simply building an artifact to help individuals accomplish a particular task or to meet a specific standard, critical design experiments focus on the development of social, technology-enhanced structures that facilitate human subjects individually and collectively in critiquing and improving themselves and the societies in which they function. Critical design experimenters agree that this substantially changes the roles of researchers, teachers, students, and administrators involved. Their point is to change the world (for the better) rather than merely to understand it. It may come as little surprise that some design researchers, as those in the example featured here, explicitly support or engage themselves in social agendas using what they come to understand for the purpose of increasing the participants' control over attendant conditions.

Quest Atlantis is a multi-user virtual environment that allows children to learn academic and social skills and to evolve social agendas as they assist the council of Atlantis in recovering the lost forms of knowledge and wisdom of the culture (Barab, Dodge, Thomas, Jackson, & Tuzun, 2007). The environment was designed to support the development of seven social commitments: personal agency, diversity affirmation, healthy communities, social responsibility, environmental awareness, creative expression, and compassionate wisdom through (a) Quests targeted toward individual commitment and (b) the technical infrastructure of the software. Changes to the original design were based on the concept of participatory design, a Scandinavian model for bringing together computer scientists and professionals to evolve more appropriate workplaces.

On the instructional side, Quest Atlantis situates itself at the intersection of education, a set of social commitments, and entertainment. The virtual world consists of worlds, each divided into three thematically related villages associated with up to 25 Quests. The themes include healthy bodies, community power, global issues, and waterways. There were five steps to the design experiment: the study (a) initially built rich understandings, (b) focused on developing critical commitments, (c) reified commitments into the design, (d) targeted the expansion of the impact, and (e) generated theoretical claims.

To build a rich understanding, the researchers conducted a 12-month ethnographic effort including more than 200 site visits and more than 500 pages of data entries in field notebooks. They conducted open-ended interviews with children individually and collectively and carried out semistructured interviews. The participating children built personal documents, including narratives and images (photographs). Finally, the researchers themselves kept diaries designed to record a day in the life of a particular participant. The researchers conducted laboratory studies with factorial ANOVA designs to test, among others, the impact of computing tools (3D vs. 2D) and collaboration (singles vs. dyads) on the ability to transfer skills to distal-level standardized items. Such experiments demonstrated that the Quest Atlantis software supports learning; other parts of the four-year study produced theoretical conjectures, including an expanded taxonomy of motivations involved while children learn through playing games.

As a result of their work, the researchers found to have been building “petite generalizations.” Petite generalizations are refined understandings of the patterns that researchers have encountered and that others in the field may likewise encounter. Most importantly, the ultimate product expanded its impact as it was redesigned, fitted, and adapted, together with the users, to the contingencies of each local setting.

The design experiment offers many advantages to the psychologist interested in designing and studying complex interventions in their naturalistic settings. Design experiment may be understood as an integrated approach to research and development that includes qualitative and quantitative approaches. This, then, allows design scientists to simultaneously (a) adapt interventions by taking into account local contingencies and (b) test hypotheses in a scientifically rigorous way that allows weeding out chance variations from true cause-and-effect relations. Design experiments thereby provide opportunities to meet the two major goals educational psychologists and learning scientists have set themselves: understanding knowing and learning scientifically and developing interventions that have a long shelf life because they meet the needs of the participants.

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Wolff-Michael Roth

DEVELOPMENT OF CORE KNOWLEDGE DOMAINS

From where does knowledge come? Scholars interested in this question have delineated three possible sources: experience, culture, and evolution. Knowledge obtained through experience is knowledge derived from one’s own observation and exploration of the physical world. Knowledge obtained through culture is knowledge initially derived by someone other than oneself but acquired through the process of cultural transmission. Knowledge obtained through evolution is knowledge of a genetic origin, endowed in humans by natural selection due to its utility to our prehuman ancestors.

Although few would dispute the claim that humans acquire knowledge through experience and culture, many have disputed the claim that humans have acquired knowledge through evolution. Indeed, this claim has remained controversial since its origins in ancient Greek philosophy and its revival in eighteenth-century Enlightenment philosophy (Stich, 1975), though, in recent years, it has gained substantial support from empirical studies of infant cognition and animal cognition. Drawing on the findings of such studies, Spelke (2000) has proposed that innate knowledge, or “core knowledge,” can be identified by three defining features: (1) domain-specificity, or a restriction on the types of objects and

relations the system can represent; (2) task-specificity, or a restriction on the goals and objectives the system can accomplish; and (3) encapsulation, or operational independence from other systems of knowledge.

Core knowledge is thought to guide learning in a variety of ways, from guiding the interpretation of one's early experiences to constraining the scope of one's early inferences to providing the foundations of one's future knowledge. Although there is some controversy as to what domains of knowledge are innate and what domains are not, scholars have pointed to at least five possibilities: (1) the domain of objects and their physical properties, (2) the domain of agents and their psychological properties, (3) the domain of space and its geometric properties, (4) the domain of number and its arithmetic properties, and (5) the domain of living things and their functional properties.

Evidence of early emergence, cross-species homology, and cross-cultural universality are stronger for some domains (e.g., the domain of number) than for others (e.g., the domain of living things). Nevertheless, there is ample evidence that all five domains emerge prior to formal instruction. Below are charted the development of three such domains: the domain of space, the domain of number, and the domain of living things. For each domain, characterizations are provided of (a) the domain's initial knowledge state, and (b) the domain's first major restructuring. Following these characterizations, this entry discusses general similarities and dissimilarities among the early transitions within each domain.

THE DOMAIN OF SPACE

Spatial cognition consists of a variety of competencies, including navigation, depth perception, landmark encoding, and reorientation. Here, the focus is on reorientation, or the process of realigning one's mental representation of the environment with the environment itself, as there is much evidence that reorientation involves an evolutionarily ancient mechanism present in both human and nonhuman animals.

The earliest studies of reorientation were conducted with rats (Cheng, 1986; Margules & Gallistel, 1988). In these studies, food-deprived rats were shown food being hidden in one of four corners of a rectangular enclosure. The rats were then removed from the enclosure and disoriented via rotation. Upon their return to the enclosure, the rats searched for the hidden food in either the correct corner or the geometrically equivalent corner, that is, the corner diagonal to the correct corner, which shares with the correct corner the property of being to the left of a short wall and to the right of a long wall (or vice versa, depending on the particular hiding location). Amazingly, the disoriented rats did not use the nongeometric properties of their enclosure, like wall color or wall odor, to guide

their search, even though these properties uniquely specified the food's location and were readily used as navigational cues by fully oriented rats. Similar results have since been obtained with monkeys (Gouteux, Thinus-Blanc, & Vauclair, 2001), fish (Sovrano, Bisazza, & Vallortigara, 2002), and chicks (Sovrano & Vallortigara, 2006).

Studies of reorientation in humans have revealed striking similarities between how disoriented children search for hidden toys and how disoriented rats search for hidden food (Hermer & Spelke, 1994; 1996). In these studies, children aged 18 to 24 months were shown a toy being hidden in the corner of a rectangular room and were then disoriented by being spun around with their eyes closed. Following disorientation, children tended to search for the toy in one of two locations: the correct corner or the geometrically equivalent corner. This behavior persisted even in rooms where the location of the toy was uniquely specified by a distinctive nongeometric cue: a blue wall. Thus, children, like rats, do not initially take nongeometric information into consideration when reorienting themselves, and they continue to ignore such information until around the age of 7 (Hermer-Vazquez, Moffet, & Munkholm, 2001).

Children's sensitivity to geometric information and only geometric information in reorientation tasks appears to be limited to a particular kind of geometry: the geometry of extended, three-dimensional surfaces. Studies that have explored children's reorientation behavior in open space have found that children do not reorient by the geometry of moveable objects within that space (Gouteux & Spelke, 2001). Moreover, studies that have explored children's reorientation behavior in different kinds of enclosures have found that children who fail to reorient by differences in wall color will nonetheless reorient by differences in wall shape (Wang, Hermer, & Spelke, 1999). The fact that children's reorientation is sensitive to some features of the environment (i.e., wall location, wall shape) but not others (i.e., wall color, object locations) suggests that the mechanism responsible for this behavior attends only to stable features of the environment unlikely to change from day to day or from season to season.

As mentioned previously, older children (and adults) do not reorient like rats. Instead, they reorient by both geometric information (e.g., wall location) and nongeometric information (e.g., wall color). What allows older children, but not younger children, to use such information? One hypothesis, suggested by Hermer & Spelke (1996), is that remembering the location of an object relative to nongeometric features of the environment requires encoding such relationships in language. In support of this hypothesis, Hermer-Vazquez and colleagues (2001) have shown that children's production of the words *left* and *right* is highly correlated with their use of

nongeometric information in reorientation tasks. Moreover, Hermer-Vazquez, Spelke, and Katsnelson (1999) have shown that adults' use of nongeometric information in these same tasks is significantly impaired when adults are required to listen to and repeat a tape recording of continuous speech, thereby preventing them from producing phrases like "left of the blue wall." These data imply that the development of spatial cognition is tied to the acquisition of spatial language, though the exact nature of this relationship has yet to be determined.

THE DOMAIN OF NUMBER

Numerical cognition, like spatial cognition, appears to be ubiquitous throughout the animal kingdom (Gallistel, 1990), and evidence of numerical cognition in humans can be found as early as six months of age. For instance, habituation studies have shown that 6-month-old infants can discriminate visual arrays of 8 dots from visual arrays of 16 dots (Xu & Spelke, 2000). Infants of this age have also been shown to discriminate auditory sequences of 8 tones from auditory sequences of 16 tones (Lipton & Spelke, 2005). By 9 months of age, infants are not only able to keep track of different numerosities but are also able to add and subtract those numerosities (McCrink & Wynn, 2004). That is, if they see five objects go behind a screen followed by another five objects, they expect to see ten objects when the screen is lowered, not five, as evidenced by a difference in how long they look at each outcome.

How do infants' number representations compare to the number representations of children and adults? Although some (e.g., Gallistel & Gelman, 2003) have argued that infants' representations form the basis of all subsequent mathematical knowledge, others (e.g., Le Corre, Van de Walle, Brannon, & Carey, 2006) have argued that these representations are too imprecise to support an understanding of integers and the operations defined over them. Evidence of such imprecision comes from the finding that although 6-month-old infants can discriminate 8 dots from 16 dots and 8 tones from 16 tones, they cannot discriminate 8 dots from 12 dots or 8 tones from 12 tones. Imprecision of this nature decreases with age, but it never disappears altogether (Barth, Kanwisher, & Spelke, 2003), which has led many to posit the existence of two distinct systems for representing number: (1) a nonverbal system capable of representing approximate numerosity, present from infancy through adulthood and shared with many nonhuman animals, and (2) a verbal system capable of representing exact numerosity, unique to humans and acquired around the age of 3 in the form of counting.

Because counting involves the mastery of a representational system not supported by core knowledge, learning how to count is not easy. In fact, studies of how

children learn to count have revealed that children acquire this ability in a succession of small, discrete steps (Wynn, 1990; Carey, 2004). First, children learn their language's "count list," or their language's list of words used to denote sets of increasing numerosity (e.g., "one," "two," "three"). Second, they learn how to apply this list to an array of objects by labeling each object in the array with one, and only one, word in the count list. Third, they learn that, when applying the count list to an array of objects, the last number word reached when counting corresponds to the cardinal value of the set. In other words, they learn that the word *four* refers not only to the fourth object encountered during the counting routine but also to the total number of objects encountered up to that point.

Evidence that children learn these three skills in stages, rather than in tandem, comes from dissociations in children's performance on simple numerical reasoning tasks. For instance, children are able to recite the count list long before they are able to apply it consistently to an array of objects. Likewise, children are able to apply the count list to an array of objects long before they realize that the last word reached when counting constitutes an answer to the question, "How many are there?" In fact, children go through a 6- to 9-month period during which time they are able to count a collection of objects but are not able to retrieve a particular number of objects from the collection. That is, when asked to retrieve a particular number of objects, they grab a handful at random and make no attempt to coordinate their knowledge of counting with their estimation of numerosity.

Of crucial importance to learning how to count is being exposed to a count list. Some cultures, such as the Piraha and Mundurucu tribes of the Amazon rain forest, do not have count lists, and the members of those cultures cannot therefore keep track of exact numerosities (Gordon, 2004; Pica, Lemer, & Izard, 2004). For instance, when shown a collection of objects and asked to select a particular number (indicated nonverbally with fingers or sticks), Piraha adults tend to produce a close match, but not an exact match, to the requested number, implying that the only system they have for representing numerosity is the imprecise system they inherited via evolution.

THE DOMAIN OF LIVING THINGS

Evidence for a core knowledge of living things comes not from studies of infant cognition or animal cognition but from studies of cross-cultural universals. These studies have revealed that, across cultures, children's early understanding of animals appears to be structured around three metaphysical commitments: (1) vitalism, or the belief that living things require energy in order to function; (2) essentialism, or the belief that living things possess an

internal “essence” that determines their outward appearance and behavior; and (3) taxonomic relatedness, or the belief that living things can be organized into inferentially rich, multilevel hierarchies.

An early-developing commitment to vitalism is evident from studies of children’s understanding of digestion, respiration, and circulation (e.g., Inagaki & Hatano, 1993; Morris, Taplin, & Gelman, 2000). In these studies, 5- and 6-year-old children are presented a variety of explanations for an activity like eating and are asked to select the best one. Although adults tend to prefer mechanistic explanations (e.g., we eat food “because we take the food into our body after the food is changed in our stomach”), children tend to prefer to vitalistic ones (e.g., we eat food “because our stomach takes in energy from the food”), regardless of their cultural upbringing. In line with these findings, preschool-aged children recognize that animals, but not artifacts, grow (Rosengren, Gelman, Kalish, & McCormick, 1991) and that consuming food is necessary for growth (Inagaki & Hatano, 1996).

Studies demonstrating an early-developing commitment to essentialism have focused not on children’s understanding of metabolic processes but on their understanding of inheritance (Gelman & Wellman, 1991; Sousa, Atran, & Medin, 2002). In these studies, 3- and 4-year-old children are told stories about a baby animal who was raised by adult animals of a different species (e.g., a cow raised by pigs) and are asked to predict which properties it would possess as an adult: the biological properties of its birth parents (e.g., a straight tail and a diet of grass) or the biological properties of its adopted parents (e.g., a curly tail and a diet of slop). Regardless of cultural upbringing, children tend to predict that the baby animal will grow to possess the biological properties of its birth parents, not its adopted parents.

Evidence of a universal commitment to taxonomic relatedness comes from studies of how individuals from different cultures categorize the flora and fauna of their local ecologies (Atran, 1990; Berlin, 1992). These studies have found that individuals the world over classify living things into hierarchies that typically include the ranks of “kingdom” (e.g., plants, animals), “life form” (e.g., trees, birds), “generic species” (e.g., oaks, parrots), and “folk-specific species” (e.g., white oaks, African Gray parrots). These ranks constrain a variety of biological inferences from inferences about how to extend known properties to novel organisms to inferences about how to extend novel properties to known organisms for children and adults alike. Indeed, children as young as 2 consistently use their knowledge of taxonomic relations to constrain their extension of known properties to novel animals (Gelman & Coley, 1990).

Despite the above evidence for an early-developing conception of living things, children have been shown to experience great difficulty grasping other aspects of biological knowledge, including the very meaning of the words *alive* and *dead* (Piaget, 1929; Carey, 1985). For instance, when children aged 8 and younger are quizzed on their knowledge of what is alive and what is not, they classify many things that are alive (e.g., flowers, tress, bugs, worms) as “not alive” and many things that are not alive (e.g., the sun, the wind, clocks, fire) as “alive.” Moreover, children of this age are reluctant to extend properties true of all living things (e.g., has cells, has babies, gets sick) to plants and insects.

These misconceptions suggest that children do not initially understand life as a process of maintaining and regulating bodily functions and death as the cessation of that process. Consequently, they confuse life with animacy, observability, or functionality, and they confuse death with inanimacy, unobservability, or nonfunctionality. Acquiring a correct conception of life appears to be tied to acquiring a mechanistic conception of biological functioning. Support for this claim comes from a study by Slaughter and Lyons (2003), in which children were questioned on their beliefs about death both before and after a teaching intervention designed to impart a mechanistic understanding of the internal workings of the human body. Before the teaching intervention, children revealed a number of misconceptions about the nature of death (e.g., that death can be avoided, that death can be reversed). After the teaching intervention, these same children revealed significantly fewer misconceptions, even though the intervention itself did not broach the topic of death.

TRANSCENDING CORE KNOWLEDGE

Each of the developmental transitions described above share at least two commonalities. First, all three transitions involve overcoming structural limitations in the architecture of core knowledge, whether they be limitations in the information used to reorient oneself in the environment, limitations in the precision with which numerosities are represented, or limitations in the properties used to identify living things. Second, all three transitions involve the acquisition of culturally constructed knowledge, whether it be knowledge of the words *left* and *right*, knowledge of a count list, or knowledge of the inner workings of the human body.

Commonalities aside, each developmental transition exemplifies a slightly different type of knowledge acquisition. For instance, children’s transition from geometry-based reorientation to landmark-based reorientation is more strategic than conceptual in nature, for this transition involves learning to attend to a spatial relationship

that had previously been neglected (i.e., “left of the blue wall”) rather than learning to conceptualize space in an entirely new way. Children’s transition from a vitalistic biology to a mechanistic biology, on the other hand, is more conceptual than strategic in nature, for this transition involves learning to conceptualize living things in an entirely new way (i.e., as self-sustaining, self-regulating machines) rather than learning to attend to a particular property of living things that had previously been neglected. The transition from an approximate representation of number to an integer-based representation of number also exemplifies a conceptual change, though the kinds of concepts that change within the domain of number (i.e., nominal-kinds concepts) are very different from the kinds of concepts that change within the domain of biology (i.e., natural-kinds concepts. Whether, and how, such a difference matters to the process of conceptual change itself has yet to be determined.

SEE ALSO *Concept Development; Theory of Mind.*

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Andrew Shtulman

DEWEY, JOHN 1859–1952

It is fair to say that the philosopher John Dewey, who was born before the Civil War in 1859 and died in 1952 just before the Eisenhower administration, has had the greatest single impact on American education of any scholar in



Portrait of John Dewey. COLUMBIANA COLLECTION, COLUMBIA UNIVERSITY LIBRARIES.

history. Dewey, more than anyone else, is associated with the alternative to traditional education known as child- or learner-centered education. Dewey's contribution to education was part and parcel of his contribution to shaping the intellectual life of the time in which he lived.

Dewey took the discipline of philosophy more seriously than most, borrowing five hundred dollars from an aunt after graduating from the University of Vermont in 1897 to pursue a doctorate at Johns Hopkins University this at a time when most philosophers at colleges were ministers with seminary degrees. Dewey's first academic job was at the University of Michigan, which was headed by a family friend. He spent 10 fruitful years in Ann Arbor, laying the groundwork for an approach to philosophy that he was able to apply to education in 1894 when he moved to the newly founded University of Chicago. Dewey was lured away from Chicago in 1904 and spent the remainder of his long career at Columbia University, retiring from that institution in 1930 but continuing to serve as an active professor emeritus until shortly before his death in 1952 at the age of 92.

There are at least three key ideas associated with John Dewey's approach to education that continue to resonate with progressive or, in current usage, *constructivist* U.S. educators. In fact, all three of the great reform movements in U.S. education, in the 1930s, 1960s, and 1990s, highlighted variations on these three themes: Individualism, the notion that it is up to the individual child, with guidance from the teacher, to make sense of his or her own experience; readiness, the notion that the child will learn when he or she is ready to learn; and pragmatism, the notion that the worth of learning lies in its instrumental value.

Individualism has repeatedly been central to reform efforts as a reliance on the pedagogy of personal experience, a belief that individuals must be the instigators of their own learning. The teacher, according to this view, works within the students' own experiential workspace as it were. The goal here, it should be emphasized, is a specific type of conceptual learning, the type that individual students induce from their own particular or discrete experience. The teacher, it is thought, in this child- or learner-centered approach, can at best only indirectly influence the inferential process of induction, pointing out to the learner patterns in particular data that become concepts and suggesting names for these patterns in a facilitative rather than a controlling way.

The second tenet of reform-oriented education in the United States is a corollary to the first: This is the need for the teacher to be watchful in fulfilling the facilitative role often described as being a *guide on the side*. Because student need is thought to drive the process

of induction, of rethinking personal experience, teaching is an opportunistic enterprise that depends on attentiveness to student needs. This idea, that students learn best when they are ready to learn, became an important curricular principle in 1966: Jerome Bruner's notion of the spiral curriculum, the idea that the way to handle differences in students' readiness to learn is to spiral back on important content that thus reappears throughout the elementary and middle school years. This principle derived from Dewey explains why curriculum content in the United States is organized in a block rather than hierarchical way as is the case in other countries, especially those where students perform better on international measures of achievement. Student achievement, particularly in mathematics and science, appears to be enhanced in countries where the content priorities at each grade level are made clear.

The third tenet, pragmatism, is part and parcel of the way Americans view knowledge. The key idea behind pragmatism is deceptively simple; the value of knowledge is a function of its usefulness or relevance. In the hands of Dewey-oriented educational progressives, this view of knowledge shifted the evaluative focus from content-oriented outcomes to so-called child- or learner-centered outcomes. In U.S. education, this process involves the substitution of measures of content knowledge for those that are thought to tap directly into student thinking processes. The issue here, a clear legacy of John Dewey, is whether process is viewed as being in service of content (the traditional view) or whether the opposite holds, namely, that content is viewed as being in service of process.

John Dewey enjoyed a long and fruitful career: His collected works, thirty-seven volumes in all, are divided into *The Early Works, 1882-1898* (five volumes), *The Middle Works, 1899-1924* (fifteen volumes), and *The Later Works, 1925-1953* (seventeen volumes). The bulk of Dewey's writing on education occurred in the first half of his career; his mature work in philosophy mostly dates from the second half of his career. One important debate, which goes beyond the scope of this entry, relates to the extent to which changes in his philosophical views after mid-career render many, if not most, of his earlier educational views obsolete. The specific issue is whether Dewey abandoned his earlier emphasis on inductionism in education, which he shared with William James, and adopted instead a more complex, realist view of learning and teaching derived from the philosophy of Charles Sanders Peirce (1839-1914). In brief, this view of learning assigns a major role to what can best be described as creative intelligence in the discovery of new ideas in the disciplines. Teaching thus is largely about getting students to look *with* ideas, not *for* ideas, as is the case in the early 2000s in the common alternative to traditional education.

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Richard S. Prawat

DIRECT INSTRUCTION

Direct instruction, as a general approach to instruction, involves explicit explanations, small learning steps, frequent review, frequent teacher-student interactions, and choral responses. This approach described by Rosenshine and Stevens (1984) is usually referred to with lower-case letters, *di*. Direct Instruction (with capital *DI*) is generally recognized in education as referring to the specific procedures and instructional material authored by Siegfried Engelmann (1931) and his colleagues. The instructional material is designed according to the principles presented in Engelmann and Carnine's *Theory of Instruction* (1982) and is supported by practices designed to control the details that affect student learning and that are under the schools' control: procedures for managing students, for placing them in the instructional sequences, for correcting errors, for scheduling instruction, and for training teachers.

The DI model was introduced in the mid-1960s at the University of Illinois and achieved impressive results with at-risk preschoolers, raising the children's IQs an average of 24 points and teaching them reading and math (Engelmann, 1970).

The DI model is guided by the basic principle that if children are not learning, the fault lies with the

instruction, not the children. DI programs are repeatedly tried out and revised before being published. Because DI instructional programs are referenced to the observed performance and deficiencies of at-risk preschoolers, the programs teach skills that have traditionally not been taught the language of instruction for example. The DI beginning language curriculum teaches prepositional concepts, actions, plurals, and parts of common objects. The program provides sufficient practice for children to learn the concepts thoroughly. The DI beginning reading program was the first to introduce phonemic-awareness skills (practice of blending and rhyming with orally presented words), completely decodable stories composed entirely of words that had been taught, and explicit instruction in comprehension skills (Engelmann & Bruner, 1969).

Each program is designed so that (a) it did uses language familiar to the children, and (b) it provides ample examples of each concept being taught. DI focuses on one concept at a time and then integrates the newly taught concept into applications that are familiar to the children. The instructional design principles of DI are based on logical analysis. One of the principles is that if what is presented to students is consistent with more than one interpretation, some students will learn the unintended interpretation. For example, if all the examples of “blue” the teacher presents are circular, some students will not learn that blue is a color, but a shape or a combination of a color and a shape. Another principle is that learners have the built-in ability to generalize from a set of examples that clearly demonstrates a concept.

Early applications of DI showed that preschoolers learned faster when the teacher used exactly the same wording in an explanation, rather than varying wording from one example to another (Carnine, 1980). DI provides a script that indicates the precise wording teachers are to say in connection with examples. The script specifies both student responses and correction procedures for more common mistakes. DI programs were the first to have scripted teacher presentations (Engelmann, 2007).

Other principles of effective instruction that emerged from the early DI efforts include the need for frequent checking of student learning, the need for adjusting the rate of new instruction according to the rate of student mastery, and the need for cumulative reviews to demonstrate to students that everything that is taught is reviewed and applied. Principles based on behavior analysis are also applied to DI teaching, including the need for students to receive plenty of reinforcement for correct responses, as well as for appropriate behavior.

DI programs are designed so that children learn only about 10% new material on each lesson. This approach assures that students who are correctly placed in an

instructional sequence will learn everything taught in the sequence. The approach also assures that students will be aware of their achievements and will tend to be more motivated to learn new material.

INSTRUCTIONAL COMPONENTS AND ACTIVITIES OF DIRECT INSTRUCTION

The published DI curricula in reading, language, math, and spelling are designed for preschool level through middle-school level with remedial programs for older students. For students to succeed they must be tested and placed into the DI curriculum where they belong. Instructional groups must be homogeneous so that all students in that group will succeed starting at the same spot in the instructional sequence. Although the activities and instructional components vary according to the content and skills the program addresses, some common features emerge, such as lessons designed so that each may be completed in a period. This provision makes it easier to measure the performance of children at any time during the year. If an average group started the program on the first lesson and has been in school 84 days, the group should be close to lesson 84 in the program and should be at mastery on all skills taught by lesson 84.

Another design feature is that lesson events are arranged so that more-reinforcing activities occur late in each lesson, not near the beginning. This feature ensures that students will work hard to get through the less reinforcing parts quickly so they “earn” the more-reinforcing activities.

In the beginning levels of the DI reading program, for instance, students start each lesson with work on the sounds different letters and letter combinations make. Next they read several new words, and words or word families that have been introduced in the last one to three lessons. The next activity is story reading. This is more reinforcing to the students than working on sounds or words in lists. Finally, students do independent work. This activity is also reinforcing.

DI introduces very little homework. The program assumes that there is a sufficient amount of time in the school day for students to do everything they need to do. What little homework is assigned is governed strictly by the rule that students must be able to perform without error at school on the same kind of assignment that they are expected to do at home before they are assigned to do it as homework. DI programs are built on the understanding that parents, particularly low-income parents, cannot be expected to teach their children at home.

DI MODEL COMPARED TO OTHER MODELS

Prevailing educational models variously called child-centered, progressive, or constructivist focus on how to teach, leaving the content up to the individual teacher, often based on student interest. The constructivist model assumes that if learners are placed in settings that provide autonomy and developmentally appropriate practices, students will learn naturally (Bruner, 1961). For example, balanced literacy proponents feel that the motivating power of “authentic” literature will help children learn to read faster than carefully constructed “decodable” stories. The frequently dismal outcomes of these approaches are what led to the creation of DI (see American Institutes for Research, *An Educator’s Guide to Schoolwide Reform* [1999] for a review of intervention outcomes).

The DI model has several features in common with behavior analysis. Both behavior analysis and DI focus on how to teach and how to respond to what students do, so that some behaviors are reinforced and others are extinguished. Both behavior analysis and DI analyze tasks and use the information to insure that pre-skills for these tasks are taught before the tasks are presented. But the DI analysis goes beyond tasks to concepts and families of related information. The result is that the manner in which the material is introduced and sequenced is more sophisticated in DI than it is in behavior analysis.

Mastery Learning might be considered by some to be another educational model similar to DI; however, it is not as complete as Direct Instruction’s model. Mastery Learning is based on the goal of bringing students to mastery of a series of objectives in sequence. Those students who achieve mastery with less practice engage in enrichment activities until the others have caught up. Then all begin work together on the next objective.

The DI model tries to arrange groups so all children in a group perform at the same level. In this way the faster students are not slowed by those who require more practice. Slower homogeneous groups progress through the lesson sequences more slowly than students who require less practice. DI also attempts to design the sequences so that mastery is achievable. Mastery Learning does not specify details of the teaching or how to sequence objectives efficiently.

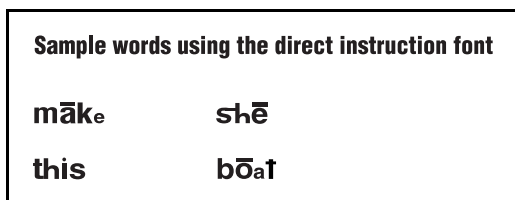


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

REVIEW OF DI CURRICULUM

Over the years many different curricula have been developed using the DI model. Two main classes of curricular sequences have emerged: developmental and remedial. The developmental curricula are designed to begin in kindergarten or first grade, teach a broad range of objectives, provide an unbroken sequence of skills across six year-long levels, and culminate in skills necessary for middle school. The remedial curricula are designed for older students (fourth grade through high school). These programs address narrower objectives. For example, the DI corrective reading strand that focuses on decoding addresses decoding problems poor readers typically have and provides specific remedies for the various problems. One problem is that students use generically different strategies for reading words in lists than they use for reading stories. The program addresses this problem through a dog that talks but becomes flustered when excited and says strings of unrelated words, such as “of for to do from go.” This technique requires students to apply the strategy they use for reading lists to read connected sentences.

DI has developmental curricula in reading, math, language and spelling. These programs are published by SRA/McGraw-Hill. More information can be found at their website under the Direct Instruction “product family.” The most complete developmental reading program is *Reading Mastery*. Designed to begin in kindergarten, *Reading Mastery* teaches beginning reading by teaching blending and a sounding-out strategy before introducing words. Also, the program has letter combinations that are joined, macrons to mark long vowels, and words with tiny letters that are not to be sounded out. (See Figure 1.) As students become proficient at reading words written with these font conventions, the letters are progressively changed until the font has no unusual features.

Connecting Math Concepts, the DI developmental program in math, teaches a broad range of math topics. As in other DI programs, concepts and strategies are taught in a series of lessons then reviewed and used in subsequent lessons and levels. Provided students are brought to mastery, the longer they use DI programs, the easier it becomes for them as well as for the teacher. The developmental programs in language include a three-year sequence, *Language for Learning*, *Language for Thinking*, and *Language for Writing*, as well as a six-level program called *Reasoning and Writing*. *Language for Learning* was developed initially to respond to the language deficits seen in at-risk preschoolers and is used in kindergartens primarily. There is also a six-level spelling program entitled *Spelling Mastery*. It, too, represents an unbroken sequence of skills from beginning levels up through middle-school spelling skills and includes unique curricular analyses such

as learning morphographs word parts which retain meaning and spelling across words.

Funnix is a CD reading program based on the *Horizons* reading series that has 120 lessons for the beginning level and 100 lessons for the following level. The program is used for tutoring or small-group instruction. The remedial reading program has two strands, *Corrective Reading Decoding* and *Corrective Reading Comprehension*. Each strand presents a three-year sequence that covers skills from those that are elementary to the middle-school level. Often the corrective reading programs are appropriate for lower-performing students in regular secondary classrooms. The *Corrective Math* series addresses remedial needs of students in math computation by focusing on an operation at a time: *Addition; Subtraction; Multiplication; Division; Basic Fractions; Fractions, Decimals and Percents; and Ratios and Equations*. The remedial spelling program is entitled *Spelling Through Morphographs*. More information can be found at the web site supported by Funnix.

RESEARCH BASE FOR DIRECT INSTRUCTION

The Direct Instruction research base is extensive and thorough. As stated in *An Educators' Guide to Schoolwide Reform*, "Direct Instruction has a lengthy and rich base of empirical research" (American Institutes for Research, 1999, p. 64). The *Educators' Guide* gave Direct Instruction its highest rating. Research has been conducted on individual Direct Instruction programs, different components of the Direct Instruction methodology, and school-wide implementations. A meta-analysis of published empirical studies is presented in Adams and Engelmann's monograph, *Research on Direct Instruction: 25 Years Beyond DISTAR* (1996). The analysis was based on 34 studies that met a strict set of criteria for analysis, including pretest scores, comparison group research designs, and use of appropriate statistical measures. The analysis disclosed that 32 of the 34 studies' effect-size scores were positive, with a mean effect size of 0.87 (Adams & Engelmann, 1996, p. 43). The monograph indicates that "effects of .75 and above are rare in educational research" (p. 42), which makes the results of the meta-analysis "overwhelmingly favorable" (p. 48).

Direct Instruction achieved impressive results in Project Follow Through (1968-1976), the largest educational experiment in history. Of the 22 models that participated in Follow Through, the Direct Instruction model displayed the highest impact on student learning in all academic subjects measured, including reading, mathematics, language, and spelling. DI also had the highest effect in all learning domains measured (basic skills, cognitive-conceptual skills, and affective measures). The Direct Instruction model was the only model in

Follow Through in which the average student score was above the 40th percentile in all academic subjects measured (Stebbins, St. Pierre, Proper, Anderson, and Cerva, 1977).

Follow-up studies indicated a lasting positive effect of Direct Instruction. Students who were in the first cohort of students in the Direct Instruction model in Williamsburg, South Carolina, had a significantly higher school graduation rate than the comparison group (Darch, Gersten, & Taylor, 1987). Students in the Direct Instruction model in New York City had significantly higher college application and acceptance rates as well as school graduation rates than the comparison group (Meyer, Gersten, & Gutkin, 1983).

Subsequent studies continue to confirm the effectiveness of the Direct Instruction model. In a 2000-2001 study of 40 schools in Houston (with a combined student population of nearly 10,000), Carlson, Francis, and Ferguson (2001) found that those schools implementing Direct Instruction outperformed the control schools significantly. Specifically, the authors concluded that the Direct Instruction implementation accelerated students' development of pre-reading and word reading skills in kindergarten and first grade, and students maintained a large lead in terms of skill acquisition over comparison students in the second grade. Students who stayed in the program longer achieved considerably better results by the end of first grade: 60% to 74% of the students at the DI schools scored above the 50th percentile on the SAT-9 Reading tests, but only 43% to 53% of the students at the control schools scored above the 50th percentile (Carlson, Francis, & Ferguson, 2001, pp. 5-7).

Since 2001, the Association for Direct Instruction has published the *Journal of Direct Instruction*. Archived articles from the journal are available via the Association's web site.

SEE ALSO *Applied Behavior Analysis; Behavioral Objectives; Constructivism: Overview; Feedback in Learning; Mastery Learning.*

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DISCOVERY LEARNING

SEE *Constructivism: Discovery Learning*.

DISCUSSION METHODS

Discussion methods are a variety of forums for open-ended, collaborative exchange of ideas among a teacher and students or among students for the purpose of furthering students' thinking, learning, problem solving, understanding, or literary appreciation. Participants present multiple points of view, respond to the ideas of others, and reflect on their own ideas in an effort to build their knowledge, understanding, or interpretation of the matter at hand. Discussions may occur among members of a dyad, small group, or whole class and be teacher-led or student-led. They frequently involve discussion of a written text, though discussion can also focus on a problem, issue, or topic that has its basis in a "text"

in the larger sense of the term (e.g., a discipline, the media, a societal norm). Other terms for discussions used for pedagogical purposes are *instructional conversations* (Tharp & Gallimore, 1988) and *substantive conversations* (Newmann, 1990).

A defining feature of discussion is that students have considerable agency in the construction of knowledge, understanding, or interpretation. In other words, they have considerable "interpretive authority" for evaluating the plausibility or validity of participants' responses. To illustrate, the following excerpt is taken from a discussion between a teacher and a small-group of second-grade students (from Eeds & Wells, 1989). They are discussing the short story, "Me and Neesie," by Eloise Greenfield. The story is about a girl, Janell, and her imaginary friend, Neesie, and the teacher and students are trying to understand why Neesie is at school with Janell for the day.

Austin: But nobody knew about her but Janell. And how could the teacher put her name down on the thing outside for her to be in the classroom if she didn't know about her?

Ashley: Well, actually, if only Janell could see her, why would Neesie be in the other classroom if Janell was the only one that could see her?

Austin: But what if she didn't go to school when Janell did?

Beth: But she did go to school when Janell did.

Chad: And nobody can see her, only Janell.

Ashley: Yeah, but why would they be in different classes if Janell's the only one that can see her? Why would she be in a different class?

Austin: I know.

Teacher: I think you're all agreeing, really, that the question doesn't make sense.

Justin: But the one who put her in the class can't see her.

Ashley: Yeah, but just Janell can.

Austin: The teacher wouldn't know about her.

Justin: I know! She would have snuck in if she's invisible.

The discourse is marked by many contributions from students and frequent student-to-student exchanges without interruption by the teacher. In this example, the only contribution from the teacher is to summarize the students' contributions. For the most part, students are responsible for constructing an understanding of why the imaginary friend, Neesie, is in school with Janell and why the fictional teacher allows Neesie to attend class for the day. The students ask questions they are genuinely

interested in exploring and that evoke a variety of responses (“authentic questions”), they build on each other’s responses by incorporating previous responses into their questions (“uptake”), and they challenge each other’s views in a collective effort to make sense of the text. Students’ contributions largely shape the discourse.

DISCUSSION VERSUS RECITATION

Discussions stand in contrast to a more traditional classroom event called *recitation*, so called because it provides a forum for the students and/or the teacher to recite what is known, usually from the reading of a written text. The defining feature of recitations is that the teacher controls the talk and has complete interpretive authority. To illustrate, the following excerpt comes from an 11th-grade English classroom (adapted from Langer, 1993, pp. 36–37). The teacher and the students have read the short story, “Tularecito,” by John Steinbeck and they are talking about the character Pancho.

Teacher: Who’s Pancho?

Mario: The employee.

Teacher: An employee, okay. Do you know anything else about Pancho?

Mariloo: He’s a Mexican Indian.

Teacher: He’s a Mexican Indian.

Tarek: He’s always sober.

Teacher: What else?

Rock: When he’s not in jail.

Teacher: When he’s not in jail, okay.

Matt: He doesn’t drive when drunk.

Teacher: All right. That’s good.

John: When he arrives at work he’s always sleepy.

Teacher: Yeah, and that’s important. Do you think he fools around? What gives you that impression?

In this case, the teacher contributed most to the talk. Indeed, in recitations, teachers typically talk about two-thirds of the time (Cazden, 2001). The discourse is marked by a pattern called the IRE (Mehan, 1979) or IRF (Sinclair & Coulthard, 1975): the teacher *initiates* a topic by asking a question (e.g., “Who’s Pancho?”); students *respond* to the question with an answer (e.g., “The employee”); and the teacher *evaluates* the student’s response or gives *feedback* (e.g., “An employee, okay”). The questions are intended to test or stimulate recall of what had been read (“known answer” or “test questions”). The teacher determines the nature of the questions, the order of the questions, and the correctness of students’ responses. Although the students offer their own responses,

the teacher does not allow them to explain what they mean about the character Pancho. Instead, she steers the talk in the direction she wants the students to take. The teacher has the ultimate interpretive authority and controls the discourse.

A criticism of recitation and the IRE/IRF pattern of discourse is that they can restrict student talk in ways that are counter-productive to the collaborative construction of knowledge, understanding, and interpretation. Students’ responses are typically no longer than two- or three- word phrases and teachers rarely acknowledge the value of students’ contributions by incorporating their responses into subsequent questions. Recitation can play a useful role in classroom pedagogy (Mercer, 1995) and there are ways of using the IRE/IRF to good effect (see Hicks, 1995; O’Connor & Michaels, 1996; Wells, 1993). Nevertheless, the oft-cited concern is that this traditional interactional cycle constrains students’ contributions and gives them little responsibility for shaping their own learning.

The relative incidence of discussion versus recitation is difficult to determine as there are few surveys of these classroom events that draw from nationally representative samples of classes, at least in the United States. Moreover, most of the research on recitation has been conducted at the secondary level. The best available reports indicate the discussions are rare in classrooms. A 1998 study by Commeyras and Degroff surveyed the pedagogical practices of a random sample of 1,519 K-12 literacy teachers and related professionals in the United States. They found that only 33% of respondents reported that they frequently or very frequently had students meet in small groups to discuss literature in their classrooms. They also found that such discussions were more common in elementary and middle school classes than they were in high school classes. Nystrand (1997) observed the instructional practices in 58 eighth-grade and 54 ninth-grade language arts and English classes in eight Midwestern communities in the United States. He found that open-ended, whole-class discussion averaged only 52 seconds per class in eighth grade and only 14 seconds per class in ninth grade. By contrast to these figures, recitation has a long and well-established history in U.S. classrooms (see Nystrand, 2006) and anecdotal reports suggest that it is still a pervasive phenomenon (Almasi, 1994; Cazden, 2001; Goldenberg, 1992; Tharp & Gallimore, 1988; Worthy & Beck, 1995).

METHODS AND DIMENSIONS

Discussion methods vary on a number of dimensions. Roby (1988) classifies types of discussions primarily on a continuum that relates to whether the teacher or students, or both, have interpretive authority. A secondary dimension is the content of the discussion. Using these

dimensions, he identifies three types of discussion. *Problematical* discussions focus on the solutions to either complex or simple problems in which the teacher is dominant in the discussions. *Dialectical* discussions focus on expressing, comparing, and refining students' (and the teacher's) points of view, and the students play a dominant role in the discussions. *Informational* discussions focus on controversial issues within an accepting atmosphere, and students have considerable freedom to bring up issues they wish to discuss. At the extremes are two types of what Roby calls "quasi-discussions": *Quiz Shows* and *Bull Sessions*. In the former, the teacher determines the questions to be asked and has almost all the interpretive authority; in the latter, the students have control over the topic and almost all the interpretive authority. In their 1949 study, Axelrod, Bloom, Ginsburg, O'Meara, and Williams, which was one of the first empirical investigations of discussion, also placed discussions on a continuum that related to whether the teacher or students had interpretive authority.

Gall and Gall (1976) classify discussions according to the instructional objectives: to achieve subject mastery, to bring about a change in attitude or opinion about an issue, or to solve a problem. An example of a subject-mastery discussion method is Manzo and Casale's (1985) *Listen-Read-Discuss Strategy*. In this method, the students listen to the teacher give a short lecture on the material to be learned, they read the pages of the text on which the lecture was based, and they then discuss questions raised by the text. An example of an issue-oriented discussion method is found in Roby (1983): *Devil's Advocate Strategy*. In this method, students articulate their positions on an issue and then take an opposing position and argue against themselves. An example of a problem-solving discussion method is Maier's (1963) *Developmental Discussion Strategy*. In this method, the teacher and students identify a problem, break it into manageable parts, and work on the parts in small groups. The small groups then reconvene as a whole class to discuss their solutions with the teacher.

Discussions about and around texts vary on a large number of dimensions. These approaches serve various purposes depending on the goals teachers set for their students, defined in terms of the stance towards the text: to acquire and retrieve information (an efferent stance), to make spontaneous, emotive connection to the text (an aesthetic or expressive stance), or to interrogate or query the text in search of the underlying arguments, assumptions, worldviews, or beliefs (a critical-analytic stance). Each approach comprises some type of instructional frame that describes the role of the teacher, the nature of the group, type of text, and so forth. Although the goals of these approaches are not identical, all have the potential to help students develop high-level thinking and comprehension of text.

Most variation across text-based discussion approaches is in the degree of control exerted by the teacher versus the students in terms of who has control of topic, who has interpretive authority, who controls turns, who chooses the text, and the relative standing on the three stances. Moreover, there is a relationship between degree of control exercised by teachers versus students and the stance toward the text. Discussions in which students have the greatest control tend to be those that give prominence to an aesthetic or expressive stance. These approaches are *Book Club* (Raphael & McMahon, 1994), *Grand Conversations* (Eeds & Wells, 1989), and *Literature Circles* (Short & Pierce, 1990). These discussions are often peer-led. Conversely, discussions in which teachers have the greatest control tend to be those that give prominence to an efferent stance. These approaches are *Instructional Conversations* (Goldenberg, 1992), *Questioning the Author* (Beck & McKeown, 2006; Beck, McKeown, Hamilton, & Kucan, 1997), and *Junior Great Books shared inquiry* (Great Books Foundation, 1987). It should be noted that *Questioning the Author* is the only discussion approach that was designed specifically to help students grapple with the meaning of informational text. Finally, discussions in which students and teachers share control tend to give prominence to a critical-analytic stance. In these approaches, the teacher has considerable control over text and topic, but students have considerable interpretive authority and control of turns. The approaches that fall into this category are *Collaborative Reasoning* (Anderson, Chinn, Waggoner, & Nguyen, 1998), *Paideia Seminars* (Billings & Fitzgerald, 2002), and *Philosophy for Children* (Sharp, 1995).

Other approaches to text-based discussion, not included in the above, are less easy to classify and there is less research on them. These are *Conversational Discussion Groups* (O'Flahavan, 1989), *Dialogical-Reading Thinking Lesson* (Commeyras, 1993), *Idea Circles* (Guthrie & McCann, 1996), and *Point-Counterpoint* (Rogers, 1990). There are also text-based discussions that have less consistency of application, so they cannot be readily labeled. These include the general class of literature discussion groups based on reader-response theory (see Gambrell & Almasi, 1996), discussion-based envisionments of literature (Langer, 1993, 1995, 2001), and instructional integrations of writing, reading, and talk (Nystrand, Gamoran, & Carbonaro, 2001; Sperling & Woodlief, 1997). *Accountable talk* is another approach to conducting intellectually stimulating discussions that, although not specifically designed for discussions about text, has applicability for promoting reading comprehension (Wolf, Crosson, & Resnick, 2004). It comprises a set of standards for productive conversation in academic contexts and forms part of the New Standards Project developed by Lauren Resnick and colleagues at the University of Pittsburgh.

Another dimension on which discussions vary is small-group versus whole-class discussions. In a 1991 study of 58 12th grade students, Sweigart found that student-led small-group discussions produced greater effects on students' recall and understanding of essays they had read than did lecture or whole-class discussion. Morrow and Smith, in a 1990 study of kindergarten students who engaged in discussions of stories that were read aloud, reported similar benefits of small-group discussions compared to one-on-one discussions with the teacher or whole-class discussions. Smaller groups provided more opportunities for students to speak, interact, and exchange points of view. Taking into account all available evidence, the best generalization that can be made is that smaller groups are better but they should not be so small as to limit the diversity of ideas necessary for productive discussions (Wienczek & O'Flahavan, 1994).

Yet another dimension is teacher-led versus student-led discussions. The relative merits of these formats have been the subject of debate and some research. On the one hand, the teacher can play an important role in discussion by keeping students on topic and modeling and scaffolding the talk to enhance the quality of their learning opportunities (O'Flahavan, Stein, Wienczek, & Marks, 1992; see also Wells, 1989). On the other hand, student-led discussions can enable students to collectively explore topics more fully and to have more control and interpretive authority (Almasi, 1994). Most probably the question as to who should lead the group is the wrong question. The issue is not so much who leads the group but how much structure and focus is provided while giving students the flexibility and responsibility for thinking and reasoning together (Mercer, 1995). Productive discussions need to be structured and focused, but flexible enough to foster generative learning and these can be teacher-led or student-led.

DISCUSSION AND STUDENT ACHIEVEMENT

Nystrand and Gamoran conducted possibly the largest study ever of the relationship between discussion and student achievement (Gamoran & Nystrand, 1991; Nystrand, 1997; Nystrand & Gamoran (1991). As described earlier, they observed the practices used in 58 eighth-grade and 54 ninth-grade language arts and English classes in eight Midwestern communities in the United States. They observed each class four times per year and assessed students' understanding and interpretation of literature at the end of each year, collecting data on over 1,895 students. Their results indicated that the features of open-ended, whole-class discussion were positively associated with students' reading comprehension,

as measured by both recall and depth of understanding, as well as response to aesthetic aspects of literature.

These results were largely replicated in a 2003 follow-up study by Applebee, Langer, Nystrand, & Gamoran of 974 students in 64 middle- and high-school English classrooms. Results showed that discussion-based practices, used in the context of academically challenging tasks, were positively related to students' reading comprehension and literature achievement.

Other correlational studies have shown similar benefits of discussion. A 2001 study by Langer, for example, studied the characteristics of instruction that accompanied student achievement in 25 schools, involving 44 teachers and 88 classes. She found that whole-class and small-group discussion was one of the characteristics of instruction in schools that showed higher than expected achievement in reading, writing, and English.

In a quasi-experimental study, Fall, Webb, and Chudowsky (2000) analyzed 10th-grade students' performance on language arts tests in which students either discussed or did not discuss a story they were required to read and interpret. Results showed that allowing students to engage in a 10-minute discussion of the story in three-person groups was positively related to students' understanding of the story.

Murphy, Wilkinson, Soter, Hennessey, and Alexander (2007) conducted a meta-analysis of quantitative studies that provided evidence of the effects of different approaches to text-based discussions on measures of teacher and student talk and/or of individual student comprehension and reasoning outcomes. Included were single-group pretest-posttest design studies and multiple-group studies. Three major findings emerged from the meta-analysis. One major finding was that the approaches to discussion differentially promoted high-level comprehension of text. Many of the approaches were highly effective at promoting students' comprehension, especially those that were more efferent in nature, namely *Questioning the Author*, *Instructional Conversations*, and *Junior Great Books shared inquiry*. Moreover, some of the approaches were effective at promoting students' critical-thinking, reasoning, argumentation, and metacognition about and around text, especially *Collaborative Reasoning* and *Junior Great Books*.

A second major finding was that increases in student talk did not necessarily result in concomitant increases in student comprehension. Rather, it seemed that a particular kind of talk was necessary to promote comprehension. This is consistent with observations from other research that the success of discussion hinges not on increasing the amount of student talk *per se*, but in enhancing the quality of the talk (Wells, 1989). A third major finding was that effects varied by students' academic ability. Results showed that the approaches exhibited greater effects when employed with below-average

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and average ability students and weaker effects with above-average students. It appears that above-average ability students could understand a text and think independently about the nuances of meaning even without participating in discussion.

Possibly the most stringent test of the benefits of discussions come from experimental and quasi-experimental studies that have examined the effects of a discussion approach, relative to a control condition, on commercially available, standardized measures (rather than researcher-developed measures). Murphy and colleagues (2007) found only five such studies: Mizerka's 1999 study of the effects of *Literature Circles*; Bird's (1984) study of the effects of *Junior Great Books*; and Banks (1987), Chamberlain (1993), and Lipman's (1975) studies of the effects of *Philosophy for Children*. Among these studies, the strongest effect was found by Lipman for *Philosophy for Children*, as measured by students' comprehension scores on the Iowa Test of Basic Skills, with an effect size of 0.55. The effect sizes for the other studies averaged approximately 0.20.

An important finding from research on discussion methods is that they can benefit both fluent and limited-English-proficient (LEP) students. Saunders and Goldenberg (1999) conducted an experimental study of the effects of *Instructional Conversations*, in combination with literature logs, on 116 fourth and fifth grade LEP and English-proficient students. Results showed both fluent and LEP students who participated in the *Instructional Conversations* + literature logs condition scored significantly higher on factual and interpretive comprehension than did students in other conditions. Other studies of *Instructional Conversations* have reported similar benefits for LEP students. Nystrand (2006) noted a number of studies that provided evidence of the benefits of discussions for L2 as well as L1 speakers.

SEE ALSO *Collaborative Learning; Questioning.*

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DISTRIBUTED COGNITION

Proponents of distributed cognition argue that the distribution of cognition across the brain extends to material settings and artifacts, to social interaction, and across time. A cognitive process involves representational states in the world and in the head that are brought into coordination with one another. This coordination may be strictly internal, but it more typically involves interaction with one or more technologies, interactions among multiple persons, and/or incorporation of products of past cognitive activity.

Because cognitive processes may extend beyond the head of the individual, researchers of distributed cognition use a broader unit of analysis when studying cognitive systems. Depending on the goals of the analysis, the boundary of the cognitive system may be defined around a person working with a tool or artifact, a team of people and their tools, or the skull of a single individual. To avoid over-attribution of internal states, distributed cognition researchers prefer to work outside-in, using analysis of visible activity to set constraints on what must be happening in the internal cognitive system.

HUTCHINS'S VIEW OF DISTRIBUTED COGNITION

Distributed cognition is most closely associated with the work of the cognitive anthropologist Edwin Hutchins (1948) at the University of California, San Diego, and with his students and colleagues. In his groundbreaking research, Hutchins studied the work of a navigation team on a navy ship. The team used specialized tools and coordinated activity to accomplish more than could be done by any individual thinker. This study led Hutchins to broaden his definition of what constituted the cognitive system and to argue that cognition is distributed in three fundamental ways: across the individual and aspects of the material environment; across multiple individuals interacting and communicating in an organized way; and across time, in that products of earlier cognitive processes change the nature of later cognitive tasks.

Material Distribution of Cognition. A cognitive task as mundane as multiplying two-digit numbers is rarely done in the head; instead, multiplication commonly involves a written representation of the problem or the use of a calculating device. Many familiar cognitive activities are impossible without such artifacts: clocks, for example, are manufactured precisely to support time telling, and much instruction in the early grades is devoted to learning to read clock times. In complex domains such as ship navigation, specialized tools and procedures have been developed over centuries to solve important, frequently recurring problems such as determining the ship's location or speed. Mastering their use is essential to becoming an expert navigator.

While such artifacts seem to amplify natural cognitive abilities a written list, for example, augments memory the most powerful cognitive artifacts transform tasks so that complex computations can be carried out through simple manipulation and perception. One example is the nautical slide rule, which can be used to solve distance-rate-time problems by moving dials, aligning marks, and reading numbers, all far simpler than applying algebra and arithmetic, even with the aid of paper and pencil or a calculator. The slide rule method is also less prone to error: The computational relations among distance, rate, and time are built into the structure of the artifact, locking out many possible errors. The use of the slide rule is easily learned, and the system of person plus artifact is powerful and reliable although not readily generalizable to other task settings. Like the slide rule, most cognitive artifacts are linked to specific practices, in which they enable humans to use simple abilities to produce sophisticated outcomes.

From the perspective of distributed cognition, a person using one or more cognitive artifacts constitutes

a cognitive functional system for solving a particular problem. The user is the glue that binds this system together—the one who coordinates the various resources, internal and external, to produce the desired result. Different functional systems can be computationally equivalent—that is, they can start from the same inputs and produce the same outputs—yet vary greatly in the demands they place on the person. For example, multiplying two-digit numbers through mental arithmetic is difficult and prone to error. Writing a multiplication problem in a conventional form and applying a school algorithm helps keep track of intermediate results but still demands accurate recall of the procedure and the multiplication tables. Punching a sequence of buttons on a calculator or looking up the answer in a table is simple to do but requires that the specialized tool be ready at hand—more likely in a work setting where tasks often repeat. These distinct methods use different resources, place different demands on memory and mental processes, and have different propensities for error, yet all accomplish the same computation.

In real-world activity, a cognitive functional system is dynamically instantiated to solve a current problem and then dissipates as soon as the problem-solving event is over. In unusual situations, the functional system may be wholly improvised and quickly forgotten; in more familiar situations, the functional system is likely to be highly conventionalized, although always fitted to the particular circumstances. Such conventional functional systems constitute a significant portion of the curriculum in schools, universities, and trade and professional training programs.

Social Distribution of Cognition. Through orchestrated group activity, humans accomplish tasks that would overwhelm any individual, while social institutions distribute labor and expertise across groups, sustaining complex societies. From sports to science, nearly every human endeavor depends on the social coordination of activity, whether among people in close proximity or widely dispersed in time and space. How social groups are organized, how work is divided, how knowledge is distributed, and how information is communicated all have important cognitive consequences.

Fundamental to distributed cognition is the idea that a group may have cognitive properties that differ from those of the individual. A group may have greater knowledge and processing capacity and speed, enabling it to accomplish a task too complex for a single person, especially under severe time pressure. In Hutchins's study of ship navigation, the team had to fix the position of the ship and project its future position at three-minute intervals; when the circumstances were most harrowing, the interval was reduced to one minute. The team succeeded by distributing subtasks into local functional systems

(individuals with specialized tools) like those discussed above and coordinating the flow of information between these systems through a distinct pattern of social interaction. This arrangement produced a global functional system for navigation that operated rapidly and reliably and that proved to be robust in the face of changing circumstances.

How work is divided across the members of a social group matters because some divisions are more productive and robust than others. In organizing group work, it is beneficial to maximize parallel effort without violating sequential dependencies in the task (what must be done before what). If some group members are idle or must undo or redo what has already been done by others, then the system will operate inefficiently. It may also be useful to divide activity in a way that provides mutual access and monitoring, both to catch errors and to promote learning—for which some modest yet non-catastrophic rate of error is beneficial. Or it may be useful to isolate some parts of the system from potential distraction or disruption. How activity is distributed across the group partially determines how the system adapts to change, making it more flexible or brittle; a modular arrangement, for example, makes it easier to alter some parts of the system without impacting others. Social organization and the distribution of labor—both physical and cognitive—crucially affect the success of the global functional system.

Other critical social factors include the distribution of knowledge and the pattern of communication among members of a group. Overlapping knowledge supports error detection, increasing the robustness of the system, while different patterns of communication can lead to different outcomes. In Hutchins's study, the promotion of quartermasters to new jobs paralleled the flow of information during the navigation task. The result was that those performing more critical parts of the task understood how the information they received had been generated since they themselves used to perform that portion of the task. Sensory activities such as sighting landmarks through a special telescope fed integrative and evaluative activities such as fixing the ship's location, projecting its future position, and assessing the quality of the fix. The operation of this socially distributed system thus parallels conventional descriptions of individual cognition.

Finally, in systems of socially distributed cognition, it is not necessary, nor is it always efficient, to have a central executive or overseer who coordinates the activities of the group; instead, the group can operate interdependently. Computational dependencies can be turned into social dependencies, so that one group member relies on another's output to perform his portion of the task; this dependence keeps the system from halting

prematurely. However, there may be times when it is helpful to have an experienced observer watch the group's activities and recommend ways to help the system operate more efficiently. Here the observer is engaged in a different activity: representing and evaluating the performance of the system—a metacognitive function.

Temporal Distribution of Cognition. Human cognition incorporates products of past activity, distributing cognition over time. Environments for human cognition are highly artificial, crafted to support certain activities, and riddled with representations. These activities follow conventional social practices and incorporate artifacts provided by others often unknown or long since deceased. The residua of past cognition—material and conceptual—become structuring resources for new cognitive functional systems. Human cognition is thus inherently cultural, where culture is a process that accumulates partial solutions to frequently encountered problems.

In addition to increasing the sophistication of human cognitive accomplishments over many generations, the temporal distribution of cognition also provides an immediate benefit: It reduces cognitive load by spreading complexity over time. A navigation chart, for example, represents the results of centuries of work by navigators and cartographers; this precomputation turns the chart into a powerful computational tool. A line drawn on the chart gains an immediate relation to all the information represented there; drawing two intersecting lines executes a computation that connects a navigator to the ages.

Here in the temporal distribution of cognition, the material, social, and conceptual come together. Every moment of practice resonates on three vastly different timescales: the conduct of the activity, the development of the practitioner, and the development of the practice. This intersection explains why researchers who study distributed cognition are drawn to studying cognition in real-world settings, to what Hutchins calls “cognition in the wild.”

HOW DISTRIBUTED COGNITION DIFFERS FROM INDIVIDUAL VIEWS OF COGNITION

The cognitive revolution that led to information processing psychology and artificial intelligence was founded on the idea that the mind, like a computer, is a symbol processing system: The senses transduce perceptual input into symbols which are operated on by an internal logic engine, producing other symbols that are programs for action. Distributed cognition preserves the view that humans are users of symbols and that cognition is computation but dispenses with internal symbol processing as the fundamental architecture of cognition. Cognition is

computation accomplished through the propagation of representational states across representational media, which may be internal or external to the individual. Representational states are propagated by bringing the media into coordination with one another. Broadening the unit of analysis to socio-technical systems actually helps make the idea of cognition as computation plausible: Inputs are transformed into outputs through the operation of cognitive functional systems. The operation of these distributed systems is what is modeled by formal systems such as computers—not internal symbol processing in the head.

IMPLICATIONS OF DISTRIBUTED COGNITION FOR EDUCATION

Because distributed cognition focuses on activity in real-world settings, most research has investigated learning in the context of work; domains include ship navigation, fleet fishing, air traffic control, and commercial aviation. Despite the limited availability of classroom-based research, distributed cognition does offer a perspective on learning that can inform classroom instruction, both for mastering conventional systems and for supporting innovation.

Distributed cognition views learning as adaptive reorganization in a functional system. This definition covers organizational learning (the activity of groups) as well as individual learning, so long as some parts of the system adapt, or are adapted, to structure in other parts. Learning may involve changes internal to the individual, changes in the world (in representations, tools, and settings), and/or changes in social interaction. Changes internal to the individual have been the focus of traditional learning theories, probably because it is the person who brings the media into coordination to accomplish the task. A broader unit of analysis, however, entails a broader understanding of what counts as learning in a cognitive system.

For students, mastering conventional systems means more than developing simple literacy and numeracy; it means learning to compose and use functional systems to reliably perform culturally valued activities. Learning to tell time from the display of hands on a clock, for example, involves learning to coordinate ideas of number, shape, and motion with structures on the clock face and with the conventions of the system of time measurement. During instruction, a teacher guides this coordination through talk, gestures, and manipulations of objects. With practice, the student becomes able to perform without this guidance. With further practice, the student begins to recognize familiar patterns and to shift strategies, for example, from counting to directly naming times; this adaptation yields a different but computationally equivalent functional system that operates more efficiently. To help students master conventional systems,

familiar teaching practices of modeling, scaffolding, and reinforcement work well, the fading of material and social supports coinciding with the encouragement of independent practice.

Innovating is different in that the individual or group must use the resources at hand to compose a functional system to accomplish a novel task, where the method for doing so may not be readily apparent. In Hutchins's study, the navigation team suffered the loss of the gyrocompass while the ship was navigating a narrow channel; the team was forced to invent new procedures immediately as the ship faced the danger of running aground. At first, the team's activity was driven almost entirely by the environment by whatever information happened to be coming in. As individuals made changes to simplify their own activity, others adapted to these changes. Eventually, the system settled into a stable pattern—a new functional system that dissipated as soon as the crisis was over. To help students innovate, teaching practices that introduce variability into established systems or that pose novel problems are likely to work best. These should be followed by comparison and analysis of different approaches, paying particular attention to the representations used, their coordination, and any adaptations that had to be made. Other topics to discuss include the specificity or generality of the approach, its propensity for error, and the demands it places on the person using it. Distributed cognition provides a useful framework for guiding such discussion.

SEE ALSO *Constructivism; Information Processing Theory; Situated Cognition.*

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Robert F. Williams

DROPPING OUT OF SCHOOL

An important focus in education research is the occurrence of high school non-completion. The work of defining, measuring, and reporting on students who drop out

of school permeates the research. Theorists and policy makers utilize varying methods of counting and reporting those students who do not complete their high school education. In addition, tracking families who opt for private school or change schools or districts and students who choose to complete requirements for a General Education Diploma further complicates the process of making accurate estimates regarding attrition.

The two prominent reporting agencies, the National Center for Educational Statistics (NCES) and the United States Bureau of the Census (Census), report on different aspects of the outcome performance. One focuses on high school completers, whereas the other focuses on non-enrolled and non-completing people who are aged 16 to 24. According to the Census, dropout estimates from 1967 to 2003 showed a decrease from 17% to 10%; however, NCES reported high school completion rates ranging between 65% to 75% for roughly the same time period (1967–2002) (Warren & Halpern-Manners, 2007). This phenomenon needs more uniform definition and measurement. The Interdivisional Task Force on School Dropout Prevention, created in response to the American Psychological Association's 1996 call for increased research and understanding into the educational outcome of dropping out, revealed that the majority of prior research did not focus on intervention and prevention programs (Doll & Hess, 2001). Much is known, however, about the individual characteristics and other factors that place students at-risk of dropping out of school.

RISK FACTORS AND PREVALENCE

Most research on the phenomenon of dropping out focuses on a deficit model, on what students are lacking. The personal characteristics that have been consistently identified as placing students at-risk for educational failure and subsequent dropout include: minority group status, low socioeconomic status/families receiving welfare, exceptionalities and disabilities, English as a second language, low test scores and grades, misbehavior/suspension, grade retention, over age for grade, absenteeism, multiple school moves, single parent homes, large urban schools, poor neighborhoods, low parental/mother education, and student emotional/behavior disorders (Nowicki, Duke, Sisney, Stricker, & Tyler, 2004; Suh, Suh, & Houston, 2007). Of the dropouts in 2005, 65% were over age for grade; 61% were minorities; 58% were male; 33% were from low-income families; and 17% were second generation or less immigrants (NCES, 2005). Researchers have increasingly moved away from deficit models of academic failure to more positively focused models such as examining environmental and instructional factors that facilitate students' resiliency (see Freeman, Leonard, & Lipari, 2007, for a review).

Inconsistent findings across dropout prevention programs highlight the problem of using deficit models, in that programs are only effective for some students, but no program has been able to improve the outcome for all at-risk students (Dynarski & Gleason, 2002). In light of the government-mandated move to increased academic accountability and performance standards on standardized tests (No Child Left Behind Act, 2002), research efforts have increasingly focused on the multi-level influences that contribute to students either being pushed out, dropping out, or persisting in school. The theoretical underpinnings of most of this work utilize Urie Bronfenbrenner's ecological systems theory as a starting point to identify obstacles and protective factors in students' environments (Cassidy & Bates, 2005; Gallagher, 2002).

CONTEXTUAL ANTECEDENTS OF DROPPING OUT

According to Bronfenbrenner, changes within and between the microsystems (school, family), exosystem (neighborhood, extended family), and the macrosystem (culture, government) can influence an individual's development, as well as the person's choices in terms of staying in school. More specifically, such administrative issues as harsh discipline policies and grade retention have been shown to be related to students' decision to dropout of school (Cassidy & Bates, 2005; Stearns, Moller, Blau, & Potochnick, 2007). Furthermore researchers and theorists have highlighted that leaving school early is not a sudden occurrence, but a process that occurs over time and results from certain interactions between student, family, and school (Christenson & Thurlow, 2004). Theorists have also emphasized that some students may begin disengaging from school as early as elementary school (Finn, 1989); whereas the documented decrease in achievement motivation that occurs during the transition into middle school (Anderman, Maehr, & Midgley, 1999) further complicates students' progress to high school completion. Beyond the demographic predictors that place students at risk of dropping out, researchers have identified how certain psychosocial factors tend to co-occur.

PSYCHOSOCIAL PREDICTORS

Research evidence from multiple theoretical and methodological approaches supports the relational nature of students' motivation and academic achievements, including high school completion (Finn, 1989; Whelage, 1989). Qualitative evidence from both dropouts and school staff members (principals, teachers, counselors) identifies the psychological and social aspects of students' decisions to withdraw from school (Anderson, Kerr-Roubicek, & Rowling, 2006; Gallagher, 2002). Such variables as feelings of

alienation, perceptions of teacher caring, feeling a sense of school belonging/community, academic valuing, academic identity, locus of control, future optimism, self-esteem, disengagement, and participation are some factors shown to be related to the outcome of dropping out (Anderson et al., 2006; Gallagher, 2002; Kemp, 2006; Nowicki et al., 2004; Osborne & Walker, 2006; Reschly & Christenson, 2006; Stearns et al., 2007; Su, Su, & Houston, 2007).

The demographic characteristic of minority group status alters how such psychological and social variables influence students' academic trajectories; this correlation has stimulated research on minority students' developmental processes. For example, Osborne and Walker found that minority students who had a high level of academic identification and subsequent high levels of academic success were more likely to withdraw from school than their Caucasian counterparts. Thus, other psychosocial variables such as stereotype threat (Steele, 1992), in which case the threat of confirming a negative stereotype negatively impacts minority students' academic performance, also play a role in students' reasons for not completing school, as well as their motivation in continuing to pursue positive academic goals. Likewise, students from low income families have been shown to greatly benefit from having an internal locus of control and higher levels of self esteem (Nowicki et al., 2004). Research has shown multiple determinants for dropping out of school and each student's trajectory may be different based on the student's personal and social circumstances. Once students have formally withdrawn from school, they face many challenges associated with the adult world of work and survival.

CONSEQUENCES OF DROPPING OUT

As emphasized in reports on Project Head Start, students identified as at-risk who receive early intervention seem to escape the negative life paths associated with dropping out of school. Some of the most noted consequences of being a high school drop out are lower economic status, higher rates of delinquency, greater reliance on government sponsored programs, higher rates of criminality (75% of inmates are high school dropouts), lost local and state tax revenues, four times higher unemployment rates, lower self-esteem (Edmonson & White, 1998), increased drug use (Dynarski & Gleason, 2002), and higher incidence of mental health problems (Brewster & Bowen, 2004). Given the gravity of these negative life outcomes, the need for intervention and prevention programs is obvious.

SUCCESSFUL INTERVENTIONS

Many dropout programs promote academic success, improved self-esteem, psychosocial skill development,

mentoring, adult behavior management training, and increased student participation in school activities. Other program initiatives focus on creating more intimate environments and helping students to overcome personal, family, and social barriers (Cassidy & Bates, 2005; Dynarski & Gleason, 2002; Prevatt & Kelly, 2003). Overall, dropout prevention/intervention programs that take a multifaceted approach appear to be the most effective in helping at-risk students complete their high school education. According to Christenson and Thurlow, successful interventions typically first address students' personal-affective needs and then address their academic needs. They also stress supportive connections between the students and their families and the teachers and student peers.

IMPLICATIONS FOR TEACHERS

Understanding both individual and environmental factors that cause students to drop out can help teachers break the negative processes that can lead to students disengaging from school and eventually withdrawing altogether. Across intervention programs, teachers who are perceived as creating caring, respectful, and relevant educational environments and experiences are the ones who tend to facilitate academic resiliency, giving students the chance at more adaptive life outcomes after high school graduation.

SEE ALSO *At-risk Students*; Bronfenbrenner, Urie; *Stereotype Threat*.

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DUAL CODING THEORY

Dual coding theory is a general theory of cognition and mind. It originated in the 1960s to explain the powerful effects that mental imagery has on memory, and it has been extended since to account for increasingly more mental phenomena. Dual coding theory has inspired much research and debate in psychology, and it has played a major role in stimulating a modern resurgence of interest in mental imagery and its role in mind. It has been described as "one of the most influential theories of cognition this century" (Marks, 1997). It has been directly applied to education in several fields. The major volumes that detail the theory, its extensions, and its empirical base are Paivio (1971, 1986, 1991, 2007), Paivio and Begg (1981), and Sadoski and Paivio (2001).

Dual coding theory is sometimes referred to as a theory of mental imagery, particularly visual imagery. However, the theory is more than that. From an historical perspective, it is the first systematic, scientific attempt to bridge two traditions in philosophy and psychology: the imagery tradition and the verbal tradition. The

imagery tradition can be traced to the emphasis on concrete experience and thought in Aristotle, the Renaissance educators' slogan of "things not words," the pragmatism of George Herbert Mead and John Dewey, and aspects of the cognitive revolution in modern psychology. The verbal tradition emphasized the abstract and can be traced to the idealist philosophy of Plato, Peter Ramus's epitome of linear verbal organization, Immanuel Kant's transcendental idealism, and the exclusive emphasis on language in behaviorist psychology. The historical tension between these traditions is recounted in Yates (1966), Carruthers (1993), Paivio (1971, 2007), and Sadoski and Paivio (2001). The implications of bridging these two traditions are far reaching but remain controversial in the early 2000s.

BASIC PRINCIPLES OF DUAL CODING THEORY

The core ideas of dual coding theory can be stated succinctly: The theory assumes that cognition involves the activity of two qualitatively different mental codes, a verbal code specialized for dealing with language in all its forms and a nonverbal code specialized for dealing with nonlinguistic objects and events in the form of mental images. These coding systems are separate but interconnected so that they can operate independently, in parallel, or through their interconnections. The linguistic, or verbal, code dominates in some tasks, the nonverbal code dominates in others, and both systems are frequently used together. The great diversity and flexibility of cognition all comes from activity within and between these codes. No deeper, abstract code is assumed.

Dual coding theory is based on the common assumption of a continuity between perception and memory. External experiences occur through the stimulation of people's senses and are encoded in memory traces that retain some of their original, concrete qualities as words and things. The theory is, therefore, multimodal because both verbal and nonverbal experiences can occur in different sense modalities, including vision, hearing, and touch (Braille) in the case of language, and all five senses in the case of mental images. Theories of working memory that propose different, modality-specific memory stores are generally consistent with dual coding theory. For example, the working memory theory of Baddeley and Hitch (1974) proposes a phonological loop for rehearsing inner speech and a visuospatial sketchpad for manipulating visual images. Dual coding theory assumes that long-term memory is modality specific as well.

Dual coding theory also assumes innate contributions to cognition and individual differences because all human nature is the product of the interaction of genes and the environment. More layers of complexity are built on these basic assumptions, including accounts of mean-

ing, memory, knowledge organization, and learning. One direct implication of the theory is that pictures or concrete language (e.g., juicy hamburger) should be understood and recalled better than abstract language (e.g., basic assumption), a consistent research finding.

APPLICATIONS AND EXTENSIONS OF DUAL CODING THEORY

Perhaps the most productive application of dual coding theory has been to literacy. The theory offers empirically supported accounts of all aspects of literacy, including decoding, comprehension, and response in reading (Sadoski & Paivio, 1994, 2001, 2004, 2007), written composition (Sadoski & Paivio, 2001), and spelling (Sadoski, Willson, Holcomb, & Boulware-Gooden, 2005). A large-scale instructional program to improve reading comprehension by teaching students to visualize while reading text was successfully applied in urban schools (Sadoski & Willson, 2006). Another application used kinesthetic imagery in teaching reading comprehension strategies such as how to locate the main idea (Block, Paris, & Whiteley, in press). An extensive review of applications to literacy is found in Sadoski and Paivio (2001, Chapter 8). A review of applications to other aspects of education is found in Clark and Paivio (1991).

The use of mental imagery and language in learning psychomotor skills also has been extensively studied. The procedure typically takes the form of guided relaxation followed by mentally imagining physical acts in detail from a verbally presented description. Two meta-analyses of experimental studies found substantial overall effects (Feltz & Landers, 1983; Driskell, Copper, & Moran, 1994). Studies employing heavily cognitive tasks (touching intersections on a grid) had larger effects than more purely motor tasks (tennis shot) or strength tasks (bench press). These techniques have been used to teach medical students to draw blood and perform basic surgery (Sadoski & Sanders, in press).

The most ambitious extension of dual coding theory is its explanation of the evolution of mind (Paivio, 2007). In this view, hominid intelligence evolved from a primeval nonverbal base into a more recent period that incorporated language. Verbal and nonverbal thought have been synergistically bound since. Mental images from memory represented perceptually absent events whether past, present, future, possible, or impossible. In turn, language provided an increasingly sophisticated system of signs for efficient thought and communication between and within our human ancestors. This combination of imagination and language is seen as the evolutionary power source of all human progress (cf. Bronowski, 1978).

CHALLENGES AND CONTROVERSIES

Dual coding theory can be contrasted with theories which assume that all cognition has a common, abstract code in the form of schemata or propositions (Sadoski, Paivio, & Goetz, 1991). This mentalese is assumed to be computational in nature, built into the brain like a computer's built-in machine code (Pylyshyn, 2003). Proponents believe that this conception is more elegant and parsimonious than dual coding theory, and some aspects of cognition have been modeled in computers to a degree (Seidenberg, 2005). However, Paivio (2007) responded that such theories lack elegance because of the complexity of their programming, and they cannot account for findings involving mental imagery, concreteness effects, and neuropsychological evidence. These debates remain unresolved and challenging.

SEE ALSO *Memory; Providing Explanations.*

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Mark C. Sadoski

DWECK, CAROL S(USAN)
1946–

Carol Susan Dweck is a leading expert on achievement motivation. She has investigated variables that impact individuals' adaptive versus maladaptive responses to academic challenges. Dweck received her BA from Barnard College, Columbia University in 1967, graduating magna cum laude with honors in psychology. She continued her education at Yale University, where she was a National Science Foundation Fellow (1967–1971) and earned a PhD in psychology in 1972. Dweck began her academic career in the Department of Psychology at the University of Illinois at Urbana-Champaign, first as an assistant professor (1972–1977) and then as an associate professor (1977–1981), and returned there later as a professor (1985–1989). From 1981 to 1985 she was a professor at Harvard University in the Laboratory for Human Development. From 1989 to 2004 she was on the faculty of Columbia University, where she was the William B. Ransford Professor of Psychology. Since 2004 Dweck has been the Lewis and Virginia Eaton Professor of Psychology at Stanford University.

ACHIEVEMENT MOTIVATION PATTERNS

Based on extensive research, Dweck has identified two major achievement motivation patterns. In each, individuals' implicit theory of intelligence (i.e., their beliefs about the nature of intelligence), goal orientation, and response to academic challenges are associated. Those with an entity theory view their intelligence as a fixed trait that cannot be developed. They tend to endorse performance goals that focus on obtaining a positive evaluation of their ability and avoiding a negative evaluation. When they experience failure they typically show a helpless response characterized by blaming failure on lack of ability, decreasing the sophistication of problem solving strategies, abandoning the task completely, and displaying negative emotion. In contrast, those with an incremental theory view their intelligence as a malleable quality with potential to be developed. They pursue learning goals that focus on increasing their skills. When faced with a challenge they demonstrate a mastery-oriented response that includes blaming failure on lack of effort, increasing the sophistication of problem-solving strategies, and displaying positive emotion. Notably, these motivation patterns impact responses to academic challenge regardless of individuals' intellectual ability (e.g., those with either low or high ability may show helplessness).

RELATIONS OF ACHIEVEMENT MOTIVATION PATTERNS TO ACADEMIC PERFORMANCE AND EDUCATIONAL PRACTICE

Research has indicated that beginning in junior high school, when academic challenges increase, achievement motivation patterns are related to student outcomes. For example, seventh grade students who endorsed an incremental theory earned higher grades in math over the next two years than students with an entity theory, even when controlling for prior achievement (Blackwell, Trzesniewski, & Dweck, 2007). College students' endorsement of learning goals positively predicted their grade in a chemistry course, as well as grade improvement across the semester (Grant & Dweck, 2003).

Dweck (2007) provides a motivation-based explanation for gender differences in math and science achievement. Girls, particularly bright girls, are especially vulnerable to a loss of confidence and helpless behavior when they encounter confusing material (Licht & Dweck, 1984). Given that math and science typically involve new concepts and skills that may cause confusion, girls' greater likelihood for maladaptive responses to such challenges may contribute to their poorer achievement in these areas.

Dweck's findings have important applications for educational practice. To promote adaptive student functioning, the classroom climate should encourage incremental

theories, learning goals, and effort-based attributions. In an intervention study, Blackwell, Trzesniewski, and Dweck (2007) taught seventh grade students that intelligence is malleable and can be developed. The intervention group exhibited stable performance in math, whereas the control group showed a steady decline. These results suggest that promoting an incremental theory generated greater motivation in the classroom. Emphasizing learning goals (and minimizing a focus on performance goals) is also a strategy for increasing mastery-oriented behavior (Elliott & Dweck, 1988). Another effective approach involves teaching students to attribute their failures to lack of effort rather than lack of ability. Effort attributers are more persistent when challenged (Dweck, 1975). Finally, although teachers frequently use praise to encourage achievement, Mueller and Dweck (1998) have shown that focusing praise on students' ability tends to have negative consequences for motivation. Specifically, those praised for their intelligence tend to care more about performance goals and show more helpless responding when challenged. Thus, educators should be careful to direct praise to students' efforts. This ultimately encourages students to value learning opportunities and persistence.

Throughout her career, Dweck has collaborated with dozens of graduate students and post-doctoral fellows.

SEE ALSO *Achievement Motivation; Goal Orientation Theory; Theories of Intelligence.*

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Cynthia A. Erdley

DYNAMIC ASSESSMENT

A procedure that attempts to modify performance, via examiner assistance, in an effort to understand learning potential, is called dynamic assessment (DA). Dynamic assessment determines whether substantive changes occur in examinee behavior if feedback is provided across an array of increasingly complex or challenging tasks. This procedure contrasts with traditional models of assessment in which there is no feedback from the examiner on student performance.

GOALS

Several authors suggest that traditional intelligence or aptitude tests (i.e., tests that measure unassisted performance on global measures of academic aptitude) underestimate general ability. That is, traditional approaches to the assessment of aptitude typically provide little feedback or practice prior to testing; therefore, performance on such measures often reflects the individual's misunderstanding of instructions more than his ability to perform the task. One possible alternative or supplement to traditional assessment is to measure an individual's performance when given examiner assistance. The goals of DA are to (a) provide a better estimate of ability, (b) measure new abilities, and (c) improve mental efficiency when compared to static testing procedures (see Embretson, 1987).

DIFFERENT MODELS

Models or variations of DA include learning potential assessment (e.g., Budoff, 1987a), testing-the-limits (Carlson & Wiedl, 1979; Swanson, 1995a), mediated assessment (e.g., Feuerstein, 1980), and assisted learning and transfer (e.g., Bransford, Delclos, Vye, Burns, & Hasselbring, 1987; Campione, Brown, Ferrara, Jones, & Steinberg, 1985). Although DA is a term used to characterize a number of distinct approaches, two common features of this approach are to determine the learner's potential for

change when given assistance and to provide a prospective measure of performance change independent of assistance. Unlike traditional testing procedures, score changes due to examiner intervention are not viewed as threatening task validity. In fact, some authors argue that construct validity increases (e.g., Budoff, 1987b; Carlson & Wiedl, 1979). To obtain information about an individual's responsiveness to hints or probes, DA approaches require the interaction of an examiner and the examinee. When a student is having difficulty, the examiner attempts to move the student from failure to success by modifying the format, providing more trials, providing information on successful strategies, or offering increasingly more direct cues, hints, or prompts. The intensity of the intervention ranges from several sessions to brief intensive prompts in one session. Thus, potential for learning new information (or accessing previously presented information) is measured in terms of the distance, difference between, and/or change from unassisted performance to a performance level with assistance.

TYPE OF MEASURES

A major goal of dynamic assessment models is to measure modifiability (Embretson, 1987; Grigorenko & Sternberg, 1998; Swanson & Lussier, 2001). A major issue is the type of scores necessary to measure modifiability (see Embretson, 1987 for a review). For example, Campione and Brown (1987) measured modifiability as the number of hints needed to solve a problem that has been failed. The fewer the hints, the more modifiability the examinee possesses. Embretson (1987) has suggested that this score merely provides a better estimate of initial ability (see p. 149). Another method to measure modifiability is to bring scores to an asymptotic level (under the probing conditions) and then obtain a measure on the test again after the probes have been removed. The basic rationale is to eliminate performance differences due to different strategies or unfamiliarity with the laboratory procedures. As yet, there is no agreed upon measure of cognitive modifiability (Grigorenko & Sternberg, 1998; Swanson & Lussier, 2001).

Several authors consider the first area of focus in DA, however, to be one of improving the processing of information. For example, utilizing Vygotsky's (1978) "zone of proximal development," Brown and French (1979) make a distinction between an individual's proximal potential and actual level of performance. In the area of child development, for example, they make a distinction between a child's actual development, that is, her completed development as might be measured on a standardized test, and her level of potential development, the degree of competence she can achieve with aid.

An assessment of the examinee's "zone of potential" (i.e., ability to access available information) typically

involves three steps (see Swanson, 1995a, 1995b, for a review). First, the examinee is administered a battery of items on a particular test. Second, if the examinee fails to retrieve the item information, the examiner provides a series of progressive probes based upon the information that was forgotten. The number of probes or hints necessary to achieve maximal performance is considered the width of the individual's zone of potential. Third, the items at which the examinee achieved the highest level of performance are readministered at a later point in time. This maintenance activity is important in assessment because it reflects the examinee's ability to benefit from the aids or probes provided by the examiner. The ability of the examinee to maintain behavior provides valuable assessment information about the potency of the aids that help the examinee access information.

LIMITATIONS

Although DA has been suggested as an alternative and/or supplement to traditional assessment, only a few critical reviews of such procedures have been published (e.g., Grigorenko & Sternberg, 1998; Swanson & Lussier, 2001). A comprehensive review of DA procedures as of 2007 was the qualitative analysis conducted by Grigorenko and Sternberg (1998). Their study reviewed the strengths and weaknesses of five different dynamic testing models: Feuerstein and colleagues' model of structural cognitive modifiability (e.g., Feuerstein, Miller, Hoffman, Rand, Mintzker, & Jensen, 1981; Feuerstein & Schur, 1997), Budoff's learning potential testing model (1987a, 1987b), Campione and Brown's transfer model (Campione, 1989, Campione & Brown, 1987), Carlson's testing-the-limits model (Campbell & Carlson, 1995; Carlson & Wiedl, 1979), and an information processing framework as conceptualized by the Swanson Cognitive Processing Test (S-CPT, Swanson, 1995a, 1995b).

Their review questioned whether DA increased the comparability of performance among students from differing backgrounds and handicapping conditions when compared to static (traditional) conditions. That is, when compared with static measures, DA has not been shown to equate the performance among children with differing learning abilities (i.e., level the playing field). In addition, Grigorenko and Sternberg (1998) suggested that cognitive modifiability (a psychological construct frequently referred to in DA literature) has not been shown to be independent of initial learning ability. Likewise, their review questions whether changes in mental processing come about because of DA or merely reflect artifacts related to retesting. That is, they argue that approximately 30% of children improve to a statistically significant extent simply because of retesting (see p. 104). Thus, changes in performance may be unrelated to DA procedures.

Swanson and Lussier (2001) used meta-analytic techniques to address some of the issues raised in Grigorenko and Sternberg's (1998) qualitative review. Their results provide a metric to compare the magnitude of the differences between DA and other approaches. Higher effect sizes are considered better than lower effect sizes. Swanson and Lussier's analysis showed that effect sizes (ES) when using DA procedures varied significantly as a function of ability group (under achievers yielded higher and children with learning disabilities yielded lower ESs than average, hearing impaired, and mentally retarded participants), chronological age (younger yield higher ESs than older ages), sample size (studies with moderate sample sizes yield larger ESs than studies with small or large sample sizes), and type of assessment procedure (testing the limits yielded larger ESs than mediated assessment). The magnitude of the ES was best predicted by the type of outcomes measure (ESs are higher on visual-spatial than verbal measures).

EDUCATIONAL APPLICATIONS

DA has direct application to the context of classroom assessment and instruction. Measuring responsiveness of an individual's performance to feedback has long been viewed as an alternative to traditional (static) ability assessment. Dynamic assessment has been suggested to teachers as a means to enhance children's performance and tap potential which might otherwise be undiscovered by traditional static approaches. For example, children with identical performance on static tests may profit differentially from feedback. An example is that children with learning problems but with the same aptitude as average achieving children may need more feedback to improve their performance than average achievers.

SEE ALSO *Classroom Assessment; High Stakes Testing; Meta-Analysis; Scaffolding; Standardized Testing.*

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H. Lee Swanson

E

EARLY CHILDHOOD DEVELOPMENT

Early childhood development is defined as “a set of concepts, principles, and facts that explain, describe and account for the processes involved in change from immature to mature status and functioning” (Katz, 1996, p. 137). Development is generally divided into three broad categories: physical development, cognitive development, and social emotional development (Berk, 2000). Physical development addresses any change in the body, including how children grow, how they move, and how they perceive their environment. Cognitive development pertains to the mental processes (e.g., language, memory, problem solving) that children use to acquire and use knowledge. Emotional and social development addresses how children handle relationships with others, as well as understand of their own feelings.

Early childhood development is generally divided into three age categories (Bredekamp & Copple, 1997). The first age category includes infants and toddlers who are between the ages of birth and 3 years of age. According to Lally and colleagues (1997), the most important factor for young infants (birth to 8 months) is security with primary caregivers. Between the ages of 9 to 18 months, mobile infants are mostly concerned with exploration and between 18 and 36 months, the central focus of development is identity, and children become more independent. The second age category of early childhood development includes preschoolers who are 3 to 5 years of age. According to Bredekamp and Copple (1997), this period of development is characterized by rapid gross motor development (e.g., jumping, hopping, skipping),

refined movement of small muscles for object manipulation, major increases in vocabulary and use of language, abstract representation of mental constructs, and the development of relationships with other young children. The final category of early childhood development includes those children in the primary grades who are between 6 and 8 years of age. Bredekamp and Copple (1997) describe highlights in primary-aged children’s development during this time: Gross and fine motor development is characterized by children’s ability to perform controlled movements and sequence motor skills. Greater reasoning, problem solving, and assimilation also characterize children’s cognitive development at this stage. During the primary years, children’s vocabulary increases at a rapid pace. In addition, their written communication skills develop. Socially, primary-aged children begin to understand others’ perspectives, are concerned with fairness, and monitor their own behavior.

INFLUENCES ON EARLY CHILDHOOD DEVELOPMENT

Practices for enhancing children’s development are influenced most by child development theories. Berk defines a theory as “an orderly, integrated set of statements that describes, explains, and predicts behavior” (2000, p. 6). Generally speaking there are four broad theoretical perspectives that guide practice in early childhood development: behaviorism and social learning theory, cognitive-developmental theory, sociocultural theory, and ecological systems theory.

B. F. Skinner (1904 1990) is most noted for his theory of behaviorism or more specifically operant

conditioning theory, which is based on the premise that children's behavior can be increased based on the presentation of reinforcers and decreased through punishment (Berk, 2000). Social learning theory, created by Albert Bandura (b. 1925), expands on operant conditioning by adding the idea that imitation or observational learning increases the chances that children will learn new behaviors. Generally speaking, behaviorists believe that children's development is outside of their own influence, that it is shaped by environmental stimuli (Daniels & Shumow, 2003).

Jean Piaget (1896–1980) is credited with the cognitive-developmental theory that “views the child as actively constructing knowledge and cognitive development as taking place in stages” (Berk, 2000, p. 21). According to his constructivist theory, Piaget asserted that children pass through four distinct stages of development, including the sensorimotor stage (birth to 2 years), preoperational stage (2 to 7 years), concrete operational stage (7 to 11), and formal operational stage (11 and beyond). Piaget believed that reasoning deepens in children as they grow, engagement in the physical and social world enhances development, and “conceptual change occurs through assimilation and accommodation” (Daniels & Shumow, 2003, p. 497).

Lev Vygotsky (1896–1934) saw child development as a kind of social constructivism, in which development is determined by culture. According to Berk and Winsler (1995) there are a number of tenets that are unique to social constructivism. First, because children's culture influences the activities, language, and education to which children are exposed, these variables affect children's development. Second, while some development is innate or influenced by biology, higher level development is affected by culture. Finally, the theory incorporates the zone of proximal development, that is, the range in children's development between their ability to perform a task independently and their ability to perform a skill with the assistance of a more competent member of their culture (adult or older child).

The ecological systems theory was originated by Urie Bronfenbrenner (1917–2005) who believed that children developed “within a complex system of relationships affected by multiple levels of the environment” (Berk, 2000, p. 26). Bronfenbrenner described four systems that influence child development. The microsystem involves those that are part of children's most immediate environment, including the child's parents and other primary caregivers. Interactions between the child and those adults impact children's development. The second system is the mesosystem and involves systems that interact with the people in the microsystem, including child care programs and schools. Exosystems are places in which children do

not spend time but which still impact children's development, including the parents' workplace policies. Finally, the macrosystem consists of “the values, laws, customs, and resources of a particular culture” (Berk, 2000, page 29). For example a culture's beliefs about the importance of high quality childcare impact children's development.

Child development theories generally guide teaching practices of children from birth to 8 years of age. Daniels and Shumow (2003) describe differences in instructional practices based on theoretical orientation. Teachers who espouse behaviorist theory generally follow more teacher-directed instructional practices, including didactic instruction with emphasis on acquisition of basic skills. Other child development theories emphasize child-centered practices. Teachers who support the constructivist theory provide child-choice, guided discovery, and cooperative learning. They emphasize critical thinking, problem solving, and intrinsic motivation. Social constructivists build their practices around a community of learners, instructional conversation, and authentic tasks, and emphasize cultural literacy, collaboration, and metacognition. Teachers emphasizing the ecological systems theory in their classrooms stress parent and community involvement, out-of-school activities, and cultural instruction. They teach social cognition, cultural awareness, and adaptive habits of coping.

PRACTICES

Many early childhood development experts believe that knowledge of child development theory should guide educational practices of children from birth to 8 years of age (Katz, 1996). Katz questions “if we do not know enough about the relationship between early experience and the ultimate competencies necessary for effective participation in democratic processes, how can we design effective educational practice?” (1996, p. 141). Theories are useful in helping researchers and teachers guide their observations (Stott & Bowman, 1996). It is from this point of view that practices for supporting the development of children from birth to 8 years of age originate. Developmentally appropriate practices are a set of standards for providing high quality early care and education experiences (Goldstein, 1997) to children, birth to 8, which are based on knowledge about “how children develop and learn” (Bredekamp & Copple, 1997, p. 9).

The National Association for the Education of Young Children (NAEYC) describes specific educational practices to which those working with young children should adhere (Bredekamp & Copple, 1997). These include: a) creating a caring community of learners; b) teaching to enhance development and learning; c) creating appropriate curriculum; d) assessing children's learning and development; and e) establishing relationships

with families. Detailed information about the application of these practices to specific age groups can be found in Bredekamp and Copple (1997). The following section provides an overview of each of these practices, empirical support for the practice, and some challenges educators face in implementing the practice in the current educational context.

Creating a Caring Community of Learners. The community in which children spend time involves both the physical and social environment and their influence impact children's development. Specific variables in early care and education settings that influence how children grow and learn include low staff/child ratios, positive social interactions between children and between children and adults, appropriate classroom arrangements, and safe and healthy practices. According to Kontos and colleagues (2002), there is evidence that the presence of these specific variables in early care and education settings are "those where children are more likely to thrive, as determined by their attachment to the teacher, their peer relations, and their verbal ability" (p. 240).

Measures are available that evaluate the physical and social environments in which children to birth to 8 spend time (i.e., Infant/Toddler Environmental Rating Scale - Revised Birth to 3; Early Childhood Environmental Rating Scale - Revised preschool; and Assessment of Practices in Early Elementary Classrooms primary). Evidence of studies that have examined the community of learners has found disturbing results in some cases. In a study of Kentucky's early care and education system, Grisham-Brown and colleagues (2005) found that young children from low social-economic backgrounds and those of minority status were more likely to participate in low quality early care and education programs than their counterparts. Similarly, a study of primary classrooms by Buchanan and colleagues (1998) found that those classrooms most likely to use developmentally inappropriate practices were those serving the largest number of children who receive free lunch. Incidentally, these same classrooms had larger class sizes than their counterparts who were engaged in developmentally appropriate practices.

Teaching to Enhance Development and Learning. Teaching practices for young children include opportunities for choice, hands-on learning, promotion of collaboration between children, use of a variety of teaching strategies, individualization, and self-regulation (Bredekamp & Copple, 1997; Buchanan et al., 1998). There is evidence that these practices support the development of young children. Kontos and colleagues (2002) found that preschool aged children experience more complex interactions with peers when engaged in creative activities than other types of activities (e.g., language arts or gross

motor). In Kontos, et al., the creative activities were those that were open ended without a finished product expected. McCormick and colleagues (2003) evaluated the 25 top-performing primary programs in Kentucky and found that one variable that differentiated those classrooms from the lowest performing classrooms was the provision of choice in selection of materials and activities. This study supports that the use of developmentally appropriate practices in primary classrooms positively impacts child outcomes.

A challenge in defining developmentally appropriate teaching strategies has been the emphasis on child-centered approaches. Whereas child-centered approaches originate from constructivist theory, didactic or teacher-directed instruction originates from a behaviorist perspective (Stipek, 2004). Because of the theoretical orientation from which child-centered practices derive, some have viewed them as synonymous with developmentally appropriate practices. However, Bredekamp and Rosegrant (1995) indicate that developmentally appropriate teaching strategies, in fact, fall along a continuum from those that are non-directive (acknowledgement) to those that are directive (direct instruction). Stipek (2004) found that teachers serving large numbers of low achieving children were more likely to use direct instruction than child-centered instructional techniques. Grisham-Brown, Hemmeter, and Pretti-Frontczak (2005) argue that in blended programs where teachers encounter groups of children with wide ability levels, it is appropriate for teachers to employ the full continuum of teaching behaviors. This view is certainly in keeping with the ideas of response to intervention, as set forth by Pretti-Frontczak and colleagues (2008) whereby children's needs are addressed using more intentional, direct instruction. By using the full continuum of optional teaching strategies, those working with young children are, in fact, addressing the individualization ideas associated with developmentally appropriate practice.

Constructing Appropriate Curriculum. According to Pretti-Frontczak and colleagues (2007) there are four parts to a curriculum framework: 1) assessment for gathering information about children; 2) scope and sequence or the developmental/content areas that will be addressed; 3) activities and instruction or the contexts and strategies for teaching; and 4) progress monitoring or methods for determining success of the instruction. Bredekamp and Copple (1997) indicate that developmentally appropriate curricula should address all areas of the children's development and all content areas, bearing in mind the child's age and considering children's cultural, linguistic, and ability differences. Grisham-Brown and colleagues (2005) indicate that collaboration between educators, families, and other support personnel is

essential for implementing a high quality curriculum for children in blended classrooms.

One key issue shaping curriculum design is the development of learning standards. Although states have had learning standards for K-12 programs since the early 1990s, early learning standards for children five and under were only developed in the mid-2000s (Scott-Little, Kagan, & Frelow, 2006). As of 2008, over 40 states and the District of Columbia have developed pre-kindergarten standards, many across all areas of development (Neuman & Roskos, 2005). The arrival of standards into programs serving children from birth to 8 years of age has challenged those who want to ensure the implementation of developmentally appropriate practices during a standards-based climate that emphasizes accountability. In the late 2000s, leading researchers in early childhood education were beginning to provide guidance for ensuring that the needs of young children are appropriately addressed within this context. Goldstein found in a qualitative study that kindergarten teachers could address content standards in a developmentally appropriate manner by “recognizing and building on the curricular stability in kindergarten, employing instructional approaches that accommodate the children’s developmental needs, setting limits, acquiescing to demands for developmentally inappropriate practices and materials, engaging in proactive education and outreach, accepting additional responsibilities, and making concessions” (2007, p. 51). Grisham-Brown (2008) and Gronlund (2006) have proposed that curricula driven by early learning standards can be appropriate, if standards are addressed at different levels, depending on the needs of the children.

Assessing Children’s Learning and Development. Specific guidelines are available regarding children’s development. The National Association for the Education of Young Children (NAEYC) and the Division for Early Childhood (DEC) advocate the use of authentic assessment practices as the primary approach for assessing young children (Division for Early Childhood, 2007; National Association for the Education of Young Children and National Association of Early Childhood Specialists in State Departments of Education, 2003). Authentic assessment strategies involve documenting learning and development of children during real-life activities and routines by familiar adults (Losardo & Notari-Syverson, 2001; Neisworth & Bagnato, 2004). Research has shown that many teachers prefer authentic assessment approaches over more traditional assessment methods (Gao, 2007; McNair et al., 2003), and there are positive relationships between the use of authentic assessment practices, other classroom practices, and child outcomes (Bagnato, 2005; Meisels et al., 2003).

Appropriate assessment practices for young children have been compromised by the accountability climate in education in the early 2000s. Early childhood leaders have advocated the use of authentic assessment approaches for accountability purposes, indicating that these methods are more appropriate for young children (Meisels et al., 2003; Neisworth & Bagnato, 2004; Grisham-Brown, 2008). Emerging research shows that authentic assessment approaches, used for accountability purposes, can yield technically adequate assessment data (Grisham-Brown, Pretti-Frontczak, & Hallam, in press), thereby not compromising the results of high-stakes assessment.

Establishing Reciprocal Relationships with Families. Indicators of active family involvement in programs serving young children should involve collaboration and communication. Bredekamp and Copple (1997) indicate that programs should collaborate with families as they design early experiences for their children using two-way communication strategies. Unlike other practices in early childhood education, family involvement has been an enduring value that few have challenged (Hoover-Dempsey & Sandler, 1995) primarily because of the positive benefits on children’s development. For example, family literacy practices have been positively linked to children’s ability to read successfully (Gambrell & Mazzoni, 1999). Grisham-Brown and colleagues (2005) provide specific examples of how to involve families in child assessment, selection of children’s priorities, and curriculum development.

The period of development between birth and 8 is unique in a child’s life. Some have argued that there are critical periods of time by which children should learn specific skills, if they are to learn them (Shore, 1997). In one compelling article, Bailey argues that there should be a shift from emphasis on critical periods to critical experiences. Bailey questions: “What are the experiences that are absolutely necessary for all children to maximize school success, mental health, and social development?” (2002, p. 290). Clearly the practices that early childhood educators implement with children from birth to 8 have the greatest impact on child outcomes. Knowledge of those practices and the underlying theoretical orientation that supports them is essential in order for young children to receive “critical experiences.”

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Jennifer Grisham-Brown

ECCLES, JACQUELYNNE S. **1944–**

Jacquelynne S. Eccles (1944) is one of the leading educational and developmental psychologists in the world. Her prolific scholarship has focused on gender-role socialization, social and motivational development in family and school contexts, and gender and ethnic identity development. Eccles received her bachelor's degree in social psychology from the University of California at Berkeley in 1966, and then taught in the Peace Corps in Ghana from 1966 to 1968. She received her Ph.D. in psychology from the University of California at Los Angeles in 1974. She was assistant professor of psychology at Smith College (1973-1976), and then moved to the University of Michigan, where she rose through the ranks to full professor between 1976 to 1988. She was professor of psychology at the University of Colorado-Boulder from 1988 to 1992, and then returned to Michigan. As of 2008, she is the McKeachie Collegiate Professor of Psychology at the University of Michigan. She has won numerous awards for her scholarship from major research societies.

Some of Eccles's research focuses on how children's self-beliefs and values are socialized at home and in school and how these beliefs and values predict young people's choices of activities to pursue and their performance in them. Another major purpose of this line of work is to investigate gender differences in choice and performance, with particular reference to gender differences in participation in math and science education and careers. Eccles and her colleagues, including Carol Kaczala, Judith Meece, Carol Midgley, and Allan Wigfield, developed the expectancy-value theoretical model of motivated choice and performance that provides the theoretical foundation for their work. This model has been highly influential in the field. They and other colleagues (including Pamela Davis-Kean, Constance Flanagan, and Janis Jacobs) have conducted several major longitudinal studies testing this model.

Major conclusions from this work include the following: 1) children's competence beliefs and expectancies for success are the strongest predictors of subsequent performance, and children's achievement values are the strongest predictor of achievement choice, even when previous performance is controlled; 2) gender differences in children's

competence beliefs and values indicate that males have more positive beliefs and values for math and sports, and girls for English and music; 3) children's beliefs and values for different academic and non-academic activities decline across the school years, with some variation in the pattern of decline for boys and girls; and 4) parents' beliefs and stereotypes, and children's perceptions of them, predict children's own beliefs and values.

A second major area of research that builds on this work is Dr. Eccles's investigations of how school environments influence the development of children's competence-related beliefs and values for different activities and their identity development. She has collaborated in this work with Bonnie Barber, Carol Midgley, David Reuman, Rob Roeser, and Arnold Sameroff, among others. Eccles began this work with middle school students, making the compelling case that there is not a good fit between middle school students' developmental stage and the school environments they typically experience. At a time when children are maturing cognitively, desire to have more control over the activities they do, and enjoy interacting with others in learning and other environments, the kinds of school environments they encounter often provide fewer of these opportunities. Eccles initially documented this mismatch in a large scale study of Midwest middle schools. Her study showed that (compared to elementary school teachers) middle school teachers believe they are less effective in teaching their students, have less close relations with them, and provide fewer opportunities for student decision-making. She and her colleagues expanded this work to a large school district in the East that has a majority African American student population. As part of both studies Eccles and her colleagues examined the effects of puberty on teacher-child and parent-child relations. They also included measures of other important psychological factors, such as self-esteem, gender and racial identity, and indicators of psychological well-being and distress. Thus, they extended their expectancy-value model in important ways.

Much of Eccles's research has been longitudinal, and in two of her major studies she and her colleagues followed children into young adulthood. They used the most sophisticated data analytic tools available and were able to provide a clear picture of the development of children's beliefs and values. In a later work Eccles studied how the opportunity structures provided by parents and other socializers and children's involvement in extracurricular activities influence their development, both with respect to their performance and choice and their evolving identities.

SEE ALSO *Expectancy Value Motivational Theory.*

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Allan Wigfield

EGOCENTRISM

Egocentrism, a concept derived from Jean Piaget's (1951) theory of cognitive development, refers to a lack of differentiation between some aspect of self and other. The paradigm case is the failure of perspective-taking that characterizes young children who are unable to infer what another person is thinking, feeling, or seeing. Unable to infer accurately the perspective of others, the egocentric child attributes to them his or her own perspective instead. The inability to decenter from one's own perspective results in egocentric confusion of social perspectives.

But egocentrism is a broader concept that encompasses a number of additional curiosities of early cognitive development, including realism (the confusion of objective and subjective), animism (confusion of animate and inanimate), and artificialism (confusion of human activity or intentions with natural causes). What these forms of egocentrism have in common is the inability to

differentiate subjective and objective perspectives. Children project subjective qualities onto external objects or events; are unable to *decenter* from their own perspective, or else assimilate objective reality to their subjective schemas, deforming reality as a result. So the child who believes that dreams take place in one's room at night (realism), that moving objects have life and consciousness (animism), or that the moon follows them because it wants to (artificialism), is displaying egocentrism just as surely as the child who is unable to differentiate self-other perspectives. Piaget suggested that egocentrism was a primary characteristic of children's thought processes until around 6 to 7 years of age, or when they are able to form mental representations during problem solving. However, while egocentrism is regarded typically as a problem of early cognitive development, such seemingly childish thought may not be entirely absent even in later periods of development.

EGOCENTRISM AND DEVELOPMENT

Elkind (1967) famously reconstructed Piaget's four broad stages of cognitive development to show that each stage is imbued with a form of egocentrism. In the sensori-motor period, for example, egocentrism is evident when the infant stops looking for hidden objects, almost as if objects no longer exist if out of sight. The sensori-motor child is egocentric with respect to objects to the extent that object permanence is confused with object perception. Sensori-motor egocentrism is overcome when children are able to form mental representations of absent objects, an ability that emerges with the symbolic functions of preoperational thought, the next stage of cognitive development. At this stage objects have permanent existence, even when not perceived, because they exist symbolically as cognitive representations.

Although preoperations liberate the child from sensori-motor egocentrism, it ensnares the child in a form of egocentrism with respect to symbols. Indeed, most of the classic examples of egocentrism are linked to this stage of cognitive development. Hence children in early childhood are unable to infer accurately the cognitive, affective, or visual perspective of others. Their thinking is prone to realism, animism, and artificialism. They fail conservation problems. They are unable to differentiate between symbols and their referents; they confuse make-believe play and reality. This preoperational egocentrism is overcome by the emergence of concrete operations, the next stage of cognitive development. At concrete operations the child can hold two mental representations at once (e.g., symbol and referent, objective and subjective) and thereby distinguish between them.

Although concrete operations liberate the child from preoperational egocentrism, the child nonetheless falls prey to a form of egocentrism all its own. In middle childhood,

children fail to differentiate the products of their cognition their convictions and claims about the world from empirical reality. It is almost as if children believe that their perspective has a certain felt necessity which renders alternative perspectives nonsense or contrary evidence inadmissible. It is not until the emergence of the final stage of cognitive development formal operations that this form of egocentrism is surmounted. At formal operations, adolescents can think theoretically, entertain contrary-to-fact propositions, generate logical possibilities, formulate hypotheses, and systematically test them. This ability to entertain multiple possibilities minimizes the felt necessity that attaches to one's own perspective. Moreover, the capacity for scientific reasoning disposes the adolescent to consider claims in light of the evidence.

But the transition to formal operations involves its own variant of egocentrism what Elkind (1967) termed "adolescent egocentrism." Here adolescents fail to differentiate between what is the object of their concern (which is the *self*) from what is the concern of others. Hence teenagers beset by adolescent egocentrism believe that others are as concerned about them as they are about themselves. They construct imaginary audiences of peer critics and admirers for whom they must perform, although being the object of so much (imagined) attention also leaves the adolescent craving privacy and vulnerable to feelings of heightened self-consciousness, shame, shyness, and embarrassment.

Adolescent egocentrism also encourages the construction of personal fables that showcase the self relative to others. Three fables capture the egocentrism of adolescence. First, adolescents are convinced of their personal uniqueness. Second, often as a result of their uniqueness, adolescents evaluate risks in a way that emphasizes a sense of invulnerability. Third, egocentric adolescents revel in subjective omnipotence, believing the self to be a source of unusual influence or power within their peer network. Personal fables are differentially related to adaptation in adolescence (Aalsma, Lapsley & Flannery, 2006). For example, personal uniqueness predicts internalizing symptoms, especially in girls. Invulnerability predicts risk behavior but counterindicates internalizing symptoms. Omnipotence predicts mastery coping and indices of positive adjustment.

EGOCENTRISM IN SOCIAL AND ACADEMIC DOMAINS

The transition to concrete operations after age 7 brings with it new cognitive abilities that diminish egocentrism. For example, a young school-age child is able to decenter from his or her own perspective so that it can be reversed with the perspective of another, yielding a reciprocal form of role-taking ("I think that you think . . ."). By the end of childhood simultaneous role-taking is a possibility so that

the child can reflect upon the self from the perspective of others. The suite of concrete operational abilities hence allow the child to be a better mind-reader, that is, allows the child to infer the intentions and perspectives of others. This ability clearly matters for communicative competence, moral reasoning, and interpersonal understanding, which are three areas that have attracted the most research on egocentrism in childhood. For example, egocentric speech is characterized by the child's use of monologue without any clear audience or in the presence of an audience but without considering that audience's view or contribution. In contrast, socialized speech involves the child responding to other's questions, adding information to the thoughts of others, or attempting to influence others through requests or commands. Piaget suggests that egocentric speech peaks at around 6 years of age, but then declines around 7 or 8 years. In the moral domain, egocentrism makes it difficult for the preschool child to understand the reason for rules other than what serves self-interest. Moral judgment and prosocial behavior require taking into account the life circumstances and perspectives of others, which is only possible when advances in perspective-taking diminish egocentric thought. Finally, egocentrism is a barrier to friendships and intimate relationships insofar as it inhibits the ability to see things from the perspective of the other. Growth of perspective-taking skills brings forth a capacity for authentic, other-regarding friendship.

Egocentrism also constrains performance on skills that are crucial to academic achievement, including understanding of number and scientific concepts. The preoperational child is incapable, for example, of hierarchical classification, seriation, multiplication of classes. The child has difficulty conserving transformations of the substance, amount, weight, and volume of objects. This skill must await the decentered, reversible thought of concrete operations.

INDIVIDUAL AND CONTEXTUAL DIFFERENCES

The role of egocentrism in cognitive development has been qualified greatly by early 21st-century research. Nobody believes that egocentrism is a pervasive cognitive failure of young children. In the social domain, for example, young children clearly are empathically sensitive and responsive to the distress of others, and they engage in prosocial behavior. Alongside egocentrism, then, is an ability to orient to the needs of others. Moreover, young children appear to show more evidence of perspective-taking when tasks require assuming the perspective of age-mates and peers rather than the perspective of adults and strangers. Similarly, whether intellectual competence or egocentrism is observed in young children appears to

vary with the nature of the tasks presented to them. Tasks that are simplified to reduce inordinate performance requirements or extensive demand on memory, for example, often reveal less egocentric responding. There is some evidence that children with learning disabilities present with role-taking deficits, indicating that such students might profit from interventions that improve social skills.

SUGGESTIONS FOR TEACHERS

For Piaget, the engine that drives cognitive development is the experience of *disequilibrium*, that is, a sense of cognitive conflict that results when current cognitive schemes are incapable of resolving contradiction. Disequilibrium is induced in classrooms that are marked by robust peer activities. Piaget and others have suggested that children learn how to take the perspectives of others better through interacting with their peers than with adults. Hence classroom activities that emphasize cooperative learning, peer group discussion, and cross-age teaching are well-suited to introduce instances of cognitive conflict that require better appreciation of the perspective of others.

SEE ALSO *Cognitive Development: Overview; Piaget, Jean.*

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*Patrick L. Hill
Daniel K. Lapsley*

EI

SEE *Emotional Intelligence.*

ELEMENTARY SCHOOL, TRANSITION TO

SEE *School Transitions: Elementary School.*

EMOTION REGULATION

An extensive body of literature indicates that children's school success is critical to their development. Students must overcome numerous challenges to perform well in

school, and it is clear that many do not. Educational researchers initially focused heavily on curricula, classroom structure, teacher-child ratios, whereas more recently, investigators have begun to focus on children's social and emotional functioning as important contributors to school success. Many teachers believe that social skills are the most important characteristic necessary for school readiness and success and that many children lack these skills (Lewit & Baker, 1995). This situation is problematic because there is evidence that emotion regulation is a better predictor of school readiness than IQ (Blair & Razza, 2007).

This entry describes (1) key theoretical issues involved in the study of children's emotion regulation and especially effortful control (EC), an index of regulatory abilities, (2) methods of measuring EC, (3) what is known about if, and why, EC is related to students' academic competence, (4) socialization correlates of EC and how educators might work to improve children's EC, and (5) strategies for classroom management.

THEORETICAL ISSUES IN THE STUDY OF EMOTION REGULATION

Emotion-related regulation is defined as "processes used to manage and change if, when, and how (e.g., how intensely) one experiences emotions and emotion-related motivational and physiological states, as well as how emotions are expressed behaviorally" (Eisenberg, Hofer, & Vaughan, 2007, p. 288). This definition is purposively broad to accommodate the assumption that emotion regulation can occur before, during, and after the onset of emotion.

Often researchers use effortful control (EC), defined as "the efficiency of executive attention including the ability to inhibit a dominant response and/or to activate a subdominant response, to plan, and to detect errors" (Rothbart & Bates, 2006, p. 129), as an index of children's regulatory abilities. Individuals high in EC can control their attention and are able to avoid or engage in behavior to accomplish a goal, even if the individual would prefer to engage in another set of behaviors. Although EC is willful, it often may be executed automatically without much thought, and children are not always aware that their thoughts or actions are regulating emotion or behavior. Key to the study of academic competence, EC is hypothesized to regulate attention, emotion, and behavior (Rothbart & Bates, 2006). The authors of a National Academy of Sciences report noted that "self-regulation is a cornerstone of early childhood development that cuts across all domains of behavior" (Shonkoff & Phillips, 2000, p. 3).

Basic regulatory processes begin early in life and become more complex as children age. Infants mostly rely on caregivers to soothe their distress and are not able

to actively engage the caregiver until approximately six months of age. In general, self-soothing and looking away from a stress inducing stimulus are quite common methods of regulation among 5- to 18-month-olds, and by 20 months toddlers' use of avoidance and self-distractions become more common (see Eisenberg et al., 2007). By 48 months of age, children often use more complex regulatory strategies and are more proficient at willfully inhibiting behavior and focusing and shifting attention, and there is a marked decline in external forms of regulation. In addition to undergoing rapid development early in life, there is evidence that components of effortful control improve, albeit more slowly, throughout childhood and even into adulthood (Williams, Ponesse, Schachar, Logan, & Tannock, 1999).

ASSESSMENT OF EMOTION REGULATION

Investigators typically measure EC and related regulatory capacities with questionnaires and structured laboratory tasks. As with all methods of assessment, each approach has both advantages and disadvantages. The focus here is on measurement issues that seem most important to the advancement of the study of EC and academic competence (see Rothbart & Bates, 2006 for a review of issues related to the measurement of EC).

A benefit of assessing EC and related constructs via questionnaires is that one can obtain information from the child and parents and teachers who witness the child's behavior in multiple contexts; however, such information is subject to self-presentation biases and error due to inaccurate perceptions and problems created by the difficulty of describing complex interactions or behaviors with relatively simple wording. The Child Behavior Questionnaire is a commonly used questionnaire for assessing children's attention focusing, attention shifting, and inhibitory control all aspects of EC (Rothbart, Ahadi, Hersey, & Fisher, 2001). Less commonly used is the Brief, but it has the advantage of assessing components of behavioral regulation such as inhibition, attention shifting, and emotional control, as well as working memory and organization of materials (Gioia, Espy, & Isquith, 2003). When behavioral measures are considered, it is common to assess inhibitory control and to some extent attention using measures such as the peg task (Diamond & Taylor, 1996). To complete this task, children are directed to tap a peg once on a table when an experimenter taps twice and to tap twice when experimenter taps once. In doing so, participants must inhibit the desire to mimic the experimenter and use attentional skills to remember the rule of responding. Kochanska and colleagues have contributed several tasks that are appropriate for assessing the ability to delay. For exam-

ple, in a M&M task, children must wait for the experimenter to ring a bell prior to eating the candy that is placed under a clear cup (see Kochanska, Coy, & Murray, 2001). Investigators interested in assessing attention and memory would find the forward and backward Digit Span tasks quite useful. In the backward Digit Span, the experimenter lists numerical digits, for example 4, 9, 3 and the participant responds in reverse: 3, 9, 4. A paper by Carlson contains a more complete summary of frequently used measures of EC and related constructs (Carlson, 2005).

THE RELATIONS BETWEEN EMOTION REGULATION AND ACADEMIC COMPETENCE

Theory and data suggest that cognitive and emotional systems are interconnected and that promoting emotion-related skills, including effortful control, can promote academic achievement. Findings indicating that attentional regulation is positively related to measures of school readiness support this conclusion (NICHD Early Child Care Research Network, 2003). Evidence indicates that the measures of regulation predict later levels of academic competence, even when the effects of cognitive variables are controlled (Blair & Razza, 2007), and long-term evidence suggests that preschoolers' ability to delay gratification, a component of EC, predicts their verbal and quantitative SAT scores (Shoda, Mischel, & Peake, 1990).

Children's EC probably is linked to their academic competence both directly and indirectly. More specifically, the attentional and planning components of EC may be directly related to academic competence, whereas the delay and inhibitory control components of EC relate to children's social and motivational processes, which in turn relate to academic competence. Indeed, many of the explanations offered for why relations exist implicate the role of students' relationships with their peers and teachers. Findings from the developmental, social, and clinical psychological literatures suggest that students high in self-regulation are likely to build relationships with teachers and peers that foster academic competencies, whereas less-regulated children are at risk for more turbulent relationships (Rothbart & Bates, 2006; Valiente, Lemery-Chalfant, Swanson, & Reiser, in press). Developing a supportive teacher-child relationship may buffer children from some risk factors associated with poor performance, perhaps because teachers are more likely to provide extra assistance to children with whom they have a positive relationship. Maintaining a good relationship with the teacher is important because declines in the nurturant teacher-child relationship precede declines in achievement, and evidence indicates that teacher-reported negativity in the teacher-child relationship is related to

achievement test scores even when controlling for verbal IQ (Hamre & Pianta, 2001).

As children age, a crucial developmental task is to become integrated into peer groups and to maintain friendships. Poor-quality friendships or a lack of friendships is hypothesized to interfere with academic competence as early as preschool and kindergarten, but it likely becomes more important with age because social competence and peer acceptance are posited to promote social inclusion and resources that promote academic success. For example, Welsh, Parke, Widaman, and O'Neil (2001) found children's prosocial behaviors were reciprocally related to academic competence. Initial findings indicate that the quality of the teacher-child relationship and children's social competence partially mediate relations between children's EC and grade point average (Valiente et al., *in press*).

HOW PARENTS AND TEACHERS CAN PROMOTE EC

Given the importance of emotion-related regulation to the formation of relationships and academic skills, it is somewhat surprising that only since 1995 has the development of EC been a focus of study. Although EC is a component of temperament and it is hypothesized to have a biological basis, many believe it is influenced by the environment (Rothbart & Bates, 2006). A number of scholars have argued that regulatory abilities are developed in relationships and can be learned. Consistent with these ideas, Eisenberg, Spinrad, and Cumberland (1998) argued that parents socialize their children's emotion regulation by (1) their reactions to children's emotions, (2) their discussion of emotion, (3) their expression of emotion, and (4) their selection or modification of situations. According to Eisenberg and colleagues, when socializing behaviors are positive and supportive they promote learning about emotions and their regulation, but when parental actions are harsh and punitive, children are likely to experience overarousal, which undermines opportunities to learn about emotions and their regulation.

Numerous cross-sectional studies demonstrate associations between parenting and EC, but longitudinal studies that are sensitive to change and that contain rich measures of both constructs are needed to determine if parenting influences children's EC. As of 2007, there were few studies of this type. For example, parents who are high in warmth and positive, as opposed to negative, have children who are rated by parents and teachers as high in EC (Valiente et al., 2006). Data from other research laboratories are consistent with the premise that positive parenting predicts growth in children's persistence across four years (Halverson & Deal, 2001). Evidence that Indonesian parents' expressions of negative

emotion and Chinese parents' style of parenting predict measures of children's EC in the theoretically expected ways suggests that relations are somewhat similar in other cultures (see Eisenberg et al., 2007).

Significantly, most theories predict reciprocal relations between parenting and children's EC. Although not all findings are consistent (Valiente et al., 2006), Eisenberg and colleagues (1999) found that 6- to 8-year-olds' regulation predicted their parents' punitive responses two years later, which, in turn, predicted 10- to 12-year-olds' regulation. This area of research needs additional theoretical and empirical attention.

Regarding relations between EC and academic competence, experimental evidence shows that teachers can improve children's inhibitory control, attentional control, and delay of gratification. In the Tools of the Mind Preschool Program, teachers embed social, emotional, and cognitive self-regulation throughout all aspects of the curricula. In a pilot evaluation where children were randomly assigned to either the Tools condition or a control condition, those in Tools performed significantly better than controls in two different EC tasks. In addition, children in Tools either met or exceed state and national standards in literacy and math (Diamond, Leong, & Bodrova, 2006). These results are consistent with Greenberg and colleagues' findings that participation in PATHS, a intervention designed to promote self-control, emotional awareness, and interpersonal problem-solving skills, leads to improvements in self-control, emotional understanding, and the ability to plan (Greenberg, Kusche, Cook, & Quamma, 1995).

STRATEGIES FOR TEACHING CHILDREN WHO ARE LOW IN REGULATION

Every teacher is likely to have at least one child in the classroom who is relatively dysregulated. To facilitate learning for all students in the class, teachers and students need to have a positive and reassuring relationship. For the classroom to run efficiently, a limited number of rules, typically less than eight, must be set by the end of the first week by both the teacher and the students (Lindberg & Swick, 2002). When the rules are violated, teachers should use discipline that is related to the violation. For example, if a student writes on the desk, that student should clean the desks. For more disruptive situations, teachers may find exchanging time-outs with colleagues effective so that they can send a child to another room to calm down for 15 to 20 minutes. It is important to note that rewards are often more effective than punishments, and the implementation of activities such as having lunch with the teacher, calling the child's parents to praise specific activities, or a token system

where students earn play money that allows them to purchase desirable gifts/activities often prevents many undesirable behaviors, even for children prone toward dysregulation (see Lindberg & Swick, 2002).

Helping children succeed in school is critical for individual students and for society. This entry touches on some of the theoretical and methodological issues involved in studying EC and academic competence. The existing body of research supports the hypothesis that EC is positively related to young children's academic competence; however, the majority of data are correlational, and there are only a handful of studies involving students beyond fifth grade. Clearly, additional longitudinal findings and data from interventions are needed before drawing firm conclusions. A promising avenue for future research involves obtaining a variety of assessments of the components of EC utilizing a variety of methodologies. By assessing EC in a variety of ways, one would be in a good position to test the hypothesis that relational processes mediate the associations between the inhibitory components of EC, but the attentional- and memory-related components of EC are both directly and indirectly related to academic competence.

SEE ALSO *Classroom Management; Peer Relationships; Special Education.*

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EMOTIONAL/BEHAVIORAL DISORDERS

Emotional disturbance (ED, here called emotional or behavioral disorder or EBD) is one of the categories of disability included under the Individuals with Disabilities Education Improvement Act, also known as IDEA, 2004. Every teacher will have at least one student who is extraordinarily difficult because of his or her behavior, simply due to the fact that most students with EBD have not been identified and placed in special education. Most of the students who are the topic of this entry are in general education classrooms, where they typically cause serious and legitimate concern for their teachers and often for their classroom peers and school administrators as well. This has been true throughout the history of compulsory education, as James Kauffman and Timothy Landrum (2006) have observed.

A frequent misunderstanding is that students with EBD are just chronically difficult irritating to teachers but not really disabled. However students can be both disturbed and disturbing, have EBD, and irritate the teacher. Some irritating students do not have EBD. Nevertheless, most students are neither particularly irritating nor have EBD. Moreover, a student who is consistently irritating is at high risk of acquiring EBD if he or she does not already have such a disability, and such a student is likely also to bring out the worst in others.

Another misunderstanding is that students with EBD exhibit their problematic behavior all the time. Such disorders tend to be episodic, highly variable, and sometimes situation-specific (for example, exhibited only when demands are placed on the student to perform or exhibited only outside the home or family). Understanding the episodic nature of EBD is critical. Expecting someone with EBD to exhibit problem behavior all the time is somewhat like expecting a person with a seizure disorder to have constant seizures. Because EBD is typically episodic, an observer may miss incidents that cause a teacher, who sees the student throughout the day and week, enormous and legitimate concern.

DEFINITION OF EBD

Defining EBD is fraught with difficulty, and the federal definition of this category of disability is seriously flawed. Distinguishing “emotional disturbance” from “behavioral disorder” is impossible. Steven Forness and Jane Knitzer recounted problems in the definition in IDEA (the federal special education law first enacted in 1975) and proposed an alternative formulated by the National Mental Health and Special Education Coalition, a coalition of more than thirty national organizations concerned with children’s mental health. Although many definitions have been proposed, Daniel Hallahan, James Kauffman,

and Paige Pullen conclude that all definitions contain these common elements:

- extreme behavior (not just slightly different from the usual)
- a chronic problem (constant and on-going, which does not resolve quickly)
- violation of social or cultural expectations

Most teachers understand that many students exhibit minor behavior problems and that some students exhibit serious problems that nonetheless fall short of disability. However, most teachers also understand that serious, persistent violations of behavioral expectations that are appropriate for a student’s social and cultural context are debilitating.

A major controversy regarding definition is the exclusion in the IDEA definition of students who are socially maladjusted but not emotionally disturbed. Sometimes identification of a student with EBD is resisted because the family or community is said to have failed to teach the individual appropriate behavior, and the problem is therefore judged to be social maladjustment, not emotional disturbance. However, exclusions based on presumed or known causes are neither logically nor morally defensible. For example, one does not conclude that a student is not blind because his or her lack of sight was caused by X (e.g., disease, accident, or genetic process). Blind simply means one cannot see, regardless of the cause. Likewise, EBD simply means a serious, persistent problem behavior regardless of cause.

The exclusion of students who are judged to be socially maladjusted is essentially uninterpretable and indefensible for two other reasons. First, it is inconsistent with the intention and writing of Eli Bower, who provided the federal definition without the exclusion. Second, the EBD most likely to be interpreted as social maladjustment (conduct disorder, which includes various forms of antisocial behavior and is closely linked to poor socialization) is one of the most serious disabilities in the EBD category (Kauffman and Landrum, 2009). Thus the exclusion of social maladjustment is both illogical, given the federal definition, and inconsistent with the IDEA principle of identifying and serving all students with disabilities.

PREVALENCE OF EBD

According to the U.S. Department of Education (2005) and the National Research Council (2002), about 1% of students in public schools in the United States receive special education under the ED (EBD) category. The Department of Health and Human Services (2001) as well as data from other studies (Costello, Egger, & Angold,

2005; Kauffman & Landrum, 2009) strongly suggest that the actual prevalence of EBD is at least five times greater (about 5%).

Students with EBD typically are rated as having behavior problems far more often than their peers and are directly observed to exhibit problems far more often than other students. Nevertheless, as Kauffman has suggested, in most cases students with EBD are not identified until their problems are severe and protracted, often because educators are afraid of labeling or of being accused of making a mistake in identification. Educators appear to be far more willing to decide that the student should be identified as having a learning disability (LD) than they are to identify a student as having EBD. As a consequence, students with EBD are often ignored or mislabeled. After reviewing the literature on identification of EBD, Costello and her colleagues concluded: "Substantively, we can say with certainty that only a small proportion of children with clear evidence of functionally impairing psychiatric disorder receive treatment" (p. 982). These children pose a heavy burden on public health, not to mention a serious problem for schools and schooling.

ASSESSMENT AND IDENTIFICATION

There is no standardized test for EBD as there is for intelligence or academic achievement. Standardized behavior rating scales and procedures for observing and evaluating problem behavior are available, but EBD is a matter of judgment that the student's behavior is seriously problematic and in need of change. In essence, teachers and other educators are the tests for EBD, as Michael Gerber suggested is the case for LD. That is, their judgments, based on comparisons to other students they have taught, comprise the test.

Assessment of internal states through projective testing and other psychoanalytic means is not a reliable basis for identification of students as having EBD. Although sometimes unconscious or internal states may be assessed by psychologists or psychiatrists, the direct observation and rating of behavior by school personnel is a better basis for judgment.

CHARACTERISTICS, VARIATIONS, AND SUBGROUPS

As a group, students with EBD tend to be lower than average in IQ and to be lower in academic achievement than most students, although there are a few high IQ and high-achieving students with EBD. Because students with EBD are typically not intellectually highly able and high-achieving, it is understandable that many would be identified as having LD. In fact, there is a substantial overlap in the characteristics of students with LD and those with

EBD, as Janine Stichter, Maureen Conroy, and James Kauffman as well as other writers (e.g., Hallahan, Kauffman & Pullen, 2009; Kauffman & Hallahan, 2005a) have noted.

Students with EBD are generally divided into two subcategories: those with externalizing behavior and those with internalizing behavior. Externalizing behavior includes aggression, disruption, and other forms of acting out; internalizing behavior includes such problems as depression, anxiety, and social withdrawal, in which the primary difficulty is private or internal. The most frequent problems observed by teachers are externalizing. However, internalizing problems can be debilitating, and students can have both types of problems, showing both types at the same time or alternating between the two.

Besides the two broad subcategories of externalizing and internalizing problems, EBD includes many other types of disorders. Kauffman and Landrum (2009) describe several subcategories of difficulty: attention and activity disorders, conduct disorders (which may be overt aggression or covert antisocial behavior), special problems of adolescence (which include delinquency, substance abuse, and early sexual activity), anxiety, depression, and schizophrenia. Many types of disorders can occur together. A case in which a particular individual exhibits simultaneous occurrence of disorders is described as comorbid. In fact, multiple or comorbid disorders are more common than are single difficulties.

Most students with EBD are not what most people would consider psychotic—unable to tell the difference between reality and unreality. However, a few students with EBD have schizophrenia, a major thought disorder that often includes hallucinations and delusions. For these students, antipsychotic medication, as well as appropriate education, is extremely important.

INTERVENTIONS AND INSTRUCTION

Intervention based on behavior principles is the most effective way of responding to EBD, as explained by Hallahan and Kauffman (2009), Kauffman and Landrum (2006, 2009), Stichter and colleagues (2008), and Hill Walker, Elizabeth Ramsey, and Frank Gresham (2004). Other interventions may appeal to one's intuition or tradition, but they tend to be less reliable and may make problems worse. Behavior principles emphasize instruction in how to behave, support for desirable behavior, and other primarily positive interventions, although effective, nonviolent, and appropriate punishment procedures may sometimes be necessary. Application of these behavior principles in teaching is also described by James Kauffman, Mark Mostert, Stanley Trent, and Patricia Pullen (2006), by Mary M. Kerr and C. Michael Nelson (2006), and by Landrum and Kauffman (2006). A

behavioral approach relies primarily on using consequences to change behavior, although instruction, talking to students, and correcting environmental factors that set the stage for misconduct are also important. Skillful application of these principles should address the problems of students with EBD, as Hill Walker, Steven Forness, and colleagues (1998) have suggested.

Appropriate academic instruction plays a primary role in programming for students with EBD and in classroom management. In fact, Kauffman, Mostert, Trent, and Pullen suggest that a teacher who is having difficulty with a student's behavior should first consider academic instruction. Joseph Witt, Amanda VanDerHeyden, and Donna Gilbertson, as well as Kathleen Lane, emphasize the importance of educators having instruction in academic skills in helping students with EBD.

Psychopharmacology plays an increasingly important role in managing EBD. The role of drugs can be overplayed or misunderstood, but medication is clearly important not only in managing such problems as attention deficit hyperactivity disorder (ADHD), depression, bi-polar disorder, and schizophrenia but also in making students with these disorders more accessible to instruction (see Steven Forness & Kelli Beard; Steven Forness, Stephanny Freeman, & Tanya Paparella; and Dean Konopasek & Steven Forness).

ISSUES IN ASSESSMENT AND EDUCATION

A major problem in assessment is fear of false identification. In fact, this fear is so common that students with EBD typically are known to have serious problems for years before they are identified, and the evidence for EBD must be so overwhelming that almost no one can argue that the identification is unjustified. Of course, such fear kills any hope of prevention, as Kauffman has pointed out.

No one suggests letting behavior problems fester until they become severe, protracted, and nearly insurmountable, yet that is what typically happens, as Kauffman, Walker and his colleagues (2004) and Phillip Wang and his associates (2005) have observed. In fact, Glen Dunlap and his colleagues present the consensus of researchers in the field that early identification of children with challenging behavior (EBD) is possible and more effective than later intervention. Moreover, Wang and his fellow researchers wrote that "long periods of untreated illness may also be harmful to those with less severe disorders" and that "most people with 1 disorder progress to develop comorbid disorders and such comorbidity is associated with an even more persistent and severe clinical course" (pp. 610-611). Thus, the case for early identification and prevention has been made

clearly, yet prevention is not typically put into practice (see Dunlap & colleagues; Kauffman). Early identification and prevention are not controversial ideas; however, when they are put into practice, controversy can arise. Complications regarding labeling, privacy, disproportionate identification of children by ethnic or color group, and doubt about misdiagnosis result in inaction.

Violence in schools is recognized as a serious problem; however, few schools use what is known about violence prevention. Get-tough policies and harsh punishment for aggression, the usual responses, are mostly counterproductive. The best approaches include school-wide behavior monitoring and behavior management procedures that emphasize careful monitoring, clear expectations, reward for desirable behavior, and nonviolent negative consequences for behavioral infractions, which have been described by Walker and his colleagues (2004) and by Kerr and Nelson (2006). However, although some EBD students commit violent acts, most do not.

The placement of students with EBD has been a matter of special concern and controversy in the context of movement toward full inclusion, the idea that all students should be placed in general education classes in their neighborhood school regardless of their disabilities (see Kauffman and Hallahan, 2005b). The placement in general education classrooms of many students with EBD is not feasible, as James Kauffman, John Lloyd, Teresa Riedel, and John Baker have suggested. The idea of basing all services for all students with EBD in the communities where they live is appealing, and community-based services are clearly feasible for some. However, closing all hospitals and residential placements for students with severe EBD and attempting to provide all services in the community has not proven feasible (Hallahan & Kauffman; Kauffman & Landrum, 2009). Effective programs for students with EBD are expensive, and inclusionary programs and community-based services promise savings for taxpayers. The anticipated cost saving makes inclusionary, community-based programs popular, although research does not show them to be particularly effective.

Adolescents and young adults with EBD are among the most frequently unemployed individuals with disabilities. Helping students with EBD make the transition from high school to work or to further education is among the most difficult tasks in special education, as Douglas Cheney and Michael Bullis have noted. Programs for the transition of students with EBD have been criticized as unsuccessful, but they are often criticized for other reasons as well. Critics may claim that they represent consignment of students to second-class citizenship or that they emphasize vocational skills when they should be focused on academic preparation for higher education.

In fact, any schooling different from that for students headed for college is vulnerable to charges that its expectations are too low.

Students who are members of ethnic minority groups in the United States, particularly African Americans, are disproportionately identified as having EBD. Although the reasons for disproportionality have not been identified unambiguously by research, multicultural special education is considered essential (Hallahan, Kauffman & Pullen, 2009). That is, special education teachers need to be sensitive to and respectful of cultural differences, but they may not understand how to do so and much of the education literature is unclear on the subject. James Kauffman, Maureen Conroy, Ralph Gardner, and Donald Oswald have suggested that effective, evidence-based education is culturally neutral and that culturally sensitive education demands attention to the individual student from a scientific perspective. Although science itself has been criticized as culturally biased, that criticism has been resoundingly rejected by many special educators, exemplified by *Challenging the Refusal of Reasoning in Special Education*, edited by Mark Mostert, Kenneth Kavale, and James Kauffman. About ethnicity, Kauffman, Conroy, Gardner, and Oswald concluded that “first and foremost we must recognize that the most culturally responsive practices are empirically validated instructional strategies. . . . At this point the data seem to suggest that this applies to all children, regardless of their ethnicity.”

SEE ALSO *Special Education*.

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James M. Kauffman

EMOTIONAL DEVELOPMENT

Along with physical and cognitive development, every child progresses through phases of emotional development. Arguably, all children differ in their individual development. Studies have shown that parents admit to having little information on emotional development, even though they also admit that their actions have great influence on their children's emotional development.

Emotions are not as easy to study or recognize as cognition, and for many decades the study of emotional development lagged behind study in other areas of child development. However, by the early twenty-first century researchers had developed several theories on emotional development.

EMOTIONAL DEVELOPMENT DEFINITION

Emotional development is the emergence of a child's experience, expression, understanding, and regulation of emotions from birth through late adolescence. It also comprises how growth and changes in these processes concerning emotions occur. Emotional development does not occur in isolation; neural, cognitive, and behav-

ioral development interact with emotional development and social and cultural influences, and context also play a role. Various emotional development theories are proposed, but there is general agreement on age-related milestones in emotional development.

Social and emotional development are strongly linked and sometimes studied or reported in tandem. Parents and other caregivers play an important role in emotional development, but as a child's world expands, other people in the social context also play a part in emotional development.

Debate continues as to exactly when emotions appear in infants. For example, smiles occur early, but the earliest ones are more likely reflexive than social. A smile may express emotion as early as 6 weeks of age but it is not until about age 6 months that a smile can be considered more emotional and social in nature. Crying is a powerful emotion for infants and may be used as a communication tool. Distress, pleasure, anger, fear, and interest are among the earliest emotions that infants express. Laughter begins at about 3 to 4 months of age. Eliciting laughter in babies at this age often involves an action that deviates from the norm, such as peek-a-boo games provoke. Development of negative emotions probably follows soon after, with anger still winning over sadness to express negative feelings. Fear begins to emerge, and infants often follow the emotions of their caregivers and form strong attachment to them.

By toddlerhood and early childhood, children begin to develop more of a sense of self. Emotions such as pride, shame, and self-recognition begin to emerge. These developments are facilitated partly by the rapid maturation of a toddler's frontal lobes and limbic circuit in the brain. These emotional developments lead to the strong sense of independence and defiance that often characterize the toddler years. Of course, toddlers also are becoming more independent physically, having developed skills such as walking. They may begin to play independently too. The self-recognition brings new levels of emotional development. For example, toddlers will begin to respond to negative signals from caregivers and others. It is at the toddler stage, or at least by age 2, that children also begin showing empathy, which is a complex emotional response to a situation. Feeling empathy requires that a child not only read emotional clues from others but understand the distinction between self and others. Actually putting one's self in the other's position also is required for empathy.

Emotional expression is still largely nonverbal, although some emotional language may develop by age 20 months. For the most part, facial expressions, crying or other vocal expressions, and gestures still express many of toddlers' emotions. In early childhood, verbal skills develop and with them, verbal reasoning. Children also

are able to talk about their feelings as they learn how to express themselves verbally. As young children enter preschool, they may be able to label their emotions and learn about them by understanding family discussions and actions concerning emotions. For example, a child may be able to say, "I am mad," or "I am sad," instead of simply expressing the emotion through actions such as crying, stomping, or yelling. This is not to say that tantrums do not occur; between toddlerhood and school age, children still express anger in the form of tantrums. Because emotions have become important to young children, they talk about them often in conversation.

Preschoolers begin to understand the rules of family, school, and society concerning how they express some of their emotions. They also can recognize nonverbal cues of emotion from one another. Preschoolers begin to distinguish between negative emotions such as sadness, anger, and fear. Although these young children have empathy, their knowledge of others' feelings generally is limited to people and situations with which they are familiar. Development of this emotional capacity also depends on positive, culturally acceptable emotional exchanges with peers. Negative emotional influences of family life that are common and harsh, particularly in the child's discipline model, can lead to problems with emotional development and even psychopathology.

ENTERING SCHOOL

As children enter school, they gain a greater sense of self and an understanding of how specific situations can lead them to experience emotions. Children may experience shame, even in reaction to emotions expressed. They also can begin to understand how an event can lead to mixed emotions. Research has shown that by about age 6, children may appreciate that people can experience one emotion, then a completely different emotion immediately after the first. The understanding of simultaneous and even conflicting emotions soon follows.

As children move into later childhood, they learn the "rules" of displaying emotion, which is a form of social and emotional development. For example, if children have been taught to do so, they may, out of politeness or respect, be able to avoid showing disappointment in a gift or the failure of an adult to fulfill a promise. As they understand the emotional states of those around them, children realize that these states are not as simple as they might have once imagined.

School-aged children begin developing emotional coping skills, even if those skills are at very basic levels. For example, children may rationalize situations and behaviors or reconstruct scenarios to make them seem less upsetting emotionally. The ability to suppress negative emotions is a factor of normal development, as well

as other influences, such as gender, the specific situation, cultural influences, and the person likely to receive the expressed emotion.

In adolescence emotions still are developing. In fact, the adolescent years often are considered an emotional period of development. Although adolescents begin to develop independence from their parents and begin to display social signs of independence by gaining employment, driving, and other activities, their emotional autonomy is represented by conflict and often negative emotions. One reason for the negative emotions may be cognitive development of abstract thinking abilities. Because adolescents can imagine all sorts of complex and theoretical scenarios for romance or in response to other relationships, they may suffer resulting emotional distress. In turn, social problems become more complex, and adolescents look to their peers to help provide a basis for how to manage the emotions they feel.

Family issues and struggles over becoming independent, with curfews, academic pressure, and romantic and other peer interactions, all place a great deal of pressure on adolescent emotions. Strong self-perceptions from earlier childhood may give way to self-doubt or feelings of worthlessness. As adolescents realize that their emotions are separate from their parents' emotions, a process called "emotional autonomy" begins. Adolescents may feel pulled between the close emotional ties they have with their parents and a need to develop independent emotional responses. If depression is going to occur, it generally begins during adolescence and is more common in girls than in boys.

EMOTIONAL REGULATION

A major part of emotional development in children and adolescents is how children recognize, label, and control the expression of their emotions in ways that generally are consistent with cultural expectations. This is called *emotional regulation*. In short, development of an emotion almost is dependent on regulation. The exact definition and models of emotional regulation have been debated. But what is apparent in the study of child and adolescent development and the development of positive instructional strategies is the complex interaction of emotional regulation and development of emotions.

Self-regulation of emotions includes recognition and delineation of emotions. Once a child can articulate an emotion, the articulation already has a somewhat regulatory effect. Children may be able to use various techniques to self-regulate as they develop and mature. Children begin learning at a young age to control certain negative emotions when in the presence of adults, but not to control them as much around peers. By about age 4, children begin to learn how to alter how they express

emotions to suit what they feel others expect them to express. The ability to do so is what psychologists call *emotional display rules*.

By about age 7 to 11 years, children are better able to regulate their emotions and to use a variety of self-regulation skills. They have likely developed expectations concerning the outcome that expressing a particular emotion to others might produce and have developed a menu of behavioral skills to control how they express their emotions. By adolescence, they adapt these skills to specific social relationships. For example, older children may express negative emotions more often to their mothers than to their fathers because they assume their fathers will react negatively to displays of emotion. Adolescents also have heightened sensitivity to how others evaluate them. Their self-consciousness and the culture-specific nature of guidelines concerning the appropriateness of emotional expression make this a particularly difficult time to learn when and how to express or regulate many emotions.

Several emotional development models and perspectives present views on emotional regulation. The functionalist perspective emphasizes that emotions serve a function of focusing action to achieve personal goals. Self-regulation is critical to emotional development because it marks a progressive ability to regulate emotions according to demands of the physical and social worlds. Actions match the demands of the situation and each family of emotions provides a range of behavior-regulatory, social-regulatory, and internal-regulatory functions for an individual.

The perspective of emotions as discrete states is based on understanding emotions as patterns of configurations in the brain, as demonstrated in cognitive neuroscientific studies. Neurochemical processes result in subjective feeling states, with accompanying automatic changes in bodily function and behavior. These give rise to basic emotions. Specific sections of the brain are associated with particular emotions. For example, the right prefrontal cortex is associated with negative affect and withdrawal. Theorists propose a maturational timetable for emergence of these basic emotions, beginning in infancy. Emotional development and regulation are dependent on cognition for the most part; cognitive development leads to new abilities to understand and self-regulate basic emotions.

Process viewpoints, also known as systems perspectives, do not disclaim the functional utility of emotions or their grounding in discrete feeling states. But the perspectives focus on how emotions emerge from one's tendency to self-organize various interacting components. These components include felt experiences, cognitive appraisals, motivations, functions, and control elements. This perspective leaves emotional regulation dynamic and open to transformation, as emotions are complex

and specific to situations. They also help form the basis of one's self and personality. Like functional and discrete state perspectives, systems theories maintain that emotions can serve adaptive functions for a child, especially in social situations.

EMOTIONS AT SCHOOL

The interplay of emotional development, social development, and academic performance is complex. C. Cybele Raver's 2002 research has established a strong link between social/emotional development and behavior and school success, particularly in the first few years of schooling. If a child's academic tasks are interrupted by problems with peers, following directions, or controlling negative emotions, the child will have trouble learning to read or staying on task in other educational activities. Research also has linked antisocial behavior with decreased academic performance.

Emotional understanding can positively relate to adaptive social behavior, yet it can negatively relate to internalizing behavior. This may lead to feelings of anxiety, depression, and loneliness. Knowledge of emotion can affect verbal ability, and in turn, academic competence. Verbal and prosocial skills are critical to academic achievement. For example, a child must be able to communicate with his or her teacher, which includes reading emotional cues. Children who do not learn to regulate emotions and who display disruptive behavior in school spend less time on tasks and receive less instruction and less positive feedback.

ASSESSING EMOTIONAL DEVELOPMENT

Taking a preventive approach to challenging behaviors by designing programs that engage students and teach them new social skills may ward off some challenging behaviors. Others may continue in spite of quality programming. Although the emotional-related behaviors may be obvious, it is important to gather some data to assess the child's emotional development or atypical development and to aid in developing a plan to improve the behavior.

Assessment begins with deciding which behavior is the most challenging and needs immediate intervention. Considerations include whether or not the behavior is harmful to the child or others, how the behavior might interfere with learning or participation in learning activities, and if the behavior will hinder development of positive social relationships. Detailed explanations of behaviors are most helpful at this stage. The second step is to conduct a functional assessment. This involves conducting interviews with parents and others to determine what precipitates the behavior and what the consequences

of the behavior are. An ABC chart of columns can help with observation.

Next is the step of developing hypothesis statements based on behavioral patterns that emerge from the functional assessment information. A support plan follows, with proposed changes to the antecedent events that lead to the behaviors and inappropriate emotional expressions. Finally, professionals can implement, evaluate, and modify the plan. Baseline rates of challenging behaviors and appropriate replacement skills should be noted and later compared.

RISK AND PROTECTION IN EMOTIONAL DEVELOPMENT

Dr. Carolyn Saarni, professor of counseling at Sonoma State University (California) has discussed two rules of emotional display, prosocial and self-protective. With prosocial rules, a child alters his or her displays of emotion to protect another's feelings. In self-protective display, the child masks emotions to avoid embarrassment or to protect himself or herself from potentially negative consequences. Research on which of these self-regulation strategies emerges first is mixed. Throughout a child's life, however, the risks of displaying emotion persist, probably most blatantly in adolescence, when peer pressure works on emotional regulation. Gender also plays a role in the types of emotions children, and adolescents, in particular, feel comfortable displaying. Boys are less likely than girls to express fear in times of stress, for example, for fear of belittlement. For the most part, self-protection and prosocial rules aid in positive emotional development.

RESEARCH ON CLASSROOM STRATEGIES

A framework that promotes positive relationships in the classroom helps prevent and address challenging behaviors. The pyramid model developed by Fox, Dunlap, Hemmeter, Joseph, and Strain in 2003 begins with positive, supportive relationships from parents, teachers, and other professionals. Many professionals agree that students with an emotional disturbance need a structured leaning environment and inclusive schooling. However, data from the Special Education Elementary Longitudinal Study (SEELS) and the National Longitudinal Transition Study-2 (NLTS2), reported in 2006, showed that elementary and middle school students with emotional disturbances tended to spend more time in special education classes than other students with disabilities. The study also showed that 75% of students with emotional disturbances were receiving extra time to complete academic tests. A low percentage were receiving mental health services.

The issue of violence has taken an elevated importance in schools. Concern has been expressed that disci-

pline provisions in the Individuals with Disabilities Education Improvement Act (IDEA), such as the "stay-put" rule and cumulative 10-school-day limit on suspensions would promote school violence by unfairly protecting students with disabilities who exhibit disruptive or violent behaviors. In 2001, the General Accounting Office reported that students with and without disabilities generally were disciplined in the same manner and that IDEA played a limited role in affecting schools' ability to properly discipline students.

SEE ALSO *Anxiety; Emotion Regulation; Evaluation (Test) Anxiety.*

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Teresa Odle

EMOTIONAL INTELLIGENCE

The term *emotional intelligence* (EI), first introduced in the 1990s by Peter Salovey of Yale University and John (Jack) Mayer of the University of New Hampshire, refers to how thinking about emotion and integrating emotion into cognitive processes both facilitate and enhance reasoning. Similar to conceptualizations of intelligence, EI

involves the capacity to engage in abstract reasoning, but about emotions in particular. According to the Salovey and Mayer model, there are individual differences in EI, such that individuals who are more skilled at perceiving, using, understanding, and managing emotions are more successful at accomplishing many learning and social tasks than those who are less skilled.

BACKGROUND

In the 1980s, the concept of intelligence was broadening to include an array of mental abilities. Most notably, Howard Gardner, who was primarily interested in helping educators to appreciate students with diverse learning styles and potentials, advised practitioners and scientists to place a greater emphasis on the search for multiple intelligences such as interpersonal intelligence. At the same time, psychologists and cognitive scientists began revisiting the Stoic idea that emotions made humans irrational and self-absorbing; specifically, they considered the alternative viewpoint that emotions could enhance cognitive tasks and social interactions.

Influenced by and active participants in these movements, psychologists Salovey and Mayer began integrating the scientific evidence showing that emotions facilitate reasoning into their theory of EI. Intelligence and emotion, prior to their theorizing, generally identified divergent areas of research.

To understand the relevance of EI, it is important to grasp the critical role emotions play in social interactions and human behavior. Research conducted by Charles Darwin in the late 1800s, Silvan Tomkins in the 1960s, Paul Ekman from the 1970s into the early 2000s, and many others show that the experience and expression of emotion communicates important information about one's relationships. For example, anger signifies that someone or something is blocking one's goal, and fear signifies that someone or something in the environment poses a threat. There is scientific evidence that these emotion signals are universal, that is, broadly understood by cultures around the world. Emotions also appear to be essential to thinking and decision making. Work by neuroscientist Antonio Damasio demonstrates that the ability to integrate emotional information with rational decision-making and other cognitive processes is essential for people to manage their daily lives. Individuals unable to attend to, process, or experience emotion due to damage to specific brain areas (i.e., prefrontal lobe area) make decisions that put themselves at risk.

THE ABILITY MODEL OF EI

The Ability Model of EI proposed by Salovey and Mayer includes four relatively distinct emotion-related abilities:

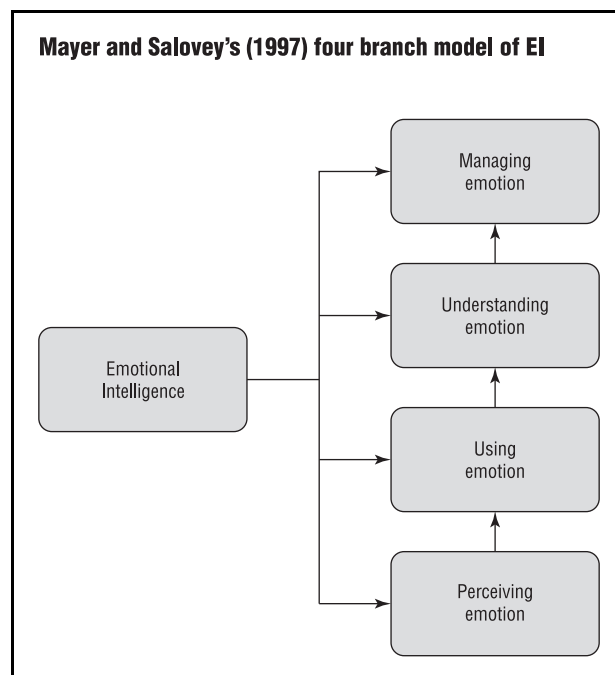


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

perceiving, using, understanding, and managing emotion. Their model is depicted in Figure 1.

Perceiving Emotion. Perceiving emotion involves identifying and differentiating emotions in one's physical states (including bodily expressions), feelings, and thoughts, and in the behavioral expressions of others (such as facial expressions, body movements, voice), as well as in the cues expressed in art, music, and other objects. Persons skilled in perceiving emotion are adept at differentiating between the range of emotion expressions (frustration, anger, and rage) in themselves and in others.

Using Emotion. Using emotion to facilitate thought refers to the use of emotion both to focus attention and to think more rationally, logically, and creatively. For example, positive emotions such as joy and amusement are more useful in stimulating creative thought while slightly negative moods such as sadness are more conducive to engaging in deductive reasoning tasks. Persons skilled at using emotions are better able to generate specific emotional states to carry out a task effectively.

Understanding Emotion. Understanding emotion is the ability to label emotions accurately with language and to know the causes and consequences of emotions, including how emotions combine, progress, and shift from one

to the other (e.g., in some situations, fear and anger combine to create jealousy). Persons skilled in this area have a rich feelings vocabulary and are knowledgeable about what causes various emotions and what behaviors or thoughts may result from their occurrence.

Managing Emotion. Managing emotion is the ability to regulate moods and emotions and involves attending and staying open to pleasant and unpleasant feelings as well as engaging in or detaching from an emotion depending on its perceived utility in a particular situation. To manage emotions effectively, persons must garner the other skill areas of EI: They must be able to accurately monitor, discriminate, and label their own and others' feelings, believe that they can improve or modify these feelings, assess the effectiveness of these strategies, and employ strategies that will alter these feelings. By effectively managing emotions, persons can accomplish situational goals, express socially appropriate emotions, and behave in socially acceptable ways.

EI theory hypothesizes that these four abilities have developmental trajectories. There are various skills within each domain that evolve from more basic to more advanced. For example, in the domain of perceiving emotion, basic skills involve accurately recognizing an emotional expression in others and more advanced skills entail expressing emotions in adaptive ways and discriminating between honest and false emotional expressions in others. EI theory also specifies that the four abilities are hierarchical in structure such that perceiving emotion is at the foundation, followed by using emotion and understanding emotion, with managing emotion at the top of the hierarchy.

The Ability Model of EI is measured by the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) and the MSCEIT-Youth Version for children. These tests require respondents to perform emotion-related tasks in order to measure their abilities within and across each of the four areas. For example, to assess perception of emotion, respondents examine a photograph of a person's face and indicate the extent to which each of four emotions is present in the expression. To assess managing emotion, respondents rate the effectiveness of different strategies to reduce a particular emotion in order to achieve a specified goal. The correctness of responses is compared to those provided by normative sample and a sample of emotion experts.

OTHER MODELS OF EI

In 1995 the concept of emotional intelligence was made wildly popular by the publication of Daniel Goleman's book, *Emotional Intelligence: Why It Can Matter More than IQ*. In the ensuing years, myriad models of EI were

created. The ability model of EI proposed originally by Salovey and Mayer was published prior to Goleman's book and stands in contrast to other models which incorporate a wide variety of personality traits and other characteristics such as optimism, happiness, and self-awareness. Proponents of these so-called *mixed* or *trait models* of EI (i.e., models that mix abilities with personality and other characteristics) typically use self-report scales instead of performance-based assessments to measure EI (i.e., respondents indicate the extent to which they believe they are able to regulate their emotions as opposed to identifying effective strategies to solve emotion-laden problems). Self-report EI scales in general overlap considerably with personality assessments (i.e., they do not measure a construct significantly distinct from existing personality scales). Responses to self-report EI scales typically do not correspond with performance on the MSCEIT, and MSCEIT scores generally are more predictive of important outcomes than self-report EI scales.

EI AND CLASSROOM LEARNING

The abilities and knowledge areas captured by the EI ability framework contribute to students' academic achievement, ability to maintain quality social relationships, psychological and physical well-being, and later life success. A meta-analysis of more than 250 studies conducted by Roger Weissberg and Joseph Durlak at the Collaborative for Social and Emotional Learning (CASEL) reveals that the average student enrolled in school-based programs that promote emotion and social skills performs significantly better on achievement tests and has better grades than non-participants. Emotionally skilled students, for example, are better able to identify the causes of their anxiety and may anticipate that an upcoming test is causing them to feel distress. To manage the distress, these students are more likely to engage in proactive behaviors such as asking teachers for help in studying and ensuring they have sufficient time and resources to prepare for the exam.

There is ample scientific evidence that the skills of EI are related to social competence (see work by Nancy Eisenberg and by Susanne Denham for examples). Students who recognize emotions in others and understand, label, express, and regulate their own emotions effectively have good social skills, strong friendships, and high opinions from peers. These positive social outcomes enhance academic achievement. For example, compared to others, students with strong friendships feel more comfortable in the school environment, receive better academic support from teachers, get more social support from peers, and develop healthier attachments to school.

The skills of EI also are related to psychological well-being and to anxiety and depression (in the expected

directions). Students with lower EI, especially boys, are more likely to engage in behaviors that put their health and well-being at risk, including drinking, smoking, using drugs, and engaging in violent behaviors. The incidence of anxiety and depression and of these behaviors interferes with learning.

In their research Brackett and Rivers found relationships between EI with teacher ratings of students' leadership skills, study skills, and their ability to adapt to changes. They also found that students with greater EI were less likely to experience (according to teacher evaluations) problems that include aggression, anxiety, conduct problems, hyperactivity, and learning difficulties.

TEACHING EMOTION SKILLS AND KNOWLEDGE IN SCHOOLS

Schools and classrooms provide an ideal place for teaching emotion skills and knowledge. For many children, school is the first opportunity for continued and stable social interactions, and it is difficult for many children to develop their emotion skills solely within the home when, more and more, both parents are working full-time and often have multiple jobs. CASEL researchers contend that "Schools and classrooms in which adults are nurturing, supportive, and caring furnish the best contextual opportunities for social emotional learning programs to be introduced, sustained and effectively provided" (Elias et al., 1997, p. 75).

With their collaborators, Brackett and Rivers have developed a series of programs to teach students how to recognize, understand, and label accurately both their own and others' emotions, appropriately express their thoughts and feelings, and regulate their emotions effectively, as well as to appreciate the significance of these skills in the academic, social, and personal lives. These programs, titled "Emotional Literacy in the Classroom" (ELC) are grounded in theory and scientific evidence, are field-tested, and are integrated easily into existing school curricula. These programs leverage reading, language arts, and social studies instruction to teach emotion knowledge using an innovative multi-faceted approach. The programs complement the regular school-day curriculum and adhere to both state and national standards. The ELC programs, which have been adopted by and tested in school districts across the United States and abroad, address the particular social and emotional needs of students and help create a caring and challenging classroom environment that fosters effective and enduring academic learning. Accompanying professional development and training programs for teachers and administrators provides educators with the skills and support they need to effectively teach emotion knowledge and skills to students.

SEE ALSO *Intelligence: An Overview*.

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Marc A. Brackett
Susan E. Rivers

EPISTEMOLOGICAL BELIEFS

Epistemology is the branch of philosophy that investigates what knowledge is and how people know whether they know something (BonJour, 2002). It addresses questions such as: What is knowledge? How do people know if they really have knowledge? What provides a justification for any knowledge that they have? For example, on what grounds are people justified in believing that electrons have negative charge or that an accused robber is guilty? Are people convinced by sensory evidence, by testimonial evidence, by strong intuitions, or by some other means?

Epistemologists, of course, have developed many ideas about how to answer questions such as these. In recent years, psychologists have become interested in whether people other than philosophers have ideas about what knowledge is and how knowledge is justified. In other words, psychologists have wondered if people have beliefs about epistemological questions (called *epistemological beliefs* or *personal epistemological beliefs*) and whether these beliefs affect in any way their learning or reasoning.

To see why these issues are important, consider the following hypothetical students, both eighth graders learning science:

- Emily believes that the scientific knowledge she is trying to master typically has a very *complex* structure with rich and numerous interconnections. Sharon, on the other hand, believes that scientific knowledge has a very *simple* structure, consisting of lists of unrelated facts.
- Emily believes that people know that scientific knowledge is true on the basis of observational evidence. In contrast, Sharon believes that people know that scientific knowledge is true because the textbook and her teacher say so.
- Emily believes that scientific theories are fallible; she knows that there are often competing theories, and it sometimes takes years to work out which theories explain the observational evidence better. Sharon, however, thinks that there is only one scientific theory on any idea, and this theory is absolutely and forever true.

In summary, Emily and Sharon differ in their beliefs about the *complexity of knowledge*, the *source of knowledge* (observation versus the authority of the teacher and text), the *certainty* of knowledge, and whether there can be (and are) *competing theories* attempting to explain the same data.

Emily's and Sharon's ideas for learning and reasoning in science have several possible implications:

1. When studying cellular processes, Emily expects to find rich interrelations among ideas, and she tries to understand them when she finds them. Sharon, on the other hand, simply tries to memorize each concept separately, never realizing that the processes are interrelated in interesting ways. In this way, beliefs about the *structure* of knowledge can influence learning.
2. When conducting an experiment on seed germination, Emily finds that the seeds sprout and grow for a while even when they are kept in the dark. She realizes that when the textbook says that "plants need sunlight to grow," this must not apply to seeds. She

decides that perhaps seeds contain their own energy for initial growth. Sharon, however, assumes that she did something wrong in her experiment, because she takes her textbook at its word, and the textbook says that plants need sunlight to grow. Thus, beliefs about the *source* of knowledge (observations versus textbooks) affect how students reason about new evidence.

3. When Emily reads a magazine article about conflicting studies regarding the role of carbohydrate consumption on weight control and health, she understands that much more evidence will probably be needed before matters are more fully understood. She decides to adopt a medium-carbohydrate diet, but she is aware that later evidence may make it necessary for her to change her mind. In contrast to Emily, Sharon is sure that her current ideas about the superiority of a low-carbohydrate diet are absolutely correct, because she learned about these ideas on a website written by an important doctor. She is puzzled why a magazine article would not just state the one correct theory. On this topic, it is clear that students' ability to understand competing ideas as well as how they act in response to these ideas can be affected by beliefs about the certainty of knowledge.

These examples illustrate that epistemological beliefs may have powerful effects on learning and reasoning. A growing body of research supports that such effects do exist (Mason & Boscolo, 2004; Qian & Alvermann, 1995; Schommer, 1990; Songer & Linn, 1991).

EMERGENCE OF PSYCHOLOGICAL RESEARCH ON EPISTEMOLOGICAL BELIEFS

Contemporary psychological research on learners' epistemological conceptions has its roots in the work of William Perry (1968/1999), who investigated the development of male Harvard students' ideas about knowledge during the college years. Other researchers, including Mary Belenky, Patricia King and Karen Kitchener, Marcia Baxter Magolda, and Deanna Kuhn have also investigated changes in epistemological ideas over time. This research has generally aimed to make claims about broad, overall epistemological stances expressed by individuals. For example, in Kuhn's scheme (Kuhn & Weinstock, 2002), children move from a realist epistemology (assertions are copies of reality) to an absolutist epistemology (assertions are correct or incorrect facts), and later to a multiplist epistemology (assertions are opinions, and everyone has a right to their own opinion), and finally (in some but not all people) an evaluativist epistemology (assertions are judgments based on weighing arguments on different sides of a question).

In the late 1980s, Marlene Schommer (Schommer, 1990) and others argued for an alternative approach to conceptualizing people's epistemologies. Schommer argued that epistemologies might be separable into independent beliefs. Schommer proposed three beliefs that would be called epistemological beliefs: a belief in how complex knowledge is (ranging from complex to simple), a belief in how certain knowledge is (ranging from highly certain to highly uncertain), and a belief in the source of knowledge (e.g., knowledge coming from authority). These beliefs were independent of each other. For instance, a person could believe in complex but certain knowledge, complex but uncertain knowledge, simple and certain knowledge, or simple but uncertain knowledge.

Methodologically, Schommer advanced an influential way to measure epistemological conceptions. In contrast to developmental work, which had relied principally on interviews and, to a lesser extent, on written, open-ended questions, Schommer developed a questionnaire called the Epistemological Questionnaire. Several different items were intended to measure the same underlying dimension. For example, two of the items that were intended to measure *certain knowledge* were (1) "Truth is unchanging" and (2) "Nothing is certain, but death and taxes." Respondents rated agreement to each statement on a Likert scale.

Other researchers have developed analogous scales tapping overlapping but not identical sets of epistemological beliefs. For example, Barbara Hofer (2000) developed a questionnaire with items that addressed four epistemological beliefs. The questionnaire was also designed so that the questions referred to a specific field. That is, the questions did not refer to knowledge in general but to knowledge in a specific field such as science or mathematics. The first two epistemological beliefs were about the nature of knowledge:

- Certainty. This belief refers to the extent to which the respondent thinks that knowledge is certain versus fallible and subject to change.
- Simplicity. This refers to the extent to which the respondent believes that knowledge is structured and organized in simple ways with a single right answer rather than in more complex ways with more than one right answer.

The third and fourth beliefs address how a person comes to "know" something.

- Source of knowledge. This belief references where knowledge comes from— from oneself (and one's own experiences) or from others (such as the teacher, the textbook writer, or experts in a field).

QUESTIONS TO ASSESS EPISTEMOLOGICAL BELIEFS

Epistemological beliefs have been measured educational psychologists in different ways and for different reasons. One variation depends on how epistemology is understood. This can range from very narrow to extremely broad theoretical concepts.

There are also many methods for measurement that are not necessarily related to one's theoretical understanding of epistemology. These methods vary according to the preference of the researcher, trends in educational research, and the compatibility of the method to the field and/or context.

Some of the qualitative methods have depended on case studies in which a general question such as: "What stands out to you about the year so far?" is posed to a sample of students. In other quantitative instances, researchers measure specific factors in surveys such as, "belief scales," where students indicate, on a scale of one to five, how much they agree with the statement: "Hard work can increase one's ability to do math."

The context of each study provides another degree of precision. Epistemological beliefs are researched in subject or grade specific contexts, from comparative and multi cultural perspectives, and within discourse of race, class, and gender. This large variety of subject matter denotes the especially broad and important nature of the study of epistemological beliefs in education and beyond.

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- Justification of knowledge. Closely related to the source of knowledge, this belief is about the kinds of justifications that are offered in support of knowledge. Justifications might be on the basis of personal experience or the authority of experts.

Other researchers have used items from these scales and have developed their own items to construct new measures.

Though inspired by the philosophical literature, research by psychologists and educational psychologists on epistemological beliefs has not been tightly linked to the philosophical literature. There are relatively few citations of the epistemological literature in psychological

and educational articles about epistemological beliefs. There has been somewhat more connection to the philosophical literature by researchers in the epistemological development tradition, especially in the seminal work of William Perry.

In a 2005 study Clark Chinn and Ala Samarapungavan (have argued that closer attention to philosophical research would suggest many other kinds of epistemological beliefs that could be explored by researchers. For example, psychologists have not explored people's beliefs about social processes of knowledge construction (e.g., are processes such as peer review or interactive argumentation conducive to arriving at true ideas?) or people's beliefs about evidence (what exactly counts as evidence? How should one respond to anomalous evidence?)

EPISTEMOLOGICAL BELIEFS VERSUS BELIEFS ABOUT LEARNING

One issue that has arisen with respect to measures of epistemological beliefs is the need to distinguish between epistemological beliefs and beliefs about learning. Barbara Hofer and Paul Pintrich (1997) argued that researchers have sometimes confused these two related but distinct sets of beliefs. An epistemological belief is a belief about the nature of knowledge or how one comes to believe that it is knowledge. A belief about learning is a belief about how people come to understand and remember ideas regardless of whether they believed them or not. For example, the belief that "knowledge is complex" is a belief about the nature of knowledge but says nothing about how people learn that knowledge. In contrast, the belief that one can learn ideas quickly is not a belief about what knowledge is or how one comes to know or believe it, but rather a belief about how one comes to *learn* the ideas. Indeed, one can learn something which is not viewed as knowledge at all (e.g., one can learn about astrology while believing it to be bunk). One can believe that knowledge is justified on the basis of observational evidence collected by experts (an epistemological belief) yet believe that the best way to learn that knowledge is by having a teacher explain it quickly (a learning belief). Learning is about understanding and remembering. Epistemology is about the criteria for deciding that something is true.

RESEARCH ON EPISTEMOLOGICAL BELIEFS

During the growth of research on epistemological development and epistemological beliefs by educational and developmental psychologists, a second body of research on epistemological beliefs was being conducted by science educators. Most science educators have characterized their research as investigating students' beliefs or ideas about the *Nature of Science* (NOS). Research on

NOS has been growing rapidly since the 1970s and 1980s. Two figures important in inspiring research on NOS were Richard Duschl and Norman Lederman. Duschl made a compelling claim that work by philosophers of science was highly relevant to many aspects of science education; he argued that science educators should align their ideas about the goals and practices of science with what was being learned by philosophers and historians of science. Science educators have responded to this call by investigating the understanding of NOS by both scientists and by students. Science educators have also linked their work more explicitly than educational psychologists have to the philosophical literature, especially to the work of Thomas Kuhn (1922–1996).

Research on students' understanding of NOS has, as one would expect, focused on epistemological issues related to science. The VNOS (Views of Nature of Science Questionnaire) was developed by Lederman and has been since refined by a number of others, including Fouad Abd-el-Khalick. In its most recent version, a few of the questions are:

- What makes science different from other disciplines of inquiry (e.g., religion, philosophy)?
- Does the development of scientific knowledge require experiments? Why or why not?
- After scientists have developed a scientific theory (e.g., atomic theory, evolution theory), does the theory ever change? Why or why not? Give examples.
- Is there a difference between a scientific theory and a scientific law? Give examples.
- Science textbooks often represent the atom as a central nucleus composed of protons (positively charged particles) and neutrons (neutral particles) with electrons (negatively charged particles) orbiting the nucleus. How certain are scientists about the structure of the atom? What specific evidence do you think scientists used to determine what an atom looks like?

These questions are centered around what science is, whether scientific knowledge changes, what scientific knowledge is based on (e.g., experiments), and so on. Other questions address how social and cultural values influence science. Another frequently used interview protocol has been developed by Carol and colleagues (Smith, Maclin, Houghton, & Hennessey, 2000).

Interestingly, at about the same time that educational psychologists began to rely less on interview measures and more on written questionnaire measures of epistemological beliefs, science educators moved in the opposite direction. Whereas early investigations of students' understanding of

NOS tended to use questionnaires, more recent work has favored interviews and open-ended written questions of the sort presented above.

INFLUENCES OF EPISTEMOLOGICAL BELIEFS ON LEARNING AND REASONING

Most researchers would probably argue that promoting more sophisticated epistemological beliefs is a worthy educational goal in its own right. This is particularly true of science educators, as national and state standards explicitly say that part of learning science is coming to understand the nature of science. Most researchers would also agree that developing more sophisticated epistemological beliefs can also benefit other aspects of learning. A large research effort has been devoted to investigating correlations between epistemological beliefs and performance on learning and reasoning tasks. Although a comprehensive summary of findings is beyond the scope of this entry, here are a few typical findings: (1) Students who believe that knowledge is certain write essays that reach unqualified conclusions, even when there is evidence supporting different viewpoints, as well (Schommer, 1990). (2) Students who believe that knowledge consists of ideas that are interconnected (rather than a disconnected series of facts) are better able to understand texts that present alternative positions on controversial ideas (Kardash & Scholes, 1996). (3) Students with more sophisticated epistemological beliefs were better able to learn from an inquiry-based learning environment (Windschitl & Andre, 1998).

These findings should not be interpreted as showing that there are always strong relationships between measure of epistemological beliefs and measure of learning and reasoning. Some have found little relationship, for example, between reasoning and beliefs about the nature of science, and students who exhibit strong progress in reasoning better may show no gains at all in epistemological beliefs (Sandoval & Morrison, 2003). In addition, correlations between epistemological beliefs and measures of learning and reasoning are often relatively low.

HOW PEOPLE FORM EPISTEMOLOGICAL BELIEFS

Many researchers investigating learners' epistemologies have proceeded on the assumption that people do in fact have at least tacit beliefs about knowledge that they can express. Other researchers have questioned this assumption. David Hammer and his colleagues (Hammer & Elby, 2002, 2003) are among those who have argued that most people (other than philosophers) probably do not think about knowledge at all. On the other hand, even if people do not have actual beliefs about knowl-

edge, they do make decisions about what counts as knowledge and what they believe. These decisions are guided by epistemological commitments which are wholly tacit, and which cannot be readily expressed. Alternatively, one can view people as engaged in epistemic practices even if they do not have explicit epistemological beliefs. The term *epistemic* indicates that an activity is oriented to deciding what to believe and why to believe it. A child who decides that bugs have six legs because she has just picked up a bug and counted the legs has engaged in an epistemic activity of forming a belief that bugs have six legs on the basis of her personal observations.

People *do* form beliefs, and by examining the basis on which they form beliefs, researchers can identify their epistemological commitments or epistemic practices. Ala Samarapungavan (1992) conducted a study in which she assessed children's epistemological commitments by observing the theory choices they made. She gave children different theories to consider and different configurations of evidence bearing on those theories. She found that even seven year olds preferred logically consistent to logically inconsistent theories. They also preferred theories that explained more evidence (as opposed to less evidence) and theories that were not inconsistent with any evidence. Through this study, Samarapungavan was able to show that even young children share some of the epistemological commitments often attributed to scientists—a preference for simplicity, consistency with the evidence, and coverage of the broadest possible scope of evidence.

DOMAIN SPECIFICITY OF EPISTEMOLOGICAL BELIEFS

Researchers interested in personal epistemologies have investigated the extent to which epistemological beliefs and epistemic practices are domain-specific. A domain-specific belief is one that is limited to a particular domain (such as mathematics, physics, and so on). For instance, a person might believe that knowledge is certain in math but not in other disciplines. A domain-general belief is one that applies generally to all or many domains. A person who believes that all knowledge in all domains is certain has a domain-general belief.

Researchers have found evidence that epistemological beliefs are domain-specific. For example, Hofer (2000) compared undergraduates' beliefs about knowledge in science with their beliefs about knowledge in psychology. The undergraduates believed that knowledge was more certain and more attainable in science than in psychology. Knowledge in psychology was justified on more personal bases than knowledge in science, which was viewed as based more on authority.

Hammer and his colleagues (Hammer & Elby, 2002, 2003; Rosenberg, Hammer, & Phelan, 2006) have argued

for a much more radically contextual view of personal epistemologies. They argue that epistemologies shift very rapidly from one context to another. For instance, students who are working in a science class may at one moment view knowledge about the rock cycle as *propagated stuff* (information told to them by a textbook or a teacher) consisting of meaningless, isolated facts, and one or two minutes later, the same students working on the same topic may shift dramatically to viewing the same knowledge as *fabricated stuff* (ideas that they are creating themselves) composed of meaningful ideas that they are trying to make sense of. Radical shifts in epistemic practices can be triggered very quickly by shifts in environmental cues. In this view, people do not have stable epistemologies at all.

Research on personal epistemologies is thriving, with alternative theories being advanced and tested and a new measurement tools being developed. The steady increase in the number of researchers investigating this topic suggests that ideas about epistemologies and epistemological development will play an important role in theorizing about how people learn and reason.

SEE ALSO *Epistemological Development*.

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EPISTEMOLOGICAL DEVELOPMENT

Epistemology, historically the province of philosophers, concerns the origin, nature, limits, methods, and justification of human knowledge. From a psychological perspective, *personal epistemology* refers to individual conceptions of knowledge and knowing and how people develop, interpret, evaluate and justify knowledge (Hofer & Pintrich, 1997, 2002). Knowledge and knowing appear to develop in a patterned sequence across the life span. Understanding the trajectory of epistemological development and how it relates to learning and education can be useful for teachers, students, and educational researchers.

TRAJECTORY OF EPISTEMOLOGICAL DEVELOPMENT

Research on epistemological development began with the work of William Perry, who conducted longitudinal interviews with several classes of Harvard students beginning in the mid-1950s, asking them a set of open-ended questions at the end of each academic year. Perry was interested in how individuals responded to the intellectual and moral relativism encountered in a pluralistic university. At the outset of his research he expected that the differences he had observed in undergraduates' views about learning and teaching were likely to be related to personality. For example, a dichotomous view of knowledge as right or wrong and to be transmitted from an all-powerful authority would be evidence of an authoritarian personality, a construct of considerable interest to psychologists in the era following World War II. What he and his research staff found, however, was that the way in which students thought about knowledge and knowing changed during the college years, and most important, this change occurred in an ordered and predictable sequence of intellectual and ethical development.

The trajectory that Perry and his colleagues identified suggested that over time individuals transformed their views of knowledge and knowing from a position of dualistic thinking (a world viewed in absolutist polar binary terms of black and white, right and wrong) toward more contingent, relativistic thought. Thus the perception of knowledge as objective and certain was not a personality characteristic, but something malleable and apparently influenced by education. Perry's research resulted in a nine-point scheme of development that became the precursor for a significant body of research and the foundation for a wide range of ideas about educational implications of epistemological development.

Other similar schemes of intellectual development with epistemological components followed, all based on Perry's work. These models include reflective judgment, developed by Patricia King and Karen Kitchener; women's ways of knowing, developed by Mary Belenky, Blythe Clinchy, Nancy Goldberger, and Jill Tarule; and epistemological reflection, developed by Marcia Baxter Magolda. Additionally, Deanna Kuhn, in her research on the skills of argument, outlined a set of epistemological assumptions that further refined into a pattern of epistemological development with colleagues Richard Cheney and Michael Weinstock. Overall, each of these approaches involves a stage-like progression of from three to nine positions, but the components and the trajectory are remarkably similar.

Typically, individuals in any of these studies, primarily of college students and adults, are perceived as beginning with absolutism, a worldview marked by dual-

ism and certainty: knowledge is black or white, right or wrong, highly certain, composed of discrete facts, and handed down from authorities unquestioningly. This position is modified as individuals come to recognize the legitimacy of other viewpoints. A midpoint on most schemes is characterized by multiplism, the idea that one opinion is equally valid as any other, that knowledge is highly uncertain, and that there is no agreed-upon means for justification. Advancement from this subjective state to a position of evaluativism (or commitment within relativism, as Perry called it) is marked by a growing realization that there are means for justification of various positions and that this enables an individual to assert some positions with confidence even if knowledge is evolving and contingent. Individuals who see the world from the upper levels of development are able to evaluate expertise, reconcile theory and evidence, provide support for their claims, and re-evaluate those claims in the light of new evidence.

EXPANDING THE SCOPE OF EPISTEMOLOGICAL DEVELOPMENT

Although the original scheme of development was based on Perry's study of males at an elite post-secondary institution in the United States in the 1950s and 1960s, the research was later extended to include broader populations: females, older adults, individuals not attending college, children and adolescents, and individuals in diverse cultures. One particularly important expansion of Perry's work in the decades that followed was the inclusion of women in the research sample and more deliberate attention to the perceptions of women, as in the women's ways of knowing study, or on gender-related patterns in the epistemological reflection research.

Belenky and her colleagues determined it important to study women only, as a means of understanding how women in particular approached knowledge and knowing. One of their contributions was in their attention to women's perceptions of the source of knowledge whether knowledge was viewed as external and received, entirely internal, or constructed in interaction with the environment. In the fourth level of a 5-point scheme, called procedural knowing, individuals may be either separate knowers who are detached, critical, and skeptical, or connected knowers, who are empathic and trusting, valuing understanding over judgment. The final stage, constructed knowing, involves integration of these two approaches, a more complex recognition of the relation between the knower and the known and a tolerance for contradiction and ambiguity.

The epistemological reflection model, derived from longitudinal interviews of both male and female college students, suggests that some patterns of knowing may be

gender-related but not gender-specific, as had been hypothesized by the authors of the women's ways of knowing study. At various stages in a five-point scheme that culminates in contextual knowing, women are more likely than men to be described as received knowers rather than mastery knowers, interpersonal rather than impersonal, and inter-individual rather than individual.

Such findings about gender-related patterns may need to be placed in the historical context of research conducted primarily in the 1980s. Little work in the 2000s has been done to assess the continuing validity of gender-related patterns of epistemological development and to determine whether changes in child-rearing or increased successes of females in education at all levels may have had an influence on epistemic worldviews. Continued research is needed in this area, and any application of gender-specific findings from these early studies should be made with caution. As with any group-level findings, generalizing from group differences to the individual is not recommended.

In addition to expanding epistemological research to include women, researchers have pursued epistemological development prior to the college years, an area that as of 2008 also needed further study. The early research on college students posited a trajectory beginning in absolutism, which implied that younger individuals simply viewed the world in absolutist terms until their beliefs were challenged in college. Surprisingly little longitudinal research has been conducted prior to college, but researchers such as Michael Boyes and Michael Chandler, who have assessed epistemological development in adolescence, have identified parallel stages similar to those in the college years. Chandler and others have thus raised questions about whether development might be recursive: Perhaps individuals move through the stages repeatedly, with enhanced understanding at each passage. In general, research on adolescence would indicate that high school students can exhibit post-absolutist perspectives, but more work is needed to distinguish this from the more nuanced perspectives of advanced college students. An established trajectory of epistemological development prior to the college years was as of 2008 not available.

Research from the late 1990s and early 2000s on young children began to illuminate the origins of epistemological development and to connect it to cognitive development. Very young children appear to begin at a state of egocentric subjectivity, a period in which the only perspective available is the knower's own. The attainment of theory of mind, a cognitive development between 3 and 5 years of age that involves a growing awareness of the beliefs, desires, and intentions of others, creates the potential for advancement toward an early sense of epistemic objectivity. Typically assessed through false belief tasks, theory of mind allows a child to know that another

individual can believe something erroneously. This cognitive awareness of multiple perspectives on knowing, and of the sense that one person can be right and another wrong, provides the foundation for absolutism.

Other researchers have been interested in understanding whether the developmental trajectory evidenced in U.S. studies is consistent in other cultures, or whether it might be an artifact of western education. In one cross-cultural study of Perry's scheme, Li-Fang Zhang found that students in Beijing, unlike those in the United States, became more dualistic during their college education, perhaps as result of an educational system that at the time of the study permitted few opportunities for individual decision making. Results of this and other studies suggest the need for sensitivity to cultural context and for more explorations of the interaction between educational environment, cultural context, and epistemological development.

DOMAIN SPECIFICITY

Much of the research on epistemological development is based on a presumption that a general cognitive framework guides one's views of knowledge and knowing across domains. Thus an individual who believes that there is one right answer and that authorities are the sole source of knowledge would believe this regardless of the area in question. By contrast, research on epistemic beliefs has been examined both generally and in regard to specific disciplines, such as math, science, or history. Students have been found to hold differing beliefs about disciplines, for example, that knowledge in chemistry is more certain than knowledge in psychology, as well as beliefs specific to disciplines, for example, that knowing history means learning dates. Math and science educators have extensively pursued an understanding of students' epistemic beliefs within these particular disciplines, exploring such conceptions as the nature of science. This area had as of 2008 seldom been investigated developmentally, however, although Ala Samarapungavan, Erik Westby, and George Bodner found that the epistemic development of chemistry students was influenced by aspects of their research experience and engagement with expert researchers.

Within the paradigm of epistemological development, some researchers began to explore domain differences, but little of this research focused on disciplines. In one such report, King and Kitchener (2004) noted in their overview of research on reflective judgment that there is a high rate of consistency in the use of epistemic assumptions in reasoning about ill-structured problems, regardless of domain. Other research on domain differences in epistemological development addressed domains not as disciplines, but in regard to judgment domains,

such as taste, morality, aesthetics, values, or facts. In their study of individuals from second grade through adulthood, Kuhn, Cheney, and Weinstock found that individuals can be at different epistemological levels depending on the domain, with individuals, for example, accepting multiple viewpoints in regard to personal taste before they accept them in regard to objective facts. The movement from multiplism to evaluativism is more likely to occur first in regard to objective facts, where warrants for claims begin to supersede individual opinions.

Domain differences have also been explored in studies of young children by Cecilia Wainryb and her colleagues, who found that even 5-year-olds display evidence of relativism in some domains more than others. Children can be expected at a fairly early age, for example, to know and accept that a friend prefers a different flavor of ice cream but can be quite certain that hitting is wrong. What this continued line of research suggests is both that epistemological development varies by judgment domain and that it is possible for aspects of multiplism to occur much younger than might have been predicted in the pioneering studies of college students.

METHODS OF INVESTIGATING EPISTEMOLOGICAL DEVELOPMENT

The original research on epistemological development was inherently phenomenological, with open-ended interviews that prompted meaning-making on the part of the student being interviewed. Perry, for example, began his end-of-semester interviews by asking "What stands out for you about this year?" Some of the researchers who followed Perry continued to use open-ended interviews, and others have posed ill-structured problems as a means of eliciting epistemological assumptions. For example, reflective judgment interviews involve responding to questions about issues such as the dangers of chemical additives in food, e.g., "Can you ever know for certain that your position on this is correct? How? Why not?" and "How is it possible that experts in the field could disagree about this subject?" Similarly, research on the epistemological aspects of argumentation employed questions about the certainty and justification of knowledge on topics such as reasons for criminal recidivism and other topics for which there are not likely to be simple, agreed-upon answers. Other studies on epistemological development involved asking individuals about the possible causes for a fictitious war or required a simulation of juror reasoning. Research interviews with young children, particularly in regard to domains of judgment, have been more likely to involve puppets and other props or vignettes with illustrated depictions of the scenario involved.

Interviews that require individuals to respond to ill-structured problems are called production tasks, as the

interviewee is asked to produce a response. The transcribed protocols that result are complicated to score and typically require trained raters. Although this method provides rich data and affords a complex understanding of participants' thinking, it is also an expensive and time-consuming approach. The need for measures that can be administered and scored more easily led to the design of written instruments, typically aimed at providing some means for scoring developmental level. These are more likely to involve recognition tasks, in which individuals indicate the similarity of prepared responses to their own understanding. For example, participants indicate how similar a statement such as the following is to their own thinking: "It is my perspective that what researchers conclude is just their own opinion." These instruments make it possible to conduct larger studies more quickly, but there is also concern about validity, reliability, and reductionism, as complex developmental phenomena are reduced to recognition of simple statements, potentially inflating individual scores.

EDUCATIONAL IMPLICATIONS

Epistemological development has significant implications for the ways individuals consider and approach knowing and learning in a wide range of contexts, across the life span. Individuals often need to make considered judgments on a wide range of issues from personal health to global environmental concerns, and these judgments typically require weighing of evidence and evaluation of competing knowledge claims. Yet research on epistemological development suggests that the skills required to do this, evidenced in the position of evaluativism, are not all that common and that adults in the United States are more likely to be either absolutists, convinced one position must be right, or, more often, multiplists, basing decisions on personal judgments and viewing opinions as equally valid. Kuhn and others have argued that epistemological understanding matters and that preparation of an educated citizenry requires more attention to this process within the educational system at all levels.

A number of researchers who work within the developmental tradition assert that the higher levels of epistemological development are consistent with the skills of critical thinking and adaptive complexity. Thus epistemological development has been viewed by some as one of the aims of education and as a potential outcome measure for a college education. Accordingly, a number of studies have evaluated students' progressions toward higher stages of the various schemes, particularly during the college years. Longitudinal interview studies conducted in college and in some cases beyond suggest that college does have a small but measurable impact on epistemological development and that graduate school

may advance this further, particularly in terms of higher stages of reflective judgment. Cross-sectional studies generally show a correlation between education and level of development and also between expertise and epistemological development.

Epistemological stance can also lead students to have different views of education, classroom tasks, and expectations of teachers. For example, absolutists would be likely to want teachers to provide objective truth, multiplists might have difficult understanding how teachers could make the judgments they do, and evaluativists would expect substantiated support for various positions. Educators' awareness of these general schemes can help them understand student reasoning and responses to particular aspects of education and to enable them to provide support for developmental transitions. The relation between education and development can also be viewed as reciprocal, with individuals interpreting learning through a current lens that is also being transformed in the process.

Overall, educators may wish to help students make a progression toward competence in evaluating multiple truth claims and understanding how knowledge is constructed, supported, and evolving. Research on epistemological development suggests that teachers need to attend to thinking skills and cognitive development as well as the mastery of content. Teachers can provide students with opportunities to discuss ill-structured problems, for example, and to recognize that not all problems have one right answer. Educators might also structure assignments so that students learn to gather support for particular positions, consider opposing viewpoints, coordinate theory and evidence, and evaluate expertise and authority. These are challenging tasks, but they are critically important in helping students develop intellectual skills.

SEE ALSO *Cognitive Strategies; Epistemological Beliefs; Metacognition; Theory of Mind.*

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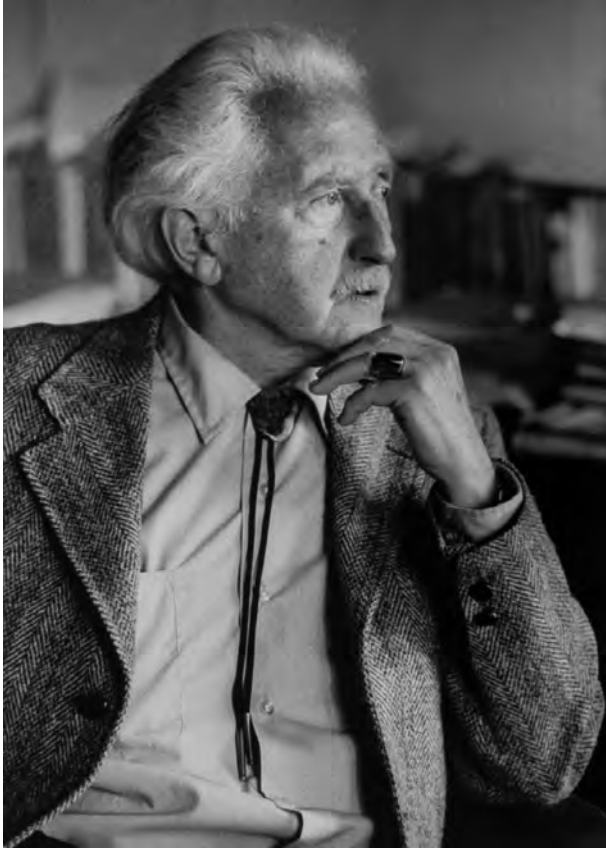
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Barbara K. Hofer

ERIKSON, ERIK

1902-1994

Erik Erickson (1902-1994), noted psychoanalyst and student of Anna Freud, is not a figure who immediately comes to mind when one thinks about the great contributors to understanding of the psychology of classroom learning. Erickson stands out among Freudians as one of the first to use a psychoanalytic perspective with children and to develop play therapy techniques for counseling. His work with World War II U.S. veterans experiencing shell shock helped solidify his understanding of the mechanisms of identity, and his famous 1968 publication, *Identity: Youth in Crisis*, helped explain the generational, social, and racial tensions of his day. The central question of his work had to do with identifying factors that affect personality.



Erik Erikson in his home study, March 4, 1975. TED STRESHINSKY/TIME & LIFE PICTURES/GETTY IMAGES.

ERIKSON'S CONTRIBUTION TO THE FIELD

Erikson's contribution to the field of educational psychology may be subtler than the mainstays of school-related research pertaining to learning and achievement. It lies not in the products of schooling, but in helping people understand the importance of interactions between teachers and students.

Erikson's work is likely to be known in many areas outside educational psychology, and any casual student of identity is familiar with his theory. His description of identity development and the mechanisms associated with this interpersonal milestone are familiar to most teachers of adolescents either through personal experience or through observation. In this context, Erikson made two important contributions regarding classroom interaction: (a) recognition that adolescence is a time when individuals search for the standards and truths that really matter, and (b) adults, and especially teachers, play an important role in adolescents' identity development. These two contributions provide insight into effective

strategies teachers can use when interacting with their adolescent students.

IDENTITY AND STANDARDS

The first contribution has to do with how Erikson understood ego and identity. Erikson agreed with Sigmund Freud's triadic model of the human psyche (id, ego, superego). Unlike Freud, who focused on the conflict between id and superego and the mediating role of the ego, Erikson described the work of the ego in terms of differentiating itself from the superego. In Erikson's view, each stage of psychosocial development, from birth to old age, involves some form of differentiation of self from others.

Differentiation of the ego has to do with the degree to which a person is what others tell him versus how much a person controls what he is. During the stage of psychosocial development associated with adolescence, the work of identity formation involves examination of social standards or values and selection of those that the adolescent believes are truly important. If choices are not actively made, the person's identity is in a state of foreclosure. If adolescents are actively involved in searching, but have not yet chosen standards, identity can be described as being in a state of moratorium, the condition most often associated with adolescence.

ROLE OF ADULTS

Given Erikson's perspective on identity development, the second important contribution is his description of the role that adults play in adolescents' identity development. This description is particularly relevant for educators. During the time of adolescent moratorium, adults can facilitate identity development in two ways. The first way is by being a "sanctioner of capabilities." (Erikson, 1968, p. 87) To adolescents, adults are the bearers of society's standards. In this generational role, adults should be clear about the standards they hold, exhibit behaviors consistent with stated beliefs, and use those standards to judge adolescents. By using society's standards to judge, adults communicate with adolescents about their capabilities and help clarify their selection of standards. Judged in an honest fashion, adolescents learn about their capabilities for adult roles. The second way adults assist with identity development is by providing an environment in which identity can be explored. During the time of moratorium, adolescents need opportunity to scrutinize society's standards and try on identities in a setting that does not impose an uncritical choice.

IDENTITY DEVELOPMENT AND TEACHER STUDENT INTERACTIONS

Adults, and especially teachers through their generational role, can contribute to adolescents' identity development

by being sanctioners of capabilities and by providing a safe environment in which adolescents can deal with their identity crisis. In his understanding the dynamics of schools and classrooms, Erikson believed these two actions are keys for effective interactions between teachers and adolescent students. Teachers who are honest about their beliefs, consistent in their actions, and who find capabilities in adolescents to sanction are, according to Erikson, more likely to sustain adolescents' initiative and elicit their cooperation in academic matters.

SEE ALSO *Classroom Environment; Identity Development; Self-Determination Theory of Motivation.*

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Doug Hamman

ETHNIC IDENTITY AND ACADEMIC ACHIEVEMENT

This entry provides an overview of the concept of ethnic identity, with a focus on its relevance for ethnic minority adolescents' academic development. Researchers and educators increasingly have recognized the important role of race-related beliefs and experiences in the academic achievement of ethnic minority children and adolescents. Various explanations have been offered to explain ethnic minority achievement and underachievement, and most implicate the role of youths' *ethnic identity* beliefs, or their self-constructed definitions of the relevance and meanings associated with being a member of their ethnic group. Ethnic minority groups face many social and

structural risks and challenges in the United States, and a stronger identification with an ethnic minority identity has been related to perceiving more ethnic group barriers and discrimination and having a higher awareness of group stigma and stereotypes. Because of this, some have suggested that a stronger ethnic group identity necessarily places youth at risk for decreased academic engagement. However, there is more support from emerging theory and research that a strong, positive sense of racial identity relates to more positive achievement values and may help adolescents maintain positive academic motivation and engagement when they perceive group barriers or have negative race-related experiences. The literature reviewed in this entry suggests a number of implications for education. One is that schools can play important roles in supporting youths' development of a positive sense of ethnic identity. Furthermore, moving away from a "colorblind" approach and recognizing youths' distinct ethnic identities as potential assets can improve schools' and educators' abilities to create truly inclusive settings.

ETHNIC IDENTITY: DEFINITION AND SIGNIFICANCE

During adolescence, individuals begin to construct a general sense of their identity, or their personal definitions of who they are, what is important to them, and appropriate ways to think and behave. During this period, youth also differentiate their various social identities, the self-constructed definitions of who they are in relation to the social groups to which they belong. A sense of ethnic identity becomes salient for many ethnic minority adolescents as they explore the significance of their ethnic group membership in defining who they are (Spencer & Markstrom-Adams, 1990; Phinney, 1990). Ethnic identity has multiple components, including individuals' views of the importance of their ethnic group to their self-definitions, the meanings they attach to their ethnic group, and their thinking about how their ethnic group affects their position in society. Thus, ethnic identities are descriptive (e.g., "I am a Mexican American"; "I am an African American"), affective ("I feel positively about being an African American"; "I think others regard my ethnic group positively"), as well as prescriptive ("I know how Chinese Americans act"; "I know how African Americans act"). Adolescents' understandings of the meanings of their social identities influence their adaptations and responses within domains in which those identities are salient. Because race and ethnicity often are salient in the domain of education, adolescents' ethnic identities may be particularly relevant in shaping how youth interpret and respond to their social and classroom contexts at school.

ETHNIC IDENTITY DURING ADOLESCENCE

Relative to younger children, adolescents have more highly developed cognitive abilities related to understanding themselves and their experiences in more complex, abstract, and indirect ways, and this period also involves intensification of particular social-cognitive attributes, e.g., heightened awareness of how they are viewed by others. Thus, they become more cognizant of the relevance of race and ethnicity in society and have a higher likelihood of perceiving experiences in terms of race and ethnicity (Spencer, Dupree, & Hartmann, 1997).

In addition to individual differences in social cognition, cultural, structural, and social influences during adolescence may affect the development of ethnic identity beliefs. Information youth appraise from interactions in their primary social contexts influences how they develop understandings of themselves in relation to the social groups to which they belong (Harter, 1990; Spencer, Dupree, & Hartmann, 1997). Adolescents' ethnic identity beliefs derive in large part from their understanding and internalization of socialization messages they receive from their families and communities about their ethnic group's history and values (Hughes & Chen, 1999). Other important influences on ethnic identity development include the social and economic opportunities and constraints youth perceive as available to members of their group in their families and communities. Finally, adolescents' increased exposure to personal and societal racism (Garcia Coll et al., 1996; Greene, Way, & Pahl, 2006) influences their ethnic identity development.

ETHNIC IDENTITY AND ETHNIC MINORITY ACADEMIC ACHIEVEMENT

Academic engagement requires linking one's personal identity to the roles of student and learner (Garcia & Pintrich, 1994), showing sustained curiosity and interest in class, and displaying intense efforts in learning tasks (Connell, Spencer, & Aber, 1994; Skinner & Belmont, 1993). Adolescents' academic engagement has been linked to social identities that are made salient in the academic domain (Garcia & Pintrich, 1994). The academic domain is one in which race often is salient for many ethnic minority adolescents. For instance, entry into secondary schools is associated with increased racial cleavage, social comparison, and heightened salience of racial and ethnic stereotypes (Fisher, Wallace, & Fenton, 2000). Thus, it is likely that minority adolescents' levels of academic engagement are influenced, in part, by their ethnic identity beliefs. Theory and research suggests that ethnic identity may serve as a risk factor for lower academic motivation and achievement as well as promote

academic motivation and achievement. The risk and promotion approaches are described below.

RACIAL IDENTITY AS AN ACADEMIC RISK FACTOR APPROACH

Within several well-known theoretical models, ethnic minority identity has been posited to place individuals at risk for decreased academic engagement through the influence of their heightened awareness of the negative status of their racial group in society (e.g., Aronson, 2002; Fordham & Ogbu, 1986; Fordham, 1988; Mickelson, 1990; Steinberg, Dornbusch, & Brown, 1992). The Cultural-Ecological framework of ethnic minority achievement offered by Fordham and Ogbu (1986), for instance, asserts that because African American populations immigrated to the United States under conditions of oppression and opportunity constraint, they developed a collective group identity that rejects institutions that are dominated by the oppressive mainstream culture, including the American educational system. As a consequence, youth's identification with a Black identity came to entail a rejection of a pro-achievement orientation, including attitudes and behaviors associated with being successful in school.

Fordham (1988) expanded on this framework, positing that sustained school success for high-achieving African American students entails minimizing their connectedness to their racial identity in exchange for mainstream attitudes and values that are better aligned with an academic identity, a process termed as becoming "raceless." A similar theme within educational research is the notion that having a "colorblind" perspective is the best way to ameliorate racial group differences in achievement. Within the education field, the majority of teachers are white, from backgrounds that differ from those of their students of color, and often have had limited multicultural training (Ford & Harris, 1996). A common ideology among teachers entering their professions and classrooms is that it is best to simply not see race or racial group differences at all but view students only as individuals (Markus, Steele, & Steele, 2000; Rousseau & Tate, 2003). However, the underlying presumption is that minority youth must de-emphasize their ethnic/cultural backgrounds in order to develop a positive academic identity and emphasize thinking and acting in ways more consistent with White middle-class norms (Delpit, 1995; Ladson-Billings, 1995; McAllister & Irvine, 2000).

Other theoretical perspectives viewing ethnic identity as a risk factor for achievement have focused on the stigma associated with identifying with an ethnic minority group in the United States. This work suggests that African American and Hispanic youth disidentify with school and academics because the academic domain is one in which their ethnic group is regarded negatively

(e.g., Crocker & Major, 1989; Osborne, 1997). While this coping strategy is theorized to protect individuals' self-concept from the negative impact of perceiving group-based discrimination and devaluation, it inhibits the motivational attitudes and behaviors that lead to good school performance. Similarly, stereotype threat theory posits that African American students' academic underperformance result from fears or apprehensions around supporting racial stereotypes related to intellectual ability, and, over time, these threat experiences lead to less personal identification with academics and engagement in the learning process (Aronson, 2002; Steele, 1997). Implicit across these perspectives is that individuals who perceive societal discrimination or stigma for their ethnic group disengage with the educational process, and those who emphasize their ethnic minority identity are particularly vulnerable to the negative effects of this discrimination and stigma on academic engagement.

LIMITATIONS OF THE ETHNIC IDENTITY AS RISK APPROACH

A major limitation of the ethnic identity-as-risk approach to understanding ethnic minority academic achievement is that there is very little empirical evidence in support of the major assertions of the approach. First, there have been few studies directly assessing the relationship between ethnic identity attitudes and academic engagement in African Americans. The few studies that have been used to support the approach do not directly address the question of whether identifying with one's race and perceiving racial barriers explains individual differences in African American students' levels of academic engagement. For instance, in the widely cited ethnographic study of urban African American high school students (Fordham & Ogbu, 1986), although low-achieving students perceived particular behaviors associated with school success e.g., spending time in library studying, reading and writing poetry, being on time as inconsistent with their personal identities, students were not asked about their racial identities nor did the youth mention ethnicity or race when discussing their academic identities (e.g., youth connected pro-achievement behaviors to being a nerd or "brainiac," not necessarily as being inconsistent with a Black identity).

Other evidence used in support of the risk approach include studies showing smaller associations between African American adolescents' self-concept and their academic grade performance relative to other ethnic groups (e.g., Demo & Parker, 1987; Osborne, 1997) and lower academic task performance for ethnic minority college students for whom racial stereotypes are made salient (e.g., Steele & Aronson, 1995). None of these studies, however, directly assessed youths' ethnic identity beliefs and thus are unable to fully demonstrate the presumed links between ethnic identity and academic engagement.

ETHNIC IDENTITY AS PROMOTING ACADEMIC ACHIEVEMENT

Although the identity-as-risk approach has received a great deal of attention, ethnic minority identity also has been conceptualized as an important psychologically protective set of beliefs that individuals have developed to buffer against the impact of racial discrimination and stigmatized status (e.g., Cross, Helms, & Parham, 1998). Researchers have begun to conceptualize racial/ethnic identity as an important resilience resource in the normative development of African American youth (e.g., Cross et al., 1999; Spencer, Cunningham, & Swanson, 1995; Spencer et al., 1997). This view of ethnic identity, while recognizing the significant challenges that confront African American youth, also acknowledges the fact that many youth are resilient in the face of those challenges. An approach that views a strong, positive sense of ethnic identity as promoting achievement is consistent with a historical view of both Black and Hispanic immigrant communities that recognizes that because the groups were denied opportunities for education and advancement (during and after slavery for African Americans) or came to the United States because of the lack of opportunities in their countries of national origin (for many Hispanic and Asian American groups), they often placed a stronger emphasis on the importance of learning and education as the primary route to mobility (Chavous, et al., 2003).

Thus, ethnic identity can relate to a meaning-making process that affords members of historically oppressed ethnic minority groups an opportunity to define their racial membership in such a way that academic success can be seen as valuable despite structural- and individual-level barriers (such as stigma and racial discrimination) to academic success. For instance, findings from a study by Altschul, Oyserman, and Bybee (2006) indicate that African American middle school students who felt more connected to their Black identity and who linked their Black identity to a value for achievement were more academically motivated and performed better than youth who identified less with their ethnic group and who didn't view academic achievement as connected to their ethnic group identity. Chavous and colleagues (2003) also found that African American high school students who had a strong ethnic group identity accompanied by group pride and awareness of societal discrimination had more positive academic attitudes and showed higher academic persistence and postsecondary educational attainment than youth who de-emphasized their ethnic identities, felt less group pride, and who were less conscious of the potential for bias against their group.

Also, there is growing evidence that having a strong, positive sense of ethnic identity may protect minority adolescents from the negative psychological and academic

impacts of perceiving ethnic group barriers or experiencing interpersonal discrimination based on their ethnic group. For instance, in a 2006 study, Sellers and colleagues found that Black youth having an ethnic identity characterized by feelings of strong group connection and group pride showed more positive psychological well being when experiencing racial discrimination compared to those adolescents with less strong feelings of connection to and positive attitudes about their ethnic group. Wong and colleagues in their 2003 study found that African American adolescents who held a strong connection to and pride in being Blacks were protected from the negative impact on academic attitudes and performance of experiencing racial discrimination at school relative to those with less of a strong, positive connection with their ethnic group.

IMPLICATIONS FOR SCHOOLS AND EDUCATORS

Although ethnic identity may be influenced by and reflect the languages, customs, cultural values, and experiences deriving from youths' homes and communities, there is evidence that school settings can play important roles in youths' ethnic identity development. Researchers find that ethnic minority adolescents frequently report experiences related to race and ethnicity within their school settings (e.g., Fisher et al., 2000; Rosenbloom & Way, 2004; Wong et al., 2003). In particular, the secondary school context provides classroom and social structures that can result in heightened racial salience and more awareness of racial group differences, including stereotypes. For instance, entry into secondary schooling is associated with more ethnic cleavage in classes and peer social groups. Teachers and class curricula often emphasize social comparison more than in elementary grades, resulting in more attention to group differences in achievement and performance (Seidman, Allen, Aber, Mitchell, & Feinman, 1994).

At school, ethnic minority adolescents are likely to have White teachers from middle-class backgrounds, even in urban schools, and teachers in general are unlikely to have received extensive training in multicultural education (Ford & Harris, 1996). Additionally, ethnic minority youth report racially biased treatment within the classroom and peer contexts at school as common occurrences, e.g., perceiving that they received poor grades or evaluations from teachers and other adults at school or harsher discipline due to race, and social exclusion or harassment due to race (Fisher et al., 2000; Romero & Roberts, 1998). Thus, schools may contribute to youths' development of ethnic identities and the extent to which youth perceive their group identity as consistent with schooling and achievement.

Teacher training practices are not necessarily designed to equip teachers to work in multicultural class settings

(Delpit, 1995; Irvine, 1986; Ladson-Billings, 1995). This will continue to be a problem as the ethnic minority population continues to rise in the United States. As noted, a perspective prevalent among educators and in professional training of teachers is the "colorblind" ideology (Delpit, 1995; Markus, Steele, & Steele, 2000). However, ethnic identity research presents growing evidence that such a perspective does not relate to positive academic outcomes for ethnic minority youth and in fact may lead to increased cultural tensions and miscommunications. The research concerning the positive influences of a strong, positive ethnic identity on youth achievement outcomes suggest that the colorblind approach (or a de-emphasis on group membership and emphasis on conforming to mainstream values) may hinder teachers from seeing the needs of their ethnic minority students and may result in students not being acknowledged in ways that facilitate their achievement. Furthermore, while teachers may not be formally trained in theory and research related to race and education, many teachers enter their classrooms with some familiarity of the most prevalent perspectives on race in education. Unfortunately, they are most likely to be familiar with the notion that certain ethnic minority youth and their families devalue educational achievement and define their ethnic identity as inconsistent with achievement (or "acting White"), while the values of other youth and families include embracing education. Such misinformation may lead to making erroneous attributions and conclusions when students show lower performance and experience academic difficulty.

Thus, school practitioners must receive training about the development of youth from multicultural backgrounds. This training should not only acknowledge the unique risks associated with membership in ethnic minority groups in the United States but also consider how youths' ethnic identities can serve as cultural assets in relation to their achievement and how to use this information to create inclusive classroom contexts for all students. Without such training, it is likely that teaching approaches and practices will be based on popular views of common sense approaches not supported by empirical research. Additionally teachers should be mindful of endorsing their own ethnic identity beliefs in the class contexts they create.

SEE ALSO *Identity Development.*

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Tabbye M. Chavous

EVALUATION (TEST) ANXIETY

In the era of the No Child Left Behind legislation there is a growing concern that high-stakes testing may have a negative impact on student learning and performance. Mulvenon, Stegman, and Ritter (2005) noted that a cursory review of the academic literature and national news sources on the impact of standardized testing reveals a plethora of anecdotal cases of students experiencing illness, anxiety, and heightened levels of stress. Furthermore, numerous studies have surveyed teachers regarding the impact of standardized tests, producing findings that low performance on these tests is correlated with increased levels of anxiety and stress. Mulvenon and colleagues conducted a survey and concluded that most of the dangers of standardized testing are overstated and that most students, parents, principals, and counselors do not report increased levels of stress or anxiety. Nevertheless, there remains a nationwide concern that an increase in high-stakes testing and test anxiety is harming students.

Test anxiety (TA) is a feeling of apprehension and discomfort accompanied by cognitive difficulties during a test. There is general consensus that it involves at least two components: (a) a pattern of physiological hyperarousal (i.e., increased heart rate, blood pressure, etc.) that may include physical changes and complaints, and (b) a cognitive obstruction or disorganization of effective problem-solving and cognitive control, including difficulty in thinking clearly (Friedman & Bendas-Jacobs, 1997). These two factors have also been termed *emotionality* (nervousness about the test situation) and *worry* (a cognitive aspect which involves concern over one's performance). A proposed third factor that has received less attention is social humiliation, referring to one's concern and awareness that others may negatively view the test performance. This third factor could easily be subsumed by the worry or cognitive component.

Test anxiety is similar to math anxiety in that both involve physiological and worry components. However,



Low performance on standardized tests has been correlated with increased levels of anxiety and stress. ©WILL & DENI MCINTYRE/CORBIS.

math anxiety can occur during math instruction and homework, whereas test anxiety only occurs in testing environments. Public speaking anxiety is also characterized by the cognitive and emotionality components, but much of the anxiety occurs before the event and tapers off after the first minute of the speech. TA is thought to persist throughout the testing experience, and its onset occurs at the start of the test.

TA has been studied as a construct for more than 50 years (Mandler & Sarason, 1952). Whether test anxiety causes poor test performance or whether previous poor test performance causes TA is unclear. Tobias (1985) proposed the latter causal relationship where previous low test scores are caused by inadequate study skills and/or poor test-taking skills, which in turn cause test anxiety. Research investigating the cause of TA has led to two models: the interference model and the skills deficit model (Birenbaum, 2007). The interference model states that high TA students are plagued by worry and distracting thoughts that interfere with their

ability to retrieve information during a test. The skill deficit model states that high TA students' problems occur before the test in the form of inadequate learning that results in poor performance. Thus, TA is simply an emotion that results from an awareness of being unprepared for the test. The former model stresses reducing TA whereas the latter model stresses an irrelevant role for TA and thus increasing learning strategies. Naveh-Benjamin and colleagues (1987) combined these models and distinguished between two types of TA students. One knows the material well but has trouble retrieving it, whereas the other has poor understanding of the material and thus cannot retrieve it. This entry refers to debilitating test anxiety, rather than facilitating test anxiety. The latter has been demonstrated in both early (Yerkes & Dodson, 1908) and subsequent (Alpert & Haber, 1960) studies where a small amount of anxiety actually improves test performance.

In this entry, normative data is provided on rates of anxiety levels, various correlates of TA are described, and evaluation and assessment of TA are discussed as are methods for helping students manage TA.

CORRELATES OF TEST ANXIETY

An excellent meta-analysis conducted by Hembree (1988) is the source of many of the conclusions presented here, and Hembree source gives a more complete coverage of TA. Where appropriate, these conclusions are updated with more recent research findings.

Normative data on rates of TA are difficult to estimate because as of 2008 large-scale studies have not been conducted. However, a study by Methia (2004) found that more than one-third of school age children experience at least some TA. As mentioned earlier, it is assumed that TA has increased in the early 2000s, possibly due to an increased emphasis on testing in schools. Whatever the precise prevalence rate may be, it is clear that TA remains a concern for educators.

Not surprisingly, TA has been found to be negatively correlated with tests of IQ and various types of achievement and aptitude (Hembree, 1988). Again, these data are correlational and not causal. Thus, it is as plausible that low achievement causes TA as it is to say that TA causes low achievement. In terms of motivational factors, although there is a negative correlation between need for achievement and TA in the elementary years, there appears to be no relationship during the high school and college years. There is a strong negative correlation between self-esteem and TA. Moreover, students with high TA tend to have an external locus of control (i.e., feeling as if they have little control over the events of their lives). TA is positively related with defensiveness

and both general state and trait anxiety, whereas it is negatively related with dominance.

One study tested the hypothesized negative impact of cognitive TA in the test preparation, performance, and reflection phases (Cassady, 2004). Students with high-cognitive TA reported lower study skills, rated tests as more threatening, and prepared less effective test notes. The high-anxiety students performed worse on tests and reported higher levels of emotionality. Cassady concluded that cognitive TA is associated with detrimental perceptions and behaviors in all phases of the learning-testing cycle.

Females typically are more prone to TA than are males, with the difference peaking during grades 5 through 10, and declining thereafter. However, this difference is not associated with lower test performance. In one study investigating differences between males and females, Chappell and colleagues (2005) found a small inverse relationship between TA and GPA in both groups. Low-test-anxious female graduate students had significantly higher GPAs than high-test-anxious female graduate students, but there were no GPA differences between low- and high-test-anxious male graduate students. Female undergraduates had significantly higher TA and higher GPAs than male undergraduates, and female graduate students had significantly higher TA and higher GPAs than male graduate students.

Both African American (in elementary school) and Hispanic students exhibit higher TA than do Caucasian students. Later-born children exhibit higher TA than do first-borns. Some researchers have proposed that TA among minority students may be partly explained by the stereotype threat hypothesis (Steele & Aronson, 1995). Based on the perception that there are negative stereotypes regarding certain groups' performance on standardized tests, group members experience higher anxiety on tests due to fear of being stereotyped or confirming the negative group stereotype. According to some, this hypothesis may help to explain why girls perform worse than boys on high-stakes math tests and why African American and Hispanic students perform worse on achievement tests than do Caucasian and Asian-American students (Osborne, 2007).

MEASURING TEST ANXIETY

Many scales are used for measuring test anxiety. Sarason's 1984 Reaction to Tests (RTT) questionnaire consists of four 10-item scales: two that measure the cognitive component (worry and test irrelevant thinking) and two that measure the emotional component (emotionality and bodily symptoms). The Friedban Scale (Friedman & Bendas-Jacob, 1997) of TA has 23 items covering three subdimensions: social derogation (eight items, e.g., "If I fail a test, I am afraid I shall be rated as stupid by my

friends.”), physical tenseness (six items, e.g., “I am very tense before a test, even if I am well prepared.”), and cognitive obstruction (nine items, e.g., “In a test, I feel like my head is empty, as if I have forgotten all I have learned.”). Internal consistency reliability coefficients for the three subscales in one study were .93, .88, and .94, respectively (Sawyer & Hollis-Sawyer, 2005), indicating satisfactory levels of internal consistency. The Test Anxiety Inventory for Children and Adolescents (Lowe & Lee, 2005) is a 45-item self-report measure for grades 4 through 12. Coefficient alphas for the TAICA have ranged from .81 to .94. There is also the Test Anxiety Inventory (Spielberger, 1980) used solely with adults. For a shorter scale that can be also be used with older students, the Westside Test Anxiety Scale (Driscoll, 2007) has 10 items covering self-assessed anxiety impairment and cognitions that can impair performance and is designed to identify students with anxiety impairments who may benefit from an anxiety-reduction intervention.

TREATING TEST ANXIETY

Most early treatments of TA were behavioral and mainly systematic desensitization—a process in which the person is trained in relaxation techniques in the presence of increasing levels of the aversive, anxiety-producing stimulus (here testing environments). Unfortunately, although the early treatments were successful in reducing TA, they were less successful in improving test performance (Allen, Elias, & Zlotlow, 1980). Tryon (1980) suggested that students also need study counseling combined with desensitization to improve test performance. However, Hembree (1988) concluded that TA reduction programs generally result in higher test performance and GPA. Ergene (2003) conducted a meta-analysis that synthesized results from TA reduction programs. The most effective treatments appear to be those that combine skill-focused approaches with behavior or cognitive approaches. Individually conducted programs, along with programs that combined individual and group counseling formats, have produced the greatest changes. More research is needed to clarify the causal role TA reduction programs may have with regard to achievement and test performance.

Regardless of its prevalence and severity, TA will continue to be a concern of parents and educators. In an era of heightened school accountability, schools (especially administrators and teachers) will be interested in ways to reduce TA in students so as to enhance test performance. Merely treating TA by desensitizing students to the testing situation may not improve their test performance because some students' struggles may be simply due to inadequate preparation. It is important to assess both TA and academic preparedness before deciding on an intervention program. Interventions that provide training in study skills

and test taking, combined with reducing the emotionality of the testing situation, are likely to be more successful in facilitating test performance.

SEE ALSO *Anxiety; Student Emotions.*

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Daniel H. Robinson

EXPECTANCY VALUE MOTIVATIONAL THEORY

Between 1980 and the early 2000s, Jacquelynne Eccles and colleagues studied the motivational and social factors influencing such long and short-range school-related goals and behaviors as school grades, course selections, and high school graduation. They elaborated a comprehensive theoretical model linking achievement-related choices to two sets of beliefs: the individual's expectations for success and the importance or value the individual attaches to the various options perceived by the individual as available (see Eccles, Wigfield, & Schiefele, 1998). In this model, they also specified the relation of these beliefs to cultural norms, experiences, aptitudes, and to those personal beliefs and attitudes that are commonly assumed to be associated with achievement-related activities (Eccles et al., 1998). In particular, they linked achievement-related beliefs, outcomes, and goals to interpretative systems such as causal attributions and other meaning-making beliefs linked to achievement-related activities and events, to the input of parents, peers, and teachers, to various social roles and other culturally based beliefs about both the nature of various tasks in a variety of achievement domains and the appropriateness of participation in such tasks, to self-perceptions and self-concepts, to perceptions of the task itself, and to the processes and consequences associated with identity formation.

For example, regarding engagement in school learning, they believe people will be most likely to engage fully in school-based learning activities if they have confidence in their ability to do well and place high value on doing well in school. High confidence in one's academic potential results from a history of doing well in school, as well from strong messages that one is academically competent from one's parents, teachers, and peers (Wigfield et al., 2006). Similarly, the personal value one attaches to learning in school is influenced by several factors: Does the person enjoy doing the subject material? Is the learning activity seen as instrumental in meeting one of the individual's long- or short-range goals? Is the person anxious about his or her ability to successfully master the learning material being presented? Does the person think that the learning task is appropriate for people like him or her?

Do the person's parents and teachers think doing well in school is important and have they provided advice on the utility value of school success for various future life options? Finally, does taking the working on the learning task interfere with other more valued options?

At the most basic psychological level, the Eccles and colleagues expectancy-value model reduces to two fundamental motivational questions: "Can I do the task?" and "Do I want to do the task?" If students answer no to the question "Can I do the task?" then they are unlikely to fully engage in the learning opportunities provided in school. But even if the answer to the first question is yes, full and sustained engagement in school learning depends on the answer to the question, "Do I want to do the task?" If the answer to this question is no, then it is also unlikely that the students will engage the learning opportunities at school.

ASKING "CAN I DO THE TASK?"

Research supports the hypothesis that a yes answer to the question, "Can I do the task?" predicts better performance and more motivation to select more challenging tasks (Wigfield et al., 2006). Importantly, confidence in one's ability to master academic work is a strong predictor of school achievement among academically struggling students (NRC, 2004). Unfortunately, negative racial, ethnic, gender, and social class stereotypes can lead teachers and school districts to communicate low expectations for the academic achievements of some groups of students through a variety of mechanisms, including differential teacher-student face-to-face daily interactions, tracking into low ability groups coupled with providing inferior educational experiences in these groups, failure to provide encouragement for high educational aspirations, and failure to provide high quality educational experiences that promote both current achievement levels and confidence and lay the groundwork for continued success in future courses (see Eccles, 2007).

ASKING "DO I WANT TO DO THE TASK?"

Fully engaging learning at school requires a desire to do the task (Wigfield et al. 2006). Eccles and colleagues argue that the perceived value of school work is determined by four related constructs: (1) the enjoyment one expects to experience while engaging in the task—intrinsic interest; (2) the extent to which engaging in the task is consistent with one's self-image or identity—attainment value; (3) the value of the task for facilitating one's long range goals or in helping one obtain immediate or long range external rewards—utility value; and (4) the perceived cost of engaging in the activity.

Intrinsic Value. Eccles and colleagues use the term *intrinsic value* to refer to either the enjoyment one feels when doing the task or the enjoyment one expects to experience while one is engaged in the task. This construct is most closely related to two related constructs: the idea of intrinsic motivation as developed by E. Deci and R. Ryan and the idea of interest as developed by theorists such as A. Krapp, A. Renniger, and U. Schiefele. According to Deci and Ryan, intrinsic motivation is highest when individuals are doing tasks that they enjoy, as well as when they are doing tasks that are personally meaningful (somewhat like *attainment value*). Interest theorists argue that engagement will be highest when individuals are doing interesting tasks. According to these theorists, interest value results from either inherent characteristics of the task (called *situational interest*) or personal characteristics of the individuals doing the task (called *personal interest*). Individual interest is considered a relatively stable evaluative orientation towards certain domains that one enjoys; situational interest is an emotional state aroused by specific features of an activity or a task. Evidence is quite strong that interests, intrinsic motivation, and intrinsic value predict greater academic engagement and learning (see Eccles et al., 1998; Wigfield et al., 2006).

Some educational psychologists are interested in individual differences in trait-like individual differences in what might be referred to as the desire to learn (e.g., Gottfried, Harter, Hidi, and Schiefele). These researchers define this enduring learning orientation in terms of three components: (1) preference for hard or challenging tasks, (2) learning that is driven by curiosity or interest, and (3) striving for competence and mastery. Empirical findings suggest that the three components are highly correlated and that high levels of a trait-like desire to learn is related to a mastery-oriented coping style for dealing with academic failure, high academic achievement, both comprehension and deep-level learning, and the use of appropriate self-regulated learning strategies in academic tasks (see Wigfield et al., 2006). Some scholars believe the component of interest should be considered as an influence on attainment value.

Situational learning is more transitory because it is based in the nature of the academic curriculum and materials themselves. The following task features arouse situational interest: personal relevance, both familiarity and novelty, high activity level, and comprehensibility (see Wigfield et al., 2006). These characteristics facilitate both engagement and learning. We classify this construct under intrinsic value.

Attainment and Utility Value. Eccles and colleagues use the term *attainment value* to refer to the link between tasks and individuals' own identities and preferences. As they grow up, individuals develop an image of who they

are and what they would like to be. This image is made up of many parts, including (1) conceptions of one's personality and capabilities, (2) long range goals and plans, (3) schema regarding the proper roles of men and women in one's culture group, (4) instrumental and terminal values, (5) motivational sets, (6) ideal images of what one should be like; (7) stable personal interests, and (8) social scripts regarding proper behavior in a variety of situations. Eccles and colleagues conceptualize attainment value in terms of these needs, personal interests, and personal values that an activity fulfills. Those parts of an individual's self-image that are central or critical to self-definition should influence the value the individual attaches to various activities such as school-based learning activities versus other activities. These differential values, in turn, should influence the individual's desire to engage fully in school-based learning activities. For example, if doing well in school and being a good student is a central part of an individual's self-image, then that person should place higher value on investing time and energy in doing well in school than in other pursuits because doing well in school has high attainment value for this individual.

Utility value is determined by how well a task fits into an individual's goals and plans or fulfills other basic psychological needs. For example, if students plan to become engineers then mastering arithmetic in elementary school and doing well in challenging mathematics and science courses in secondary school will have high utility value because it will allow them to take college track mathematics in secondary school and then get into college training programs in engineering. If not, then the value of doing the work necessary to succeed in these courses may be too low to motivate their effort.

Regarding what might influence the attainment value and utility of doing well and being engaged in school, J. Connell and colleagues proposed three basic human needs that should influence the attainment value of any task or situation: the needs for competence, relatedness, and autonomy. They argue that people's motivation to engage in the demands of any particular situation or setting is influenced by the extent to which the setting provides opportunities to experience autonomy, social relatedness, and a sense of competence. If schools and classrooms do not provide these opportunities, then individuals will not become engaged in school learning and will try to disengage by whatever means are available to them. In contrast, if classroom experiences provide opportunities for students to fulfill these basic needs, then the attainment value of fully engaging in the learning agenda of school should be increased.

The importance of competence needs, in particular, has received a great deal of attention in the achievement

literature. This research has shown that early school failure predicts disengagement from school (Eccles et al., 1998; Wigfield et al., 2006). Given this evidence, it is essential that teachers set up their instructional practices in ways that allow all children to experience success at their mastery attempts, particularly at critical school transitions when academic failure may precipitate a downward spiral of disengagement leading to school drop out. Researchers in the area of achievement goal theory (e.g., Maehr & Midgley) have explored the importance of mastery-oriented classrooms. These researchers hypothesize that school learning tasks vary along at least two important dimensions: (1) the extent to which mastery or improvement is stressed (i.e., a mastery focus); and (2) the extent to which doing better than others is stressed (i.e., a performance focus). They argue that the greater the focus on mastery instead of performance, the greater the likelihood that all students will feel competent and will have repeated experiences of mastery. Their research supports this hypothesis.

Evidence also supports the importance for school engagement. For example, several researchers (e.g., Goodenow, Patrich, Roeser, Ryan, & Wentzel), have shown that feelings of belongingness in classrooms and schools, as well as a sense of being part of a supportive learning community, predict increased engagement and school learning. In addition, one of the major benefits of both cooperative learning structures and Catholic schools is that they increase all students' sense of belonging in their classroom's and school's agenda (see Eccles, 2007).

In contrast, experiences of racial, ethnic, religious, linguistic, and gender discrimination are likely to undermine minority and female students' sense of belonging at school. For example, C. Wong and her colleagues showed that experiences of racial discrimination predicted declines in school achievement. Similarly, C. Steele and his colleagues argue that students who believe that their teachers have low expectations for their academic performance will disidentify with school learning as a way of coping with experiences of racial and ethnic discrimination at school (see Eccles, 2007).

Deci, Ryan, and their colleagues have done most of the work on the importance of support for autonomy in classrooms for students' motivation to fully engage the learning agenda of the classroom. They argue that individuals need to feel personally responsible for their behavior and their goals. To the extent that teachers create opportunities for this to be the case, students are more motivated to do their school work and learn the material better.

Eccles and colleagues believe that people need to feel that they are considered valuable contributors to their social groups and institutions. This need is likely to

become especially salient during adolescence. One intervention study was done based on this need: the Coca Cola study (see Eccles, 2007). In this project, at-risk adolescents were asked to provide cross-age peer tutoring in reading to first graders. Those adolescents who had this experience over an extended period of time showed an increased commitment to their own academic performance as evidenced by increases in their grades and high school graduation rates.

Individual differences in school motivation are also likely to be linked to individual differences in self-schema and both personal and social goals and identities. As noted above, these differences should be directly related to the perceived attainment value of various activities. The work of Eccles and colleagues on gender differences in high school math and science course enrollment illustrates the importance of the perceived utility value of various course options. Using longitudinal methods, they demonstrated that gender differences in students' decisions to enroll in advanced mathematics are mediated primarily by gender differences in the value that the students' attached to mathematics. More specifically, their findings indicate that young women are less likely than the young men to enroll in advanced high school mathematics and physics courses primarily because they feel that math and physical science are less important, less useful, and less enjoyable than do young men. Furthermore, young women tend to think that advanced math and physics are less important and enjoyable than the many other advanced high school courses they could be taking instead. Interestingly, interventions based on making physics more interesting to females by using more human biological examples of physical principles have been quite successful at increasing females' engagement in physics classes.

Perceived Cost. The value of a task also depends on a set of beliefs that can best be characterized as the cost of participating in the activity. Cost is influenced by many factors, such as anticipated anxiety, fear of failure, fear of the social consequences of success, such as rejection by peers or anticipated racial discrimination, or anger from one's parents or other key people, and fear of loss of a sense of self-worth.

This conceptualization of cost is similar to the kinds of dynamics discussed by M. Covington in his self-worth theory. Covington defined the motive for self-worth as the desire to establish and maintain a positive self-image or sense of self-worth. Because children spend so much time in classrooms and are evaluated so frequently there, Covington argued that protecting one's sense of academic competence is likely to be critical for maintaining a positive sense of self-worth. However, school evaluation, competition, and social comparison can make it difficult

for some children to maintain the belief that they are competent academically. Covington outlined various strategies children develop to avoid appearing to lack ability, including procrastination, making excuses, avoiding challenging tasks, and not trying. Therefore, if failure seems likely, some children will not try, precisely because trying and failing threatens their ability self-concepts.

Avoiding challenging tasks is a good way to avoid or minimize failure experiences. Similarly, work by R. Newman and his colleagues demonstrated that students may be reluctant to ask for help in classrooms because they think that this will make them appear to be stupid.

Cost can also be conceptualized in terms of the loss of time and energy for other activities. People have limited time and energy. They cannot do everything they would like. They must choose among activities. Eccles and colleagues asserted that cost is especially important to choice and that socio-cultural processes linked to social identity formation and cultural socialization should have a big influence of the perceived cost of the various activities competing for young people's time and energy. Schools need to provide young people with genuine reasons for attaching higher subjective task value to engaging in school work than in engaging in the variety of tasks associated with other aspects on their daily lives.

As noted above, the expectancy-value model focuses attention on two fundamental motivational questions: "Can I do the task?" and "Do I want to do the task?" The first question illustrates the expectancy component. If students answer no to this question, then they will be unlikely to fully engage in the learning opportunities provided in school. But even if the answer to this question is yes, full and sustained engagement in school learning depends on the answer to the question "Do I want to do the task?" This question illustrates the value component of the model. If the answer to this question is no, then it is also unlikely that the students will engage the learning opportunities at school. It is critical that school environments provide students with the kinds of experiences that will allow them to answer yes to both of these questions.

SEE ALSO Eccles, Jacquelynne S.; *Goal Orientation Theory; School Belonging; Teacher Expectations.*

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Jacquelynne S. Eccles

EXPERIMENTAL RESEARCH

Suppose teachers wished to determine which of two methods of reading instruction was most effective—one that involved 20 minutes of direct instruction in phonics each day throughout the academic year in grade 1 or one that involved the current practice of having the teacher read a book to the class for 20 minutes each day throughout the year in grade 1. Similarly, suppose they wished to determine whether children learn better in a small class (i.e., with 15 students) or a large class (i.e., with 30 students). Finally, suppose they wished to determine whether requiring students to take a short quiz during each meeting of a college lecture class would result in better performance on the final exam than not giving quizzes.

Each of these situations can be examined best by using experimental research methodology in which investigators compare the mean performance of two or more groups on an appropriate test. In experimental research, it is customary to distinguish between the independent variable and the dependent measure. The independent variable is the feature that is different between the groups—for example, whether 20 minutes of time each day is used for phonics instruction or reading aloud to students, whether the class size is small or large, or whether a short quiz is given during each class meeting. The dependent measure is the score that is used to compare the performance of the groups—for example, the score on a reading test administered at the end of the year, the change in performance on academic tests from the beginning of the year to the end of the year, or the score on a final exam in the class. When researchers compare two or more groups on one or more measures, they use experimental research methodology.

EXPERIMENTAL RESEARCH DEFINED

Experimental research is based on a methodology that meets three criteria: (a) random assignment—the subjects (or other entities) are randomly assigned to treatment groups, (b) experimental control—all features of the treatments are identical except for the independent variable (i.e., the feature being tested), and (c) appropriate measures—the dependent measures are appropriate for testing the research hypothesis. For example, in the class

size example, random assignment involves finding a group of students and randomly choosing some to be in small classes (i.e., consisting of 15 students) and some to be in large classes (i.e., consisting of 30 students). The researcher cannot use pre-existing small or large classes because doing so would violate the criterion of random assignment. The problem with violating random assignment is that the groups may systemically differ; for example, students in the smaller classes may be at more wealthy schools that also have more resources, better teachers, and better-prepared students. This violation of the random assignment criterion, sometimes called *self-selection*, is a serious methodological flaw in experimental research.

In the class size example, the criterion of experimental control is reflected in having the classes equivalent on all relevant features except class size. That is, large and small classes should have teachers who are equivalent in teaching skill, students who are equivalent in academic ability, and classrooms that are physically equivalent; they should also have equivalence in support services, length of school day, percentages based on gender, English language proficiency, ethnicity, and so on. If the groups differ on an important variable other than class size, determining whether differences in test performance can be attributed to class size will be difficult. This violation of the experimental control criterion, called *confounding*, is a serious methodological flaw in experimental research.

Finally, in the class size example, the dependent measure should test the research hypothesis that class size affects academic learning, so an appropriate measure would be to give an achievement test covering the curriculum at the start and end of the year. The appropriate measures criterion would be violated if the dependent measure were a survey asking students how well they enjoyed school this year or an ungraded portfolio of their artwork over the year. When a test does not measure what is intended, the test lacks *validity*; invalid tests represent a serious methodological flaw in experimental research.

BENEFITS AND LIMITATIONS OF EXPERIMENTAL RESEARCH

Experimental research is generally recognized as the most appropriate method for drawing causal conclusions about instructional interventions, for example, which instructional method is most effective for which type of student under which conditions. In a careful analysis of educational research methods, Richard Shavelson and Lisa Towne concluded that “from a scientific perspective, randomized trials (we also use the term experiment to refer to causal studies that feature random assignment) are the ideal for establishing whether one or more factors caused change in an outcome because of their strong ability to enable fair comparisons” (2002, p. 110). Sim-

ilarly, Richard Mayer notes: “experimental methods which involve random assignment to treatments and control of extraneous variables have been the gold standard for educational psychology since the field evolved in the early 1900s” (2005, p. 74). Mayer states, “when properly implemented, they allow for drawing causal conclusions, such as the conclusion that a particular instructional method causes better learning outcomes” (p. 75). Overall, if one wants to determine whether a particular instructional intervention causes an improvement in student learning, then one should use experimental research methodology.

Although experiments are widely recognized as the method of choice for determining the effects of an instructional intervention, they are subject to limitations involving method and theory. First, concerning method, the requirements for random assignment, experiment control, and appropriate measures can impose artificiality on the situation. Perfectly controlled conditions are generally not possible in authentic educational environments such as schools. Thus, there may be a tradeoff between experimental rigor and practical authenticity, in which highly controlled experiments may be too far removed from real classroom contexts. Experimental researchers should be sensitive to this limitation, by incorporating mitigating features in their experiments that maintain ecological validity.

Second, concerning theory, experimental research may be able to tell that one method of instruction is better than conventional practice, but may not be able to specify why; it may not be able to pinpoint the mechanisms that create the improvement. In these cases, it is useful to derive clear predictions from competing theories so experimental research can be used to test the specific predictions of competing theories. In addition, more focused research methods such as naturalistic observation or in-depth interviews may provide richer data that allows for the development of a detailed explanation for why an intervention might have a new effect. Experimental researchers should be sensitive to this limitation, by using complementary methods in addition to experiments that provide new kinds of evidence.

EXPERIMENTAL DESIGNS

Three common research designs used in experimental research are between subjects, within subjects, and factorial designs. In between-subjects designs, subjects are assigned to one of two (or more) groups with each group constituting a specific treatment. For example, in a between-subjects design, students may be assigned to spend two school years in a small class or a large class. In within-subjects designs, the same subject receives two (or more) treatments. For example, students may be assigned to a small class for one year and a large class

RANDOMIZED TRIALS IN EDUCATIONAL RESEARCH

Experimental research helps test and possibly provide evidence on which to base a causal relationship between factors. In the late 1940s, Ronald A. Fisher (1890–1962) of England began testing hypotheses on crops by dividing them into groups that were similar in composition and treatment to isolate certain effects on the crops. Soon he and others began refining the same principles for use in human research.

To ensure that groups are similar when testing variables, researchers began using randomization. By randomly placing subjects into groups that say, receive a treatment or receive a placebo, researchers help ensure that participants with the same features do not cluster into one group. The larger the study groups, the more likely randomization will produce groups approximately equal on relevant characteristics. Nonrandomized trials and smaller participant groups produce greater chance for bias in group formation. In education research, these experiments also involve randomly assigning participants to an experimental group and at least one control group.

The Elementary and Secondary Education Act (ESEA) of 2001 and the Educational Sciences Reform Act (ERSA) of 2002 both established clear policies from the federal government concerning a preference for “scientifically based research.” A federal emphasis on the use of randomized trials in educational research is reflected in the fact that 70% of the studies funded by the Institute of Education Sciences in 2001 were to employ randomized designs.

The federal government and other sources say that the field of education lags behind other fields in use of randomized trials to determine effectiveness of methods. Critics of experimental research say that the time involved in designing, conducting, and publishing the trials makes them less effective than qualitative research. Frederick Erickson and Kris Gutierrez of the University of

California, Los Angeles argued that comparing educational research to the medical failed to consider social facts, as well as possible side effects.

Evidence based research aims to bring scientific authority to all specialties of behavioral and clinical medicine. However, the effectiveness of clinical trials can be marred by bias from financial interests and other biases, as evidenced in recent medical trials. In a 2002 Hastings Center Report, physicians Jason Klein and Albert Fleischman of the Albert Einstein College of Medicine argued that financial incentives to physicians should be limited. In 2007 many drug companies and physicians were under scrutiny for financial incentives and full disclosure of clinical trial results.

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for the next year, or vice versa. Within-subjects designs are problematic when experience with one treatment may spill over and affect the subject's experience in the following treatment, as would likely be the case with the class size example. In factorial designs, groups are based on two (or more) factors, such as one factor being large

or small class size and another factor being whether the subject is a boy or girl, which yields four cells (corresponding to four groups). In a factorial design it is possible to test for main effects, such as whether class size affects learning, and interactions, such as whether class size has equivalent effects for boys and girls.

Finally, a quasi-experiment has the trappings (and some of the advantages) of an experiment but may not fully meet all of the criteria, such as a study in which matched groups are used (rather than randomly assigned groups) or a study that compares people based on a characteristic (such as differences between boys and girls or high and low-achieving students).

COMPARISON TO OTHER RESEARCH METHODS

In educational research, it is customary to distinguish between experimental and observational research methods, quantitative and qualitative measures, and applied versus basic research goals.

First, if experimental methods are preferred for testing causal hypotheses, what is the role of observational methods, in which a researcher carefully describes what happens in a natural environment? Observational methods can be used in an initial phase of research, as a way of generating more specific hypotheses to be tested in experiments, and observational methods can be used in conjunction with experiments to help provide a richer theoretical explanation for the observed effects. However, a collection of observations, such as portions of transcripts of conversations among students, is generally not sufficient for testing causal hypotheses. An important type of observational method is a correlational study, in which subjects generate scores on a variety of measures. By looking at the pattern of correlations, using a variety of statistical techniques, it is possible to see which factors tend to go together. However, controlled experiments are required in order to determine if the correlated factors are causally related.

Second, should educational research be based on quantitative measures (e.g., those involving numbers) or qualitative measures (e.g., those involving verbal descriptions)? Experiments may use either type of measure, depending on the research hypothesis being tested, but even qualitative descriptions can often be converted into quantitative measures by counting various events.

Third, should educational research be basic or applied? In a compelling answer to this question, Donald Stokes argues for “use-inspired basic research” (1997, p. 73). For example, in educational research, experimental researchers could examine basic principles of how instruction influences learning, that is, experiments aimed at the basic question of how to help people learn within the practical setting of schools.

HISTORICAL OVERVIEW AND 21ST CENTURY TRENDS

Applying experimental research methods to questions about human behavior is recognized as one of the greatest scientific advances of the 20th century. Between 1975 and 2005, in particular, experimental research methodology has enabled an explosion of educationally relevant

findings on how to design effective instruction in subject areas such as reading, writing, mathematics, and science.

In spite of these advances, Peggy Hsieh and colleagues (2005) found that the percentage of articles based on randomized experiments declined from 40 percent in 1983 to 26 percent in 2004 in primary educational psychology journals and from 33 percent in 1983 to 4 percent in 2004 in primary educational research journals. The authors conclude that “the use of experimental methodology in educational research appears to be on the decline” (Hsieh et al., 2005, p. 528). They characterize the decline as “unfortunate” especially in light of growing concerns about “the untrustworthiness of educational research findings” (Hsieh, et al., 2005, p. 528). In a slightly earlier report to the National Research Council, Shavelson and Towne also noted the consensus view that the “reputation of educational research is quite poor” (2002, p. 23). The decline in training in experimental research methods in schools of education can be seen as an example of the deskilling of educational researchers, marginalizing one of the most powerful and productive research methodologies and ultimately marginalizing educational researchers as well.

Valerie Reyna notes that, as a reaction against the perceived low quality of educational research, members of the U.S. Congress passed bills that were signed into law in 2001 and 2002 requiring that educational practices in the United States be based on “scientifically-based research” (2005, p. 30) Reyna shows that the definition of scientifically based research includes research using “experimental or quasi-experimental designs in which individuals . . . are assigned to different conditions and with appropriate controls to evaluate the effects of the condition of interest” and using “measures . . . that provide reliable and valid data” (2005, p. 38). According to Reyna “two landmark pieces of legislation were passed that could substantially change educational practice” not by endorsing a particular program or policy but rather by calling for educational researchers to “embrace . . . the scientific method for generating knowledge that will govern educational practice in classrooms” (2005, p. 49). Similarly, in their report to the National Research Council, Shavelson and Towne call for “evidence-based research” in education—the fundamental principle of science that hypotheses should be tested against relevant empirical evidence rather than ideology, opinion, or random observation (2002, p. 3).

Early 21st-century trends in experimental research include the use of effect size, meta-analysis, randomized field trials, and net impact.

The Use of Effect Size. Effect size is a measure of the strength of an effect in an experiment. Jacob Cohen (1988) suggested a simple measure of effect size—referred to as Cohen’s *d*—in which the mean of the control group is subtracted from the mean of the treatment group and this

difference is divided by the pooled standard deviation of the groups. According to Cohen, effect sizes can be classified as small ($d = .2$), medium ($d = .5$) and large ($d = .8$). Use of effect size allows educational policy makers to determine if an instructional treatment causes a statistically significant effect and if it has a practical effect. Hsieh et al. reported an increase in studies reporting effect size in educational psychology journals between 1995 and 2005, starting with 4 percent in 1995 to 61 percent in 2004, whereas the rate remained steady at about 25 percent from 1995 to 2004 for a primary educational research journal (2005).

The Use of Meta-analysis. The effect size measure allows for a particular instructional effect to be compared across experiments using a common metric, yielding a new kind of literature synthesis called meta-analysis. In meta-analysis, researchers tally the effect sizes of the same comparison across many different experiments, yielding an average effect size. For example, Gene Glass and Mary Smith (1978) reported a pioneering meta-analysis of research on class size revealing small positive effects of smaller class size. In the early 2000s meta-analysis is commonly used to review and summarize experimental research.

The Use of Randomized Trials. Randomized field trials (RFT), randomized clinical trials (RCT) and randomized trials (RT) refer to a particularly rigorous form of experimental research in which students (or other entities) are randomly assigned to treatments within an authentic field setting. Gary Burtless states that “a randomized field trial . . . is simply a controlled experiment that takes place outside a laboratory setting” (2002, p. 180).

Although randomized trials have been used in medical research and research on public policy, they are rarely used in educational research. However, there are some notable exceptions such as a study of effects of class size conducted in Tennessee, reported by Jeremy Finn and Charles Achilles (1999). As part of the study, 11,600 students in 79 schools across the state were assigned along with their teachers to small classes (13–17 students), regular classes (22–26 students), or regular classes with full-time teacher aides. Students stayed in the program from kindergarten through third grade, and then all were returned to regular classes. Importantly, the study showed that students in the small classes outperformed those in the regular classes, with or without aides, and the effects were greatest for minorities. Frederick Mosteller called the Tennessee class size study “one of the most important educational investigations ever carried out” (1995, p. 113). In the foreword to *Evidence Matters* by Frederick Mosteller and Robert Boruch, the authors observe, “When properly conducted, randomized field trials—often called the gold standard in research involving human subjects—allow for fairly precise estimates of

programmatic effects” (2002, p. vi). Using an appropriate unit of measure (for example, individual students, classrooms, or schools) is an important consideration in research using randomized field trials.

Net Impact. Judith Gueron (2002, p. 18) distinguishes between an intervention’s outcomes (e.g., the percentage of students graduating from a school or passing a certification test) and its net impact (e.g., the percentage who graduate or who pass a certification test who would not have without the intervention). Gueron argues that “administrators often know and tout their program’s outcomes, but they rarely know the program’s net impacts” (p. 18). When administrators focus on the question, “Is the new intervention effective?” they focus only on outcomes. When they focus on the question, “Does the new intervention have more impact than the current practice?” they focus on net impact. In order to determine an intervention’s net impact, experimental researchers compare the outcomes with current practice (e.g., current instructional method) to the outcomes with the new intervention (e.g., the new instructional method). In short, Gueron argues that the question “Compared to what?” is an important and profound issue in experimental research.

In their analysis of educational research methodologies, Shavelson and Towne note: “decisions about education are sometimes instituted with no scientific basis at all, but rather are derived from ideology or deeply held beliefs” (2002, p. 17). In contrast, experimental research methodology has the potential to be a tool for promoting effective change in education in which decisions about instructional interventions are guided by scientific evidence and grounded in research-based theory. In the preface to Gary Phye, Daniel Robinson, and Joel Levin’s *Empirical Methods for Evaluating Educational Interventions*, Gary Phye observed: “we are on the cusp of a reaffirmation that experimental research strategies provide the strongest evidence” for testing the effects of educational interventions (2005, p. xi). Finally, Robert Boruch quotes Walter Lippman who, in the 1930s, said: “Unless we are honestly experimental, we will leave the great questions of society and its improvement to the ignorant opponents of change on the one hand, and the ignorant advocates of change on the other” (2005, p. 189). In short, the experimental research methodology that fueled an explosion of scientific research about humans in the 1900s remains a powerful and indispensable tool for educational researchers in the new millennium.

SEE ALSO *Research Methods: An Overview*.

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EXPERT-NOVICE STUDIES

Expert-novice studies involve natural contrasts between individuals at *relatively* high performance levels in a given domain (academic discipline or profession or hobby) and individuals at a *relatively* low performance level in that given domain. The word “relatively” is emphasized because expertise is a continuum rather than two discrete states and a given study usually just compares two points

along the continuum. For example, one classic study compared physics faculty (experts) against physics graduate students (novices), whereas another classic study compared undergraduates who had performed very well in an introductory course (experts) against undergraduates who performed much less well in that same course (novices).

Some researchers use the terms *expert* and *novice* in a more restricted, absolute way. For example, expert, for these researchers, is applied to individuals having spent at least 10 years of focused practice in a domain. This categorization method is called the 10-year-rule. It is based on the empirical observation that world-class expertise in a domain generally takes at least 10 years of focused practice, whether that domain be game playing, sports, writing, music composition, music playing, or scientific research (Hayes, 1985). The term novice, in the absolute sense, applies to individuals who have just learned the basics of the given domain but have not had an opportunity to practice. In other words, they can do basic tasks in the domain (unlike completely uninformed individuals), but only at a very low level of performance.

In general, experts are much faster and more accurate than novices in typical tasks in the domain of expertise being examined. Expert-novice studies have examined many different possible factors underlying this large performance difference, including differences in memory ability (how much of a problem is remembered), facts/chunks (how many example situations are known), representations/schemas (what features of problems are perceived), and procedures/strategies (what solution methods are used). Expert-novice differences have been found for all of those factors, although particular expert-novice studies tend to focus on only a subset of these dimensions, as illustrated in the following prototypical studies.

PROTOTYPICAL STUDIES

Chase and Simon (1973) recruited three participants of varying chess skill for their study (one master chess player, one Class A player, and one beginner). Each participant completed two different tasks involving side-by-side chessboards with a divider between them. The left board presented a different configuration each trial, and the right board was used by the participants to make responses. For the perception task, the participants were asked to recreate 14 game configurations, completing each as quickly and accurately as possible. For the memory task, the participants viewed an additional 14 game configurations for only five seconds and needed to recreate each configuration from memory. Each configuration was repeated until the participant correctly recreated the configuration. The game configurations varied by whether they were selected from the middle of a game or the end of the game and whether they were actual game configurations or random organizations of the pieces (i.e., unlikely to occur in a game).

Chase and Simon found that recall ability increased with chess skill ability. This relationship only occurred in recreations of actual configurations, not with random configurations. Chase and Simon hypothesized that the expert memory advantage was specific to actual configurations because experts saw chessboards in terms of familiar chunks, and random configurations did not have familiar chunks. Chase and Simon empirically estimated chunk size by using the time intervals between the placements of each chess piece as participants were recreating the configurations. Using this information to parse the chunks for each participant, they found that master chess players indeed had more chunks and larger chunks than the less skilled players. Even though the chunk size was larger, the chunks still fit within the accepted memory span that is to say, chess masters did not have better memory ability, just bigger chunks.

Another classic expert-novice study involved the study of representations rather than chunks. Chi, Feltovich, and Glaser (1981) recruited 16 participants of varying physics knowledge (eight experts included advanced PhD students from the physics department and eight novices included undergraduates who had just completed a semester of mechanics). Each participant sorted 24 physics problems selected from eight chapters of a physics textbook that were copied onto note cards. They were instructed to make their categorizations based on the similarities of the solutions. After the sorting process, they explained why they chose to group certain problems.

While there were no differences in the number of categories the experts and novices used in the sorting task, there was very little overlap in the category labels used by the experts and novices. From both the categorizations and the explanations, it was clear that novices grouped by what the problems looked like (e.g., incline planes or pulley problems) and experts grouped by the major physics principle necessary to solve each problem (e.g., conservation of energy problems or Newton's second law).

ROLE OF EXPERT NOVICE STUDIES IN EDUCATIONAL RESEARCH

Expert-novice studies have many important roles in educational research. First, they define the educational end point. The core of educational research is about defining how to structure teaching and learning rather than in defining what should be taught or learned, at least with respect to the end point of learning. From somewhere else, there must be input on the appropriate targets of learning. Expert-novice studies are a very important method of specifying those targets, and they are a method that has systematic advantages over simply asking disciplinary experts to list the target knowledge. The reason is that one hallmark of expertise is that much of the knowl-

edge is tacit and situationally evoked (Patel, Arocha, & Kaufman, 1999) experts don't know all the things they know and do, and it is hard to systematically extract the things they do know.

Second, expert-novice studies define the educational start point. Young children are remarkably adept at some things (e.g., extracting patterns from statistics in the environmental input) and young adults are remarkably weak at other things (e.g., reasoning about confounded variables in very simple situations). Research on where novices sit with respect to experts establishes empirically where the biggest gains need to be made by the learner.

This start-to-endpoint view of expert-novice studies connects with a knowledge decomposition view of curriculum design: what are all the individual knowledge and skill components that make up the goals of educational interventions (Gagne, 1962)? Here the assumption is that expertise is made up of many independent skills and knowledge, and instruction must cover each of these skills and knowledge in some logical order.

A variation of this decomposition perspective, derived from expertise research that emphasized the contextualized nature of knowledge and skills, is that experts not only know facts and have separable skills but are also better able to selectively and appropriately apply facts and skills in particular contexts (Lemaire & Siegler, 1995). For example, the early expertise studies on chess suggested that experts had tens of thousands of chess chunks, but the research also showed that experts had associated moves with these chunks that allowed them to quickly "see" which moves were worth considering. The educational implication is that students must learn these connections with the correct contexts (and perhaps break connections with the wrong contexts).

A third important use of expert-novice studies for educational research is to provide models of some form of education that was clearly successful. Expertise research has generally ruled out the genetic or talent perspective on expertise, which makes especially salient the question of what environmental factors were in place to develop that expertise (Ericsson, Krampe, & Tesch-Roemer, 1993). That is, can we develop better models for instruction on the basis of these success stories? For example, some researchers have considered the ways in which experts and novices interact in many settings that lead to high levels of expertise (e.g., in a professional or sport setting), namely apprenticeship. The observation is that novices are asked to participate in authentic disciplinary activities from the beginning (e.g., playing in full basketball games), and move gradually from peripheral, supporting roles to central, independent roles (Collins, Brown, & Newman, 1989). Another important educational implication from this angle on expertise research is the central importance of

focused practice: expertise is developed through thousands of hours of focused, regular practice, and curricula that devote much less time to an important topic are unlikely to be successful (Ericsson et al., 1993).

A fourth focus involves the importance of some expertise for learning in addition to performance. For example, research on learning by analogy has found that more expert students are better able to find relevant features in examples and learn by analogy to these examples than more novice students, who tend to encode problems in more superficial ways (Novick, 1988). This kind of research suggests which knowledge and skills should be placed earlier in the curriculum because they enable or accelerate later learning.

EXPERT EXPERT EXTENSIONS OF EXPERT NOVICE RESEARCH

Expertise is often treated as a single dimension, such that there is only one way of being more expert in a given domain. However, expertise is actually more nuanced than that single dimension view, and individuals can be more or less expert on different dimensions. For example, a person might be an expert on facts of a domain, but not expert in the skills of a domain, such as in the case of a U.S. Civil War buff with no training in historical thinking. Another person might have considerable training in the skills relevant to a particular domain but relatively little knowledge of the facts relevant to that domain, such as in the case of a physics researcher working on biology research. Studies that compare different kinds of experts allow for some teasing apart of the importance of different kinds of knowledge or skill on performance in different kinds of circumstances. For example, Voss, Tyler, and Yengo (1983) compared political scientists with expertise in the Soviet Union against political scientists with expertise on other regions, as well as comparing them to chemistry faculty and undergraduates. They found that some aspects of reasoning performance (on a problem relating to solving a political science problem involving the Soviet Union) depended upon training in political science in general whereas other aspects of reasoning performance depended specifically on being an expert on that exact region.

Most importantly for educational research, expert-expert studies can address the central educational question of generality and transfer of knowledge. A tension in curriculum design is the extent to which reasoning skills can be taught outside of a context or in some arbitrary context, or whether reasoning skills must be taught specifically in the context in which they will be later used. An example would be statistics or research methods. These are often stand-alone courses, with the idea that students will later be able to apply the skills learned in those courses to

whatever later contexts they need to apply them in, even if those contexts involve reasoning *about* very different content. The alternative approach is to teach only more specialized reasoning courses that are specific to subgroups of students' goal reasoning domain, or maybe have them take many such courses if they are unsure about their target domain. The general reasoning course approach is more efficient, but depends upon there being successful transfer. Expert-expert studies help address this question methodologically: if an expert in one domain can successfully solve problems in another domain, then the general training approach is a viable one. In fact, some recent studies have found generality to many aspects of training (e.g., Schunn & Anderson, 1999).

STATISTICAL ANALYTICAL TECHNIQUES USED IN EXPERT NOVICE RESEARCH

Although expertise is really a continuum rather than true categorical stages as the term "expert-novice" implies, expert-novice studies tend to focus on extreme group comparisons. Thus, the independent variables tend to be categorical. Dependent variables used in expert-novice research can be quite diverse, ranging from simple quantitative performance measures (such as accuracy or solution time) to more qualitative measures such as protocol analysis. In the case of simple performance metrics, basic univariate statistics such as ANOVA and t-tests are commonly used. In the case of protocol analysis, statistical techniques relevant to analysis of frequencies are used (e.g., Chi-Squared or other non-parametric tests). Because experts are often hard to find in large quantities, the minimum N assumptions of many statistical tests are not met, and low N variations of those tests are required (e.g., Fisher-exact instead of Chi-Squared).

STRENGTHS AND WEAKNESSES OF EXPERT NOVICE RESEARCH

In abstract terms, expert-novice research generally involves high external validity at the cost of low internal validity. To be more specific, expert-novice contrasts tend to involve participants similar to ultimate situations of interest working on tasks of ultimate interest, in contrast to using participants of convenience working on highly simplified tasks with questionable levels of motivation to perform the given experimental tasks. However, the downside is that the statistical power of the studies is often low because experts are hard to find and the statistical method is by necessity the lower powered, between-subjects method. There are also many confounded variables bundled with expertise because one cannot randomly assign participants to expertise. Thus,

expert-novice research is an excellent methodological tool that should work in conjunction with other techniques that have better statistical power and methodological control but perhaps lower external validity.

Another important methodological feature of expert-novice research involves confirmatory versus exploratory research. Because expertise is a natural variable rather than an experimentally controlled one, expertise research tends to be more exploratory. Exploratory research has the advantage of being able to provide many unexpected findings, but it often involves looking at many possible dependent variables to find which of the many complex ways in which expertise could express itself is relevant to the given domain/task being studied. This “fishing expedition” nature of data analysis in expert-novice studies is why qualitative data is so often collected—it allows the researcher to explore many different dimensions of behavior after the data is collected. It also explains why expert-novice studies are slow to be analyzed and published.

SEE ALSO *Expertise*.

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EXPERTISE

The notion of expertise underlies many facets of the educational process. Educators look to subject matter experts to inform the selection of content and establish levels of optimal performance against which student performance can be compared. Expert teachers are highly valued and actively sought out to serve as mentors and master teachers for those who are less experienced in the classroom. It is also hoped that students acquire expertise in some area so that they may be successful in their future academic and professional endeavors. Despite the centrality of expertise in education, however, there are substantial challenges that exist in defining it.

DEFINITIONS OF EXPERTISE

Expertise is difficult to define with precision. Generally, experts are expected to outperform non-experts consistently on tasks in a specific domain. However, scholars disagree about the most effective means by which to identify these individuals. K. Anders Ericsson (1948) argues that experts are those individuals who reliably excel on specific key tasks that are central to performance in a domain (Ericsson & Smith, 1991). In contrast, Robert Sternberg (1949) suggests that such narrowly bounded criteria are inauthentic and do not represent expertise as it occurs in professional settings (Sternberg & Horvath, 1995, 1998; Sternberg, Gigorenko, & Ferrari, 2002). Rather than relying on a static list of necessary and sufficient characteristics for expertise, he advocates a “family resemblance” approach in which the central tendencies of expertise (proficiency, experience, etc.) may manifest differently among different experts within and across domains.

It is also an open question in some domains whether or not it is possible to be an expert. James Shanteau (1943) reports that the reliability of expert evaluations and predictions varies significantly by domain. For example, expert weather forecasters are almost perfectly consistent ($r=0.98$) in their predictions when presented with the same information on different occasions (Shanteau, 2000; Shanteau, Weiss, Thomas, & Pounds, 2002). In contrast, expert stockbrokers ($r=0.40$) and expert pathologists ($r=0.50$) are fairly inconsistent. Similarly, the level of agreement between experts in a field varies between

domains and is closely related to rates of internal consistency. Shanteau suggests that evidence of unreliability in expert judgment does not inherently invalidate claims of expertise. In some cases, experts may discern multiple valid paths to reach a desired goal and evaluate the information at hand in that context. In other cases, the scientific knowledge base that supports experts' decision-making may itself be underdeveloped—as is the case in social sciences such as economics, psychology, and education. Experts in these domains may apply the best available knowledge of the field consistently and effectively but need to fill knowledge gaps with personal judgments that are less reliable.

In contrast, Robyn Dawes (1936) argues that expertise can exist only in fields for which advanced training and accumulated experience lead to higher reliability and success rates. His 1994 book, *House of Cards*, analyzed the fields of clinical psychology and psychotherapy and found that licensed practitioners were no more successful in helping their clients than laypeople with minimal training. Further, supposed experts in the field were no more accurate than novices when interpreting the results of psychological tests (e.g., Rorschach and sentence completion tests) or predicting the future behaviors of the individuals whom they evaluated. His conclusion was that expertise could not exist in the domain.

The problem of defining expertise increases for fields in which there is little agreement on desired outcomes or best practices. In the field of education, for example, identifying and expert teachers and training novices to become experts are considered to be crucial. The early work of David Berliner (1938) and others observed that teachers considered to be experts typically had a superior understanding of relevant factors impacting classroom dynamics, were better able to improvise during lessons to adapt to their students' abilities, and more successfully managed competing demands for their limited attentional resources (Berliner, 1986, 1987; Carter, Sabers, Cushing, Pinnegar, & Berliner, 1987; Carter, Cushing, Sabers, Stein, & Berliner, 1988; Sabers, Cushing, & Berliner, 1991).

However, in his recent work, Berliner (2005) suggests that two major issues prevent an adequate understanding of expertise in teaching. First, there are multiple standards of "good teaching" that are dependent upon cultural norms. Second, there is persistent disagreement on the desired outcomes of public education and appropriate ways to measure student success in relation to them. Thus, an expert teacher would need to be both a "good" teacher in a cultural sense by implementing commonly embraced practices and an "effective" teacher in terms of measured student learning outcomes (Berliner, 1987, 2005). The fact that teaching effectiveness must be evaluated on the basis of students' achievement

rather than the actions of the teachers themselves further problematizes the concept of the expert pedagogue, because cultural, contextual, and personal factors impact student performance and are beyond the control and/or professional responsibility of an individual teacher.

RESEARCH FINDINGS ON EXPERTISE

Research stemming from the field of cognitive psychology in the 1970s and 1980s has yielded a sizeable body of evidence for common traits across domains of expertise. The seminal book by Michelene Chi, Robert Glaser, and Marshall Farr, *The Nature of Expertise* (1988), compiled examinations of data from typewriting, restaurant orders, mental arithmetic, computer programming, judicial decision-making, and medicine. The overview chapter listed seven primary attributes that characterize the performance of most experts across domains. These observations have helped to shape the development of the field:

1. Experts excel mainly in their own domains;
2. Experts perceive large meaningful patterns in their domain;
3. Experts are fast; they are faster than novices at performing the skills of their domain, and they quickly solve problems with little error;
4. Experts have superior short-term and long-term memory;
5. Experts see and represent a problem in their domain at a deeper (more principled) level than novices; novices tend to represent a problem at a superficial level;
6. Experts spend a great deal of time analyzing a problem qualitatively;
7. Experts have strong self-monitoring skills.

When performing in their domains, experts rely on their highly refined mental models to represent and solve the problems they encounter. These schemas allow experts to identify the problem type and respond using efficient and effective strategies that leverage their deep understanding of the problem structure (Chi, Feltovich, & Glaser, 1981). Using known strategies, they are able to proceed directly toward the desired outcome. Referred to as "forward reasoning," this process differs sharply from novices' approaches to problem solving, which typically involve reasoning backward from the desired outcome to identify appropriate intermediate steps (Chi, Glaser, & Rees, 1982).

In addition to these characteristics, studies from various domains suggest that experts typically have at least 10 years of experience in their fields. In a major review of the research, Ericsson and his colleagues (Ericsson, Krampe, & Tesch-Römer, 1993) analyzed many

studies of training outcomes across a wide range of tasks (e.g., Morse Code operation, musical performance, Olympic sporting events) and found strong evidence that years of experience alone was not sufficient for explaining performance outcomes. Replicating these findings, their own study demonstrated that in some cases expert professional pianists had up to six fewer years of experience than their less-skilled amateur counterparts.

To explain this discrepancy, Ericsson proposes that those individuals who become experts engage in focused and intensive training during their years of experience known as *deliberate practice* that is qualitatively different than other types of experience within the domain. Defined as “the individualized training activities especially designed by a coach or teacher to improve specific aspects of an individual’s performance through repetition and successive refinement [that includes] monitor[ing] their training with full concentration, which is effortful and limits the duration of daily training” (Ericsson & Lehmann, 1996, pp. 278–279), deliberate practice is not considered to be inherently motivating. It is specifically intended to refine performance and remediate any facet of relevant skills in which there is room for improvement (Ericsson & Charness, 1994).

Ericsson characterizes experts’ performance as demonstrating maximal adaptation to task constraints. In simpler terms, this means that experts have shaped their skills to maximize the efficiency of their actions within the structural context of their domains as they solve relevant problems. Such adaptations can take the form of “shortcuts” that would not be feasible for non-experts but produce superior results when employed appropriately. For example, expert athletes learn to anticipate changing conditions rapidly and respond effectively before the new condition has actually formed (e.g., anticipating the gunshot that starts a race). Likewise, chess masters can visualize the ways in which a particular move may prevent or allow an opening several moves later in a game and make preemptive decisions on that basis.

When task constraints change, however, some experts are unable to adapt successfully to the new situation while others retain their high levels of performance. Giyoo Hatano (1936–2006) characterized members of these respective groups as *adaptive* and *routine* experts (Hatano, 1982). Adaptive experts typically understand why their skills are effective under normal circumstances and successfully modify them to fit the new situation or invent new procedures as necessary (Hatano & Inagaki, 1986, 2000). However, it is challenging to reliably identify adaptive experts. Studies of expert bridge players, electronics troubleshooters, and others have found that changing task constraints (e.g., point values in bridge) or introducing highly unusual situations often leads to weak performance by

EXPERTISE AND IQ

Expertise is often attributed to high levels of intelligence. However, studies of expertise consistently find that there is no correlation between IQ and experts’ performance. Ericsson (1998; Ericsson & Charness, 1994; Ericsson & Lehmann, 1996) investigated reports of child prodigies who are reputed to perform feats rivaling top experts’ abilities. However, in instances where these abilities have been sufficiently documented to permit independent validation, the prodigies consistently have approximately 10 years of deliberate practice that was initiated and supported by parents, tutors, or coaches as young as 18 months old. The available evidence indicates that even those abilities typically attributed to innate talent (e.g., perfect pitch, exceptional memory, reflexes, muscle strength and endurance, etc.) can be fostered through environmental factors and training experiences for children who are highly motivated to succeed in these tasks.

individuals who typically demonstrate high levels of expertise in their domains under routine conditions.

DIFFERENT PERSPECTIVES ON THE DEVELOPMENT OF EXPERTISE

As discussed above, Ericsson’s findings across domains indicate that world-class performers tend to require about 10 years of deliberate practice prior to attaining that status. However, other research from various fields suggests that other factors may also play a role. Dean Keith Simonton (1948) argues that those experts who demonstrate adaptive expertise through creative innovations in their respective fields typically score higher on personality measures of nonconformity, independence, openness to experience, ego strength, introversion, and aggressiveness. They are also significantly more willing to take risks than routine experts in their fields (Simonton, 1999, 2000). Additional research also suggests that highly creative experts tend to have broader interests than their less creative counterparts (Simonton, 1976).

Simonton’s analyses also indicate that several assumptions of the deliberate practice hypothesis are not borne out with regard to experts in creative fields like music composition and scientific discovery. He argues that if deliberate practice were the sole factor affecting the development of expertise, then the best

experts ought to be those with the most years of deliberate practice. However, his (1991a, 1991b) studies of 120 classical composers and 2,026 scientists and inventors indicated that those who were most productive and considered to be most eminent in their respective fields trained for fewer years and made major contributions sooner after their first accomplishments than those considered to be less important contributors. Further, the career trajectories of creative experts tend to peak and then decline, despite ongoing deliberate practice, and the odds of generating a creative success do not change significantly over the course of a career (Simonton, 1985, 1986, 1997).

Ericsson (1998, 2004) suggests that practice which becomes rote rather than deliberate may limit the development of expertise in this way. Research in cognitive skill development indicates that as people practice new skills, they typically require less and less conscious attention directed to their actions while maintaining a consistent level of performance. For example, learning to read or drive a car is typically highly effortful, slow, and halting when it is first learned. However, with continued practice, performance becomes fluent with little or no attention directed to the component skills (e.g., pronunciation or word recognition during reading; shifting gears or stepping on the brake pedal while driving). This *automaticity* of skills results in performance that is very fast and consistent. It may also lead to people being unaware of how they perform those skills and even whether or not the skills were used in a particular situation. As skills automate, they demand fewer cognitive resources, so attention can be redirected to other tasks.

What is done with surplus attention during practice and performance is likely a critical factor in the development of advanced and creative expertise. In deliberate practice, this attention is reinvested to continually monitor and improve performance. However, when spare attention is allocated to unrelated activities (e.g., talking on a cellular phone while driving), skill development plateaus.

For this reason, Ericsson argues that automaticity should be avoided as individuals seek to become experts. However, research on skill acquisition and expertise from cognitive science indicates that automaticity in fundamental domain skills is necessary to make available the attentional resources required to develop and execute more sophisticated strategies. Spare attention during performance is especially important for adaptive experts, because they must allocate their cognitive resources to recognizing and understanding novel or unusual aspects of a task and the implications of resulting atypical constraints. Therefore, those routine skills that are directly applicable to the new task must not demand conscious attention that would compete with these needs.

David Feldon (1975) suggests that what differentiates adaptive experts who are able to leverage their automaticity from routine experts whose flexibility is limited by it is the number and relevance of the decision points in their procedures (Clark, Feldon, van Merriënboer, Yates, & Early, 2008; Feldon, 2007a). As skills automate and basic skills combine to form more complex procedures, consciously mediated decision points remain where details of the specific situation determine which of several possible strategies will be the best to employ from an expert's repertoire in that instance. Thus, the training most likely to lead to adaptive expertise presents learners with a wide variety of practice scenarios to support the development of appropriately placed decision points and to avoid inappropriate automatization of requisite skills (Clark, Feldon, Howard, & Choi, 2006; Feldon, 2007b).

IMPLICATIONS OF RESEARCH ON EXPERTISE FOR INSTRUCTION

Conventional wisdom suggests that if a learner needs to know how to do something well, the best instructor would be an expert in the field. However, research indicates that this is not always the case. Trends in the findings on experts' instructional abilities indicate that, overall, experts are (1) inaccurate in their assessments of learners' knowledge and abilities relevant to learning procedures in an expert's field, and (2) inaccurate in their explanations of how they accomplish tasks within their domains.

Pamela Hinds' studies of experts as instructors demonstrate that experts are significantly worse than non-experts in predicting the amount of time that it would take novices to learn presented material within the experts' domain of expertise. Further, debiasing techniques that are often effective in improving the accuracy of non-experts' preliminary assessments of novices did not improve their predictions (Hinds, 1999). In another study, Hinds compared the efficacy of one-on-one instruction between novices and experts with one-on-one peer instruction among novices. She found that when novices taught other novices how to perform a task, the students were better able to perform the procedure correctly than when experts provided the instruction. However, if the novice learners were asked to complete a task that required adjustments to the procedure that was taught, those who learned from the experts performed better (Hinds, Patterson, & Pfeffer, 2001).

These findings indicate that the explanations of experts offer an advantage, because their sophisticated mental models of their domains allowed them to structure the information that they provided to be broadly applicable. This differed from the overly specific explanations of novices, which were based solely on their experiences with the single task in the study. However, it seems that experts

excluded specific information which would have been helpful to learners as they attempted to perform the task. This may have occurred (1) because the experts overestimated learners' pre-existing knowledge bases, (2) because they could not successfully explain the automated skills they themselves use, or (3) for a combination of both reasons.

Feldon's investigations of experts' self-report accuracy (2004, 2007a, 2007c) indicate that automaticity does play a role in limiting their abilities to fully describe their own problem-solving processes. Analysis of experts' explanations of their actions during a recorded task revealed that inaccuracies represented both omissions of relevant steps in their activities and statements that directly contradicted their actions. If the only reason for experts' inaccurate explanations was an overestimation of students' abilities, then only errors of omission would be expected. However, the presence of errors of commission indicates that experts' may lack an awareness of their own actions that would limit the accuracy and completeness of their explanations to others.

Research on ways to maximize the benefits of experts' knowledge for instruction has identified techniques that appear to avoid the limitations of experts' limited self-awareness within their domains. Collectively known as *cognitive task analysis* (CTA), these techniques involve intensive, highly structured interviews with multiple experts to identify and collectively validate complete explanations of effective ways to perform a specific task within the domain of expertise. Instructors then incorporate these protocols into their course materials to supplement or replace their own explanations of the skills to be learned. Controlled studies of CTA-based instruction consistently demonstrate dramatic effect sizes favoring its use over more traditional unscaffolded explanations by experts in diverse domains including medicine, electronic systems troubleshooting, and spreadsheet applications (Clark et al., 2008; Feldon, 2007a; Feldon & Clark, 2006).

SEE ALSO *Expert-Novice Studies*.

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David F. Feldon

F

FEEDBACK IN LEARNING

Feedback occurs when the output of a system becomes an input to the same system, causing the system to respond dynamically to its previous productions. In learning, feedback can occur when consequences or products of a learner's behavior or cognition indicate the degree to which a goal or expectation is left unmet. Such information allows learners to check and improve the quality of their understanding, their application of knowledge and skill, and the processes by which they acquire new capabilities. In order for the consequences of behavior or cognition to influence further learning (and thus operate as feedback), at least three conditions must be met:

- A learner with implicit or explicit learning goals or expectations
- An environment that makes the consequences of action or cognition observable
- The ability of the learner to note and interpret the consequences of action or cognition.

In educational contexts, feedback appears in various guises, often tailored by an agent in the learner's environment with the specific intent of altering or nurturing some aspect of the learning process. In interpersonal interactions, feedback can appear in dialogues between a teacher and student or in the discourse of students engaged in collaboration. Feedback can be a smile or a frown, verbal corrections and explanations, or a display of expert performance after a novice attempt. A teacher can provide feedback to students about whether specific performance

criteria have been met in formative assessments. Feedback can appear in myriad mediated forms—paper-based workbooks and programmed instruction, computer-based tutorials, and computer-based simulations—where students check their answers or study informative consequences (e.g., the correct answer, suggestions for improvement, and simulation results). Many inquiry and project-based educational programs rely on learners to test hypotheses and gain new knowledge from analysis of experimental results. The capable, independent learner can find feedback in all sorts of interactions with the learning context if the learner has clear goals and expectations and abilities to perceive and interpret relevant consequences of action and cognition.

A BRIEF HISTORY OF FEEDBACK

In the early twentieth century, the term *feedback* referred to electrical systems used in audio broadcast. For example, feedback was brought to public attention in a notorious series of lawsuits over a patent for a circuit that would amplify radio signals by feeding back the signal into the circuit in rapid oscillations. Engineers came to use feedback to refer to products of a mechanical or electrical system that allowed the system to regulate itself. For example, if a heating system warms air temperature beyond a specified point, a thermostat can switch the system off and restart the heating system once the air temperature cools. Feedback became an explicit and crucial engineering concern as industry and the military sought to increasingly automate during World War II.

In 1948 *Cybernetics: Control and Communication in the Animal and the Machine*, by Norbert Wiener (1894–1964) made an enormously influential articulation of the role of

feedback in the operation of all varieties of mechanical, biological, psychological, and social systems. Coining the term cybernetics from the Greek for *steersman*, Weiner conceived of a new science to investigate how feedback and information dissemination regulate systems. With ideas both persuasive and prescient, Weiner imagined how feedback systems could be linked to complex calculating machines to create mechanical brains that demonstrate artificial intelligence, the machine learning and action that is responsive to dynamic features of a changing environment.

Simultaneous with conceptualizations of feedback in engineering, behaviorism emerged as a psychological paradigm which emphasized the consequences of an organism's behavior as the primary determinant of future behavior. Simply put, behaviorism argued that certain behavioral consequences act as reinforcers, increasing the subsequent frequency of behaviors that produce them. A child might increase, for example, the frequency of behaviors that lead to acquiring candy. Some consequences act as punishment, dramatically reducing the frequency of a behavior that produces them. Without reinforcing or punishing consequences, a behavior extinguishes, diminishes to some baseline frequency.

However, behaviorism struggled to account for the operation of some behavioral consequences and learning phenomena. How might it explain behaviors that persist in spite of punishment or which seem indifferent to reinforcement? How might behaviorism account for one-time learning and sudden insight, early acquisition of the grammar of a language, creativity, and actions that seem guided by abstract concept, not perceptible stimuli? Such phenomena implied the operation of some mental apparatus that could perform interpretative transformations on stimuli and produce new capabilities that are not so directly derived from simple behavior-consequence contingencies.

The combined influence of the cybernetics paradigm, weaknesses in behaviorism's account of learning, and developments in computer technology made psychology and education ripe for a so-called cognitive revolution. A new paradigm of humans as processors of information, borrowed from computing, supplanted behaviorism. Perceptible stimuli were no longer only considered cues or consequences for behavior, but informative signals that could be interpreted by mental apparatus, stored in meaning-preserving ways in memory, and used to inform future goal-directed action. The consequences of that action could then be fed back into the interpretive mental processor.

CONTEMPORARY VIEWS OF INSTRUCTIONAL FEEDBACK

At the beginning of the twenty-first century, the information-processing paradigm still provides a standard conceptualization of instructional feedback. For example, for

the influential instructional psychologist, Robert Gagné (1916–2002), learning is the encoding of information from short-term into long-term memory storage. In subsequent practice, newly stored knowledge is retrieved and applied. Feedback, the consequences of knowledge applications, re-enters the cognitive system, causing potential alterations in goals, learning processes, and stored knowledge.

Feedback's conceptualization has evolved in two significant ways. First, the source of feedback is no longer presumed to be a teacher or even external consequences. Butler and Winne, for example, emphasize the importance of internal sources of feedback generated through self-monitoring as a critical engine of self-regulated learning. In the absence of teacher-provided feedback, capable learners could interpret the consequences of their actions and cognitions in light of learning goals and thus provide feedback to themselves.

Second, some researchers distinguish among types of feedback. Bangert-Drowns, Kulik, Kulik, and Morgan suggested that feedback can provide information about knowledge retrieval and application, emotional and motivational states, and strategic management of learning. It could indicate whether a performance is correct, explain the nature of an error, provide prototypical responses, or simply display the consequences of actions. Each of these likely requires different features to be optimally effective. Hattie and Timperley, extending Kluger and DeNisi's suggestion that feedback loops can be hierarchically nested one in another, proposed four levels of feedback: about the quality of task performance, about the cognitive processes used to accomplish the task, about the ways in which a learner could better manage learning engagement, and about the self. Evidence suggests that these different kinds of feedback will be differentially effective according to different standards; for example, information about the self may not provide effective performance enhancements because it does not indicate specific ways in which knowledge or learning processes can be adjusted.

OPTIMIZING FEEDBACK FOR LEARNING

Feedback in learning is difficult to research. It has been found to inform learners about the following:

- The accuracy or efficiency of knowledge and its retrieval or application
- The quality of mental operations applied to information
- The quality of psychomotor performance
- The viability of a hypothesis or expectation
- The emotional or motivational state of the learner

- The efficiency or quality of learning processes employed in a learning task
- The management of learning processes
- Enduring qualities and goals of self
- The nature of relationships with co-learners and teachers.

Different feedback features might be differentially effective for different learners and different aspects of learning. Even apparently straightforward feedback depends on the interpretation of a learner. A learner could interpret the response “incorrect” as indicating a need to revise knowledge, a personal rejection, the confirmation of a hypothesis, or a hint to work harder.

Despite these difficulties, some generalities about feedback effects are possible. Kulhavy suggested and Bangert-Drowns, Kulik, Kulik, and Morgan supported that if feedback is available before a learner actively attempts to perform a task (presearch availability), the learner may not be cognitively and motivationally prepared to effectively use the feedback. Kulhavy also suggested and subsequent research corroborates that response certitude, the degree to which learners feel most sure of their knowledge, makes disconfirming corrective feedback more salient and thus more influential in learning. Kluger and DeNisi suggest that feedback most effectively enhances performance when it directs attention to motivational and task-specific goals, not self-related goals. Research on the timing of externally provided instructional feedback immediate or delayed after some learner performance has yielded highly varied results. Hattie and Timperley suggest that this variation might be accounted for by level of feedback; immediate task feedback might most benefit task performance, but delayed processing feedback might most enhance cognitive processing of information.

Clearly, feedback is a critical, ubiquitous, and complex feature of learning processes guided by teachers or directed by learners themselves. Educators would do well to create environments that support challenging standards and goal-setting and provide informative feedback. Students can also benefit from assistance regarding how to look for and use feedback and how to provide feedback for themselves. Future research will continue to clarify conditions that optimize feedback effects for different tasks and learners.

SEE ALSO *Behaviorism; Gagné, Robert Mills; Information Processing Theory; Operant Conditioning; Rewards; Self-Regulated Learning.*

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Robert L. Bangert-Drowns

FIRST (PRIMARY) LANGUAGE ACQUISITION

The term *first language acquisition* refers to children's natural acquisition of the language or languages they hear from birth. It is distinguished from second language acquisition, which begins later, and from foreign language learning, which typically involves formal instruction.

First language acquisition is a rapid process. In the span of just a few years, newborn infants who neither speak nor understand any language become young children who comment, question, and express their ideas in the language of their community. This change does not occur all at once. First, newborns' cries give way to coos and babbles. Then, infants who coo and babble start to show signs of comprehension such as turning when they hear their name. Infants then become toddlers who say “bye-bye” and “all gone” and start to label the people and objects in their environment. As their vocabularies continue to grow, children start to combine words. Children's first word combinations, such as “all gone juice” and “read me,” are short and are missing parts found in adults' sentences. Gradually children's immature sentences are replaced by longer and more adultlike sentences. As children learn to talk, their comprehension abilities also develop, typically in advance of their productive speech. As children master language, they also become masters at using language to communicate. One-year-olds who can only point and label become 2-year-olds who comment,

question, and command, and 4-year-olds who can carry on coherent conversations. Studies of middle-class, typically developing children acquiring English have documented that by four years of age children are nearly adult like in phonological properties of their speech; they have vocabularies of several thousand words, and they produce most of the types of structures observable in the speech of adults (Hoff, 2008).

THEORIES OF FIRST LANGUAGE ACQUISITION

First language acquisition is a robust process. Despite differences among cultures in the kind of early language experience provided to children, all normal children in anything remotely approximating a normal environment learn to talk (Hoff, 2006a). The rapidity and robustness of first language acquisition, along with its status as an accomplishment unique to humans, suggests to some that first language acquisition is supported by language specific innate knowledge. Language, according to this view, is encoded in the human genome—as are stereoscopic vision and bipedal locomotion. Another argument for the position that language has significant innate support comes from analyses of the nature of language knowledge in both the adult and child. Once language is acquired, speakers and hearers have the capacity to produce and understand an infinite number of novel sentences. This productivity of language poses a challenge to efforts to account for language acquisition on the basis of experience. Somehow children go beyond what they have experienced and construct a grammar that allows them to produce an infinite number of different sentences from a finite inventory of words. The argument for innate linguistic knowledge is also supported by evidence that very young children are sensitive to structural properties of language for which there is no obvious explanation in terms of infants' experience (Lidz, 2007).

INFANT ATTENTION TO AND RECOGNITION OF ENVIRONMENTAL SPEECH

Although it is not possible at this point to fully explain how language could be acquired without language-specific innate knowledge, there is mounting evidence that children can and do learn a great deal from their environments. Infants come to the language learning task equipped with attentional biases and learning capacities that operate on the experience their environments provide. Infants are biased to attend to speech over other environmental noises, and they pay particular attention to speech that has the exaggerated rhythm and intonation contour that characterizes the speech addressed to infants. Infants are excellent at extracting patterns from input, and this capacity for what is

termed statistical learning may make a substantial contribution to the language acquisition process (Gerken, 2007). For example, infants learn which acoustic features tend to co-occur in the speech they hear, with the result that their speech perception becomes tuned to the particular speech sounds used in the language they hear (Maye, Werker, & Gerken, 2002). A side effect of this tuning to the native language is a decline in the ability to hear sound contrasts that are not used in the ambient language. Thus, the basis for the foreign accent that is characteristic of late-acquired second languages is laid in infancy (Kuhl, Conboy, Padden, & Pruitt, 2005).

Infants also detect patterns among speech sounds. In experimental testing, it has been demonstrated that eight-month-old infants can detect patterns of co-occurring syllables in a stream of sound that they were exposed to for only two minutes (Saffran, Aslin, & Newport, 1996). These pattern learning abilities allow infants to recognize many familiar sound patterns in their language before they have learned the meanings associated with them. By nine months, infants have learned that some sound sequences are typical of their language and others are not. For example, American and Dutch nine-month-olds can discriminate English from Dutch words based on differences between them in what are allowable sound sequences (Jusczyk, Friederici, Wessels, Svenkerud, & Jusczyk, 1993; Gerken & Aslin, 2005).

Pattern learning may also provide children the basics of grammar. In experimental testing, 1-year-old children have demonstrated the ability to learn the patterns among words in word strings that they hear such that they later can distinguish sequences that violate this pattern from other sequences that are grammatical (Gomez & Gerken, 1999). It has been suggested that children may also learn the grammatical categories of their language (e.g., noun and verb) by noticing distributional regularities (e.g., all the words that are nouns are frequently preceded by “the”). Noticing co-occurrences also is one source of information about word meanings. When children hear the same word in many different contexts, they can use information about what is constant across those situations to narrow down the possible meanings of the word.

USING A COMMUNICATION SYSTEM TO MAKE CONTACT

Language acquisition is not solely a matter of learning the sounds, the words, and the grammar of language. In acquiring language children acquire a system that is used to communicate. Human infants are social beings, and the basic human desire to make contact with others is part of the foundation of language acquisition. (Children with autism seem not to have this desire to the same degree as typically developing children, and this difference is thought to be one root of the language disturbances that are characteristic of autism.) An important



Reading to a child encourages language development. © BRIAN MCENTIRE, 2008. USED UNDER LICENSE FROM SHUTTERSTOCK.COM.

social-cognitive ability that contributes to communicative interaction and to language development is the capacity for joint attention. Around the age of 10 months, children become able to actively engage their parents (and other individuals) while simultaneously focusing on an object of interest. In the first two years of life, language interaction that occurs in episodes of joint attention seems to be particularly useful to the language learning process (Baldwin & Meyer, 2007). More specifically, children as young as 18 months can use speakers' eye gaze as a clue to the referent of the words the speaker is producing. Children's non-linguistic, cognitive understandings also support word learning because a great deal of word learning consists of mapping sound sequences onto concepts children already understand nonlinguistically (Poulin-Dubois & Graham, 2007).

Many properties of children's language learning experience support the process of language acquisition. When

adults (and older children) talk to infants they speak more slowly, clearly, at a higher pitch, and with exaggerated intonation. This special register for talking to children has been called *motherese*. Infants have been shown to prefer to listen to motherese over adult-directed speech, even when the speech is in another language. The properties of motherese may also be beneficial for language acquisition. Vowel sounds are more consistent in infant-directed speech, and the stress patterns that indicate word and phrase boundaries are exaggerated. Mothers and other adults also tend to provide labels and information about things that they present to children, which aids children in vocabulary building. Infant and child-directed speech is characterized by repeating and expanding on the words and phrases children produce, which also may help children learn word meanings and sentence structure (Hoff, 2008).

FACILITATING FIRST LANGUAGE ACQUISITION

Although all normal children acquire language, there are large individual differences in the rate at which children acquire language and therefore in the language skills children possess when they enter school (Hoff, 2006b; 2006c). These individual differences in oral language skill are predictive of success in acquiring literacy. Some of these individual differences may be the result of differences among children in language learning ability, but to a significant degree, variance among children in their language skills reflects variability in the language learning experiences they have had (Hoff, 2003a). Studies of children within the United States have shown that children who experience more one-to-one conversation with adults have more rapid language development. Thus, a supportive environment for language acquisition is one that is characterized by a great deal of verbal engagement with the child (Huttenlocher et al., 1991; Hart & Risley, 1994). The quality of the speech children hear also matters.

Contrary to the view that children require simple input, speech that uses a rich vocabulary and long, information-containing utterances has been found to promote language development (Hoff & Naigles, 2002; Pan, Rowe, Singer, & Snow, 2005). Children who hear a more diverse vocabulary develop larger vocabularies themselves even at age 2 (Hoff & Naigles, 2002; Pan et al., 2005). Thus, successful and optimal language acquisition is contingent upon the richness of language input a child is exposed to. In addition, grammatical development seems to be accelerated when child-directed speech repeats and expands on a phrase or utterance a child attempts to produce (Hoff-Ginsberg, 1985, 1986). Studies of children in the United States suggest that book reading with an adult is a positive activity that provides children with a great deal of language input. Studies show that mothers produce more speech during book reading time than during toy play time, and this speech is richer than that produced during play time. Object labeling is also frequent during book reading, which may facilitate lexical development (Hoff, 2003b).

BILINGUAL FIRST LANGUAGE ACQUISITION

First language acquisition can be the acquisition of more than one language. The term bilingual first language acquisition has been used to refer to the circumstance in which a child acquires two languages from birth (Genesee & Nicoladis, 2007). (There has been very little research on the acquisition of more than two languages.) In the case of bilingual first language acquisition, the course of language development is largely unaffected by bilingualism. Infants seem to have the ability to distinguish two different types of

sound streams based on the acoustic characteristics of the languages, and they are able to build two separate language systems. The rate of development in each language depends on the amount of exposure children receive. Typically, bilingually developing children show more rapid development in the language that they hear more (Pearson, 2008).

In sum, the human infant brings a social inclination, powerful learning abilities, and perhaps language-specific innate knowledge to the language learning task. In order for language acquisition to occur, the environment must meet those abilities by providing children with communicative experience. Linguistically rich and responsive communicative environments promote optimal language development.

SEE ALSO *Second Language Acquisition*.

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FLOW THEORY

Flow theory was proposed by Mihaly Csikszentmihalyi to describe the experiences of intrinsically motivated people, those who were engaged in an activity chosen for its own sake (Csikszentmihalyi, 1975, 1997). Such activities were viewed as worth doing just for the sake of doing them rather than as means to another end. While other research on intrinsic motivation focused on behavioral outcomes, Csikszentmihalyi attempted to describe the quality of subjective experience, or how intrinsic motivation felt. Further, he sought to explain the characteristics of activities that people were intrinsically motivated to pursue, and why such activities were rewarding.

Under certain conditions, people's experiences are optimal. Csikszentmihalyi (1975, 1997) and his colleagues, Rathunde, Whalen and Nakamura, defined optimal experiences as those that were accompanied by a merging of action and awareness, strong concentration on the task at hand, and a loss of awareness of time. At such times, people concentrate

so hard on the current task that they forget about time and the world around them: They are thoroughly engrossed. Further, these activities are accompanied by positive emotions. They termed this quality of experience "flow."

The experience of flow is possible under certain circumstances: when individuals find the activities challenging and also believe they have the skills to accomplish them. Optimal experience, or flow, occurs when a person perceives the challenges in a certain situation and the skills brought to it as both balanced and above average. In contrast, when challenges and skills are unbalanced, such as when challenges outpace skills, an activity could evoke anxiety. The various ratios of challenges and skills are predicted to be associated with different qualities of experience: flow with high challenges and skills, apathy with low challenges and low skills, anxiety with high challenges and low skills, and boredom or relaxation with low challenges and high skills. The original classification scheme based on level of challenge and skill, described above (flow, relaxation, anxiety, and apathy) has been further refined into an eight-category scheme, and a twenty-four-category scheme. All schemes are based on the tenet that levels of challenge and skill interact to affect the quality of experience.

The idea of optimal challenge is not new to the field of education. Indeed, both Lev Vygotsky, a Russian psychologist (1896-1934), and Jean Piaget, a Swiss psychologist (1896-1980), contended that learning best occurs when people engage in activities that are at the peak of their abilities, when they have to work to their full potential to accomplish a task. However, the study of the experience of optimally challenging activities and the method of study are unique to flow theory.

MAJOR RESEARCH METHODS

Flow theorists not only study those who are intrinsically motivated to participate in an activity, but also individuals engaged in everyday activities. Csikszentmihalyi developed the Experience Sampling Method (ESM) to explore how individuals experience activities throughout their daily lives. The ESM involves randomly alerting individuals to answer questions about what they are currently doing, as well as their emotions, motivation, concentration, and thoughts associated with the task. Alerting methods have included beepers, watches, or PDAs set to randomly alert throughout a given time period. In this way, researchers can gain access to the thoughts and feelings during an activity as individuals are engaged in it. Other methods require individuals to recall how they felt or what they were thinking during prior activities, relying on memory.

The standard use of the Experience Sampling Method is to electronically beep students randomly during the day and ask that they complete a questionnaire (the Experience

Sampling Form, ESF, validated by Csikszentmihalyi and Larson). The first items on the ESF ask individuals to describe the activity in which they are currently engaged, followed by a series of questions to assess levels of motivation, cognition, and affect associated with the activity. These are Likert-type items (in which responses can range from 1 = not at all to 9 = very much) that resemble, for example: “Was this activity important to you?” “How hard were you concentrating?” “How do you feel about the challenges of the activity?” “How did you feel about your skills in the activity?” An additional thirteen semantic-differential items measure emotion during the activity (e.g., happy-sad, excited-bored, and sociable-lonely). Each activity can then be classified into the flow categories as determined by the level of perceived challenge and skill above or below average.

With such a method, researchers are able to determine (a) the amount of time spent in different types of activities throughout a day, week, or month, (b) which individuals spent more or less time in certain activities, (c) how different activities were experienced (both cognitively and emotionally) and which were most or least enjoyed, (d) characteristics of the environment or context that best contribute to optimal experiences and (e) which individuals were more likely to enjoy different activities.

While this method is often used to gain an understanding across all the activities in everyday life, some researchers have specified the types of activities they want to study. For example, some researchers, such as Schweinle and colleagues and Shernoff and Hoogstra, have limited the random alerts to times when participants are in school or completing homework. In this way, they gain information about the experience of different school and homework activities, such as whole-class instruction, group projects, watching videos, taking tests or quizzes, etc.

One drawback to the ESM is that it can be expensive and time consuming. Further, it requires using a large number of participants to get a broad range of experiences. It is also difficult in educational settings where teachers may not be amenable to some students randomly stopping their activity to complete questionnaires. Some researchers have adapted the ESM to assess the experience of specific activities without random beeps. For example, Schweinle and colleagues were interested in elementary students’ experience of mathematics classes. Rather than beeping students randomly throughout their math classes, they asked students to complete ESFs at the end of twelve different math classes across a school year. This type of method provided information specific to activities during math class rather than a cross-section of activities in everyday life. One drawback, though, was that it required students to recall their math class and respond with a general sense of how they experienced the whole class rather than specific points throughout the math class. Using the tradi-

tional ESM or modified versions, researchers have learned about how students experience school and academic activities and the environments that contribute to the most optimal academic experiences.

FACTORS INFLUENCING FLOW AND MOTIVATIONAL CONSEQUENCES

One benefit of flow theory is that it presumes that motivation, cognition, and affect are situational. Whereas much research in motivation has focused on relatively decontextualized individual psychological processes, flow theory presumes that these psychological processes are made meaningful by the environment. The ESM allows for study of both the environment and the persons within the setting. For example, researchers have used the ESM to determine how students spend their days and how they experience those activities. In one study, Shernoff, Knauth, and Makris found that high school students spend most of their classroom time paying attention to the teacher lecture (23%) or performing individual tasks such as writing notes or completing homework assignments (23%). Only about 8% of students’ time was spent in interactive activities, including classroom discussion (5%) and group tasks or laboratory experiments (3%). In short, students were engaged in intellectually challenging tasks for more than half of the day; however, roughly one-third of their time was spent passively listening to the teacher lecture or observing a video.

Using the ESM, Shernoff and colleagues were also able to determine the quality of the students’ experiences while engaged in each of these activities. Specifically, while students enjoyed watching videos and TV in class, they viewed these activities as the least challenging. Students also enjoyed individual work, which they reported most positively in terms of academic challenge, affect, control, and motivation. Lecture was viewed as unchallenging and was met with negative affect and lower levels of control. Considering that students spend approximately one-third of their time in the classroom passively listening to teachers or video, students may not be adequately challenged or motivated to learn.

Further, researchers have examined the quality of the experience as it relates to the balance of the challenge and skill of the activities. Researchers have for years extolled the benefits of high challenge matched with skill level, or optimal challenge. Vygotsky explained that the highest levels of learning occur when students are pushed to perform just beyond their current ability levels. As their skill levels increase, so must the level of challenge, maintaining an optimal balance that encourages continuous learning.

Flow theory further contends that, not only do activities with high challenge matched with high skill offer the best opportunities for learning, but they also provide an optimal environment for positive affect and intrinsic motivation. (It should be mentioned that not all activities with high challenge and high skill elicit flow states. However, flow states can only occur when high challenge is coupled with high skill.) If students believe that they have the skills to produce the desired results, positive affect is more likely to be experienced. When challenges and skills are optimal and balanced, students can experience higher levels engagement, attention, concentration and interest, according to Shernoff and his colleagues, as well as higher levels of positive affect, interaction with the class, efficacy, and value of the material, according to Schweinle and her colleagues (2006).

Interestingly, it is still possible to have positive affect if skill exceeds challenge. In fact, Schweinle and colleagues (in press) found that a student's skill level, rather than the perceived challenge of the activity, was the most significant factor in predicting positive affect and efficacy. While students may feel more positive if they believe they can succeed whether or not the challenge is high, only activities with high levels of challenge will also provide opportunities to learn. Phrased another way, students must have high to moderate levels of efficacy to demonstrate a preference for challenge. Teachers can use these tenets of flow theory to provide for optimal learning as well as positive affect and motivation to learn.

IMPLICATIONS FOR TEACHERS

Teachers encourage flow and intrinsic motivation by creating an environment that fosters enjoyable learning experiences. Ideally, to encourage optimal experiences, teachers must provide optimal challenge and support for competence (or skill). Schweinle and colleagues also found that, in classrooms where students reported high positive affect, efficacy and value of the material, teachers balanced levels of challenge and skill as well as (a) provided immediate, constructive feedback, (b) encouraged students to persist, (c) encouraged cooperation rather than competition, (d) supported student autonomy, (e) ensured that new challenges were tempered with support to match students' skill, (f) emphasized the importance of the material, and (g) pressed students to understand the principles rather than memorize algorithms.

Csikszentmihalyi (1997) argues that when teachers provide immediate, informational feedback regarding student performance, students become more interested and persistent with goal setting. Additionally, intrinsic motivation and self-efficacy increases in students. If a student receives non-constructive feedback, such as evaluating an individual's trait, motivation will decrease and negative affect may occur.

In addition to providing effective feedback, teachers can also increase intrinsic motivation and classroom experience by supporting student autonomy. Students become more involved when instructional activities are perceived as important and when students perceive themselves as autonomous and in control over their environment, according to Shernoff, Schneider, and Csikszentmihalyi. Schools can promote autonomy by minimizing external controls to facilitate conceptual understanding, allowing students to set goals and choose their own activities. In such a way, students are more likely to feel in control of their goals. However, if teachers provide a controlling environment by inflicting deadlines, stressing grades and performance, and demanding specific solutions rather than creativity, a decrease in affect, interest, and motivation could occur.

Positive affect may be one of the most powerful predictors of intrinsic motivation. Humor, expressions of enjoyment towards the subject matter, and utilizing kindness and sensitivity can produce a positive atmosphere in the classroom. In contrast, if teachers use threats, sarcasm, and directives, students may become less motivated and may experience negative affect. In addition to providing a positive atmosphere, teachers should also encourage social relationships. Schweinle's research suggests that teachers who allow students to work with their peers will help build cooperation in the classroom and an increased commitment and interest in the subject matter.

Challenge and feeling competent are important for optimal experiences. Teachers support this when they use students' errors as learning opportunities and provide chances for students to show their skill levels. The students' skill levels should match the challenge of class activities to encourage flow experiences. The difficulty level of tasks should increase as student skills increase. If a student maintains low skills and perceives the task as highly challenging, then the student may become anxious and experience negative feelings. To provide an ideal level of challenge, teachers can scaffold tasks, provide adequate time for students to complete tasks, and reduce long-term goals into smaller units, which follows Vygotsky's principles. This could increase the enjoyment of math, lessen anxiety, increase feelings of success, and ultimately create an environment conducive to optimal experiences.

Optimal experience in classrooms is important for students' learning and motivation at the present and also for their future educational plans. Shernoff and Hoogstra found that when students experience cognitive and emotional engagement with a specific topic, the resulting feelings may guide post-high school plans, such as college courses or majors. Further, interest and enjoyment with

certain topics were essential factors for highly engaged students when making career decisions.

In sum, flow theory addresses how students experience educational contexts and how this experience influences learning and motivation. Activities that challenge students, but are still within their ability to accomplish, set the stage for optimal emotional and motivational experiences as well as optimal learning. Within the context of balanced challenge and skill, teachers can also improve the chances of positive experience by supporting autonomy; providing immediate, constructive feedback; encouraging cooperation among students; supporting positive affect; and pressing understanding rather than rote learning.

SEE ALSO *Interest; Intrinsic and Extrinsic Motivation; Piaget, Jean; Vygotsky, Lev Semenovich.*

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FLYNN EFFECT

SEE *Misdiagnoses of Disabilities.*

FOREIGN LANGUAGES, LEARNING AND TEACHING

SEE *Learning and Teaching Foreign Languages.*

FORMATIVE AND SUMMATIVE ASSESSMENT

Assessment is the use of a variety of procedures to collect information about learning and instruction. Formative and summative assessment represent two classifications of assessment, each with a distinct purpose. Formative assessment is commonly referred to as assessment for learning, in which the focus is on monitoring student response to and progress with instruction. Formative assessment provides immediate feedback to both the teacher and student regarding the learning process. Summative assessment is commonly referred to as assessment of learning, in which the focus is on determining what the student has learned at the end of a unit of instruction or at the end of a grade level (e.g., through grade-level, standardized assessments). Summative assessment helps determine to what extent the instructional and learning goals have been met. Formative and summative assessment contribute in different ways to the larger goals of the assessment process.

PROCEDURES USED IN FORMATIVE ASSESSMENT

Formative assessment includes a variety of procedures such as observation, feedback, and journaling. However, there are some general principles that constitute effective formative assessment. Key requirements for successful formative assessment include the use of quality assessment tools and the subsequent use of the information

derived from these assessments to improve instruction. The defining characteristic of formative assessment is its interactive or cyclical nature (Sadler, 1988). At the classroom level, for example, teachers collect information about a student's learning, make corresponding adjustments in their instruction, and continue to collect information. Formative assessment can result in significant learning gains but only when the assessment results are used to inform the instructional and learning process (Black & William, 1998). This condition requires the collection, analysis of, and response to information about student progress.

The most common procedures of formative assessment include the following.

Feedback. A teacher provides oral or written feedback to student discussion or work. For example, a teacher responds orally to a question asked in class; provides a written comment in a response or reflective journal; or provides feedback on student work.

Curriculum-based measurement (CBM). This set of standardized measures is used to determine student progress and performance (Deno, 2001). An example is the use of oral reading fluency (the number of words a student can read correctly during a timed reading of a passage) as an indicator of a student's overall reading ability (Fuchs et al., 2001).

Self-assessment. Students reflect on and monitor their progress. This activity may be performed in conjunction with a CBM, in relation to predetermined academic and behavioral goals, or with learning contracts.

Observation. A teacher observes and records a student's level of engagement, academic and/or affective behavior; develops a plan of action to support that student; implements the plan; and continues to record observations to determine its effectiveness.

Portfolios. A growth portfolio can be used to create a record of student growth in a number of areas. For example, a teacher may use writing portfolios to collect evidence of a student's progress in developing writing skills.

PROCEDURES USED IN SUMMATIVE ASSESSMENT

Summative assessment also employs a variety of tools and methods for obtaining information about what has been learned. In this way, summative assessment provides information at the student, classroom, and school levels. Defining characteristics of effective summative assessment

include a clear alignment between assessment, curriculum, and instruction, as well as the use of assessments that are both valid and reliable. When objectives are clearly specified and connected to instruction, summative assessment provides information about a student's achievement of specific learning objectives.

Summative assessments (or more accurately, large-scale, standardized assessments) are frequently criticized for a variety of reasons: 1) they provide information too late about a student's performance (Popham, 1999); 2) they are disconnected from actual classroom practice (Shepard, 2001); 3) they suffer from "construct underrepresentation" (Messick, 1989), meaning that one assessment typically cannot represent the full content area, so only those areas that are easily measured will be assessed, and hence, taught; and 4) they have a lack of "consequential validity" (Messick, 1989), meaning that the test results are used in an inappropriate way. This last concern is related to state accountability systems because high stakes, such as student retention or teacher performance pay, are attached to performance on state assessment systems, yet most of these assessments have not been designed for the broad and numerous purposes they serve (Baker & Linn, 2004). Nevertheless, summative assessments can provide critical information about students' overall learning as well as an indication of the quality of classroom instruction, especially when they are accompanied by other sources of information and are used to inform practice rather than to reward or sanction. Examples of summative assessment include the following.

End of unit tests or projects. When assessments reflect the stated learning objectives, a well-designed end of unit test provides teachers with information about individual students (identifying any student who failed to meet objectives), as well as provides an overall indication of classroom instruction.

Course grades. If end of course grades are based on specified criteria, course grades provide information on how well a student has met the overall expectations for a particular course.

Standardized assessments. Tests that accurately reflect state performance and content standards provide an indication of how many students are achieving to established grade-level expectations.

Portfolios. When used as part of an evaluation of student learning, portfolios provide evidence to support attainment of stated learning objectives.

Although formative and summative assessments serve different purposes, they should be used ultimately within an integrated system of assessment, curriculum, and instruction. To be effective in informing the learning process, assessments must be directly integrated with theories

about the content, instruction, and the learning process (Herman et al., 2006) and must be valid and reliable for the purposes for which they are used. Summative assessments should be created prior to instruction to capture and identify both the content and process of learning that represent the desired outcomes. In this way, summative assessment can serve as a guide for directing the curriculum and instruction. Performance on summative assessments must serve as a valid inference of instructional quality. For example, teacher grades generally have strong validity when compared to student performance on other academic measures (Hoge & Colardarci, 1989).

Formative assessments are more informal in nature but must also serve as valid indicators of student performance if they are to be useful in informing the teaching process. Curriculum-based measurement represents a standardized process of formative assessment that relies on the use of valid measures of student progress in a given academic area. Additionally, a strong evidence base supports the use of interactive feedback (Black & William, 1998) to increase student achievement.

HOW OUTCOMES INFORM INSTRUCTION AND EDUCATIONAL PRACTICES

A consistent feature of the research findings on formative assessment is that attention to the interactive nature of formative assessment can lead to significant learning gains (Black & William, 1998; Herman et al., 2006). Reviews of research on formative assessment processes support the use of questioning, observation, and self-assessment. Similarly, research has demonstrated positive effects on student achievement with the use of CBM (Stecker et al., 2005). Frequent monitoring of student progress to a determined goal and performance level results in higher achievement for students, particularly when teachers use the data collected to inform their instructional practices (Stecker et al., 2005).

Formative assessment can be most directly used at the individual student level because it measures how a particular student is progressing in the instructional program and identifies where support may be needed. The focus on individual students provides immediate feedback on their progress within the curriculum. Formative assessment may also be evaluated at the classroom level to inform teaching practices because it reveals how many students may be experiencing difficulty. If several students are having difficulty, then perhaps a more general change in instruction is needed. CBM in particular serves in these dual roles, but other types of formative assessment such as portfolios and journals can be used in a similar way.

Summative assessment informs instructional practices in a different yet equally important way as formative assessment.

Critics of large-scale assessments argue that they adversely affect the classroom and remain disconnected from instruction (Shepard, 2001) to the extent that they are not useful in the instructional process. However, summative assessment can serve both as a guide to teaching methods and to improving curriculum to better match the interests and needs of the students. A primary use of assessment data is in planning curricula. For example, if a school's performance on a state assessment indicates high percentages of students who do not meet standards in writing, then the school could collect more information on its writing curricula, student writing performance (through portfolios or other classroom work), and professional development needs for its teachers. After collecting such information, the school may then review and adopt new writing curricula as well as provide professional development to its teachers in order to support stronger student achievement in writing. Ongoing evaluation of the writing program would be conducted through the use of formative and summative assessment. In this manner, when summative and formative assessments are aligned, they can inform the instructional process and support both the daily instructional practices of teachers as well as the longer-term planning of curricula and instruction.

Assessment entails a collection of procedures that inform the learning process. Formative and summative assessment entail integrated components of the larger process of assessment, instruction, and curriculum. However, an ample research base suggests that practitioners have difficulty implementing formative assessments (Marsh, 2007) and responding to data collected through summative assessments (Popham, 1999). When formative assessments are used in conjunction with summative assessment, the potential exists to improve outcomes for all students (Stiggins, 2002), both those meeting a minimum performance standard and all other students across the spectrum. Assessments can only serve this purpose, however, when teachers are supported to implement and respond to the procedures through corresponding adjustments in their instruction (Herman et al., 2006; Marsh, 2007).

SEE ALSO *Criterion-Referenced Tests; Standardized Testing.*

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FRIENDSHIPS

SEE *Peer Relationships: Friendships*.

G

GAGE, NATHANIEL LEES 1917–

Nathaniel Lees Gage is one of the most highly regarded educational psychologists of his time, the editor of the first *Handbook of Research on Teaching* (1963a), the champion of the scientifically based assertion in the field of education (Gage, 1978; 1985), and the “proud papa” of some of the most productive educational psychologists working since the late twentieth century in the United States and Canada.

N. L. Gage was born in New Jersey in 1917, one of two sons of Polish emigrants determined to raise their children as intellectuals. After departing the east coast as a junior in college, Gage completed his bachelors degree at the University of Minnesota, where he majored in psychology and worked in the lab of B. F. Skinner (1904–1990). Upon graduating college in 1938, Gage enrolled in a then new educational psychology doctoral program at Purdue University to work with a professor named H. H. Remmers. Gage and Remmers collaborated for many years until Gage completed his doctorate in 1947.

The career of Gage since that time spans his tenure as assistant and then associate professor at the University of Illinois beginning in 1948, through his presidency of the educational psychology division (Division 15) of the American Psychological Association (APA) in 1960, and his presidency of the American Educational Research Association (AERA) in 1962, to his long and acclaimed university teaching as the Margaret Jacks Professor of Education at Stanford University, where he retired Emeritus in 1987 at age 70. Throughout his career Gage was known to his students as a warm, engaging man, always

present with a smile and a twinkle in his eye. Many of those students simply called their esteemed professor “Nate.”

Three contributions for which Gage is perhaps most widely known are his highly commended editing of the first *Handbook of Research on Teaching*, his ability to produce some of the most prominent professors in immediately succeeding generations of educational psychologists, and his strong writing on the scientific basis of research on teaching. Each of these achievements deserves some elaboration.

The *Handbook*, as it came to be called by students who dog-eared its pages between its publication date of 1963 and the appearance of the second *Handbook* a decade later, is a masterful collection of chapters written by established scholars in education that reshaped the landscape of educational research. The *Handbook* organized a heretofore scattered field both substantively and methodologically, with Gage’s (1963b) own chapter on “Paradigms for Research on Teaching” as a guide. The *Handbook* provided cogent criticism of extant research methods in the field of education and models for addressing key issues in sampling, design, measurement, and data analysis; some chapters of the volume, such as that of Campbell and Stanley on experimental design, were developed into books. It was Gage who secured funding for the *Handbook*, selected its topics and authors, and meticulously edited each and every page. Widespread attention to the *Handbook* gave new promise to diligent empirical work in education, inspiring a generation of scholars to take up the gauntlet in their own careers.

Gage's own chapter in the *Handbook*, which was translated into German, encouraged him to focus his own research efforts into the 1970s on classroom research on teaching. Working at the Stanford Center for Research and Development in Teaching, which he helped to found in 1965, Gage was able to secure federal funding to build and sustain a research team that labored over the next two decades to move from correlational to experimental methods in assessing the validity of process-product models connecting teacher behavior to student learning outcomes in a variety of field-based samples (e.g., Gage, 1967). Gage had a knack for finding promising graduate students to direct and form his teams. Directors were Christopher Clark and John Crawford, who with their teams and Gage produced papers published in archived journals demonstrating the important influence of particular combinations and sequences of instructional behavior in influencing student classroom learning. Some of the students on those teams who have gone on to become APA Division 15 and AERA presidents in their own right, deans of schools of education, and endowed chairs at major research universities in the United States and Canada, include Ronald Marx, Penelope Peterson, Dale Schunk, and Philip Winne.

Other projects Gage completed with prominent educational psychologists include a textbook, co-authored with David Berliner, for teaching educational psychology that ran to six editions (Gage & Berliner, 1998), and book chapters and reports with Theodore Coladarci, Torsten Husen, Barak Rosenshine, and Albert Yee. Gage's closest professional colleague at Stanford was Richard Snow. All of the students mentioned had early successes stemming, in part, from Gage's steady influence Gage, and many have contributed chapters to one or more of the subsequent three handbooks of research on teaching.

The books that Gage wrote arguing cogently for evidence-based assertions in the field of education are often cited as background for a resurgence of this view since 2002. The first book (Gage, 1978), written as a series of sponsored lectures at Teachers College, Columbia University, has been on the basic reading list of doctoral courses in research on teaching since its publication.

Following his retirement, Gage continued to be active in conceptualizing and writing, working on a theoretical extension of his ideas on the "hard gains" still to be made in the field of educational psychology. Gage sought a theory of research on teaching that had solid empirical evidence as a basis, a theory that explained in technical terms how teachers can make a real difference in the lives of their students. In 1985 Gage wrote *Hard Gains in the Soft Sciences*, and since then he has penned articles in several other refereed journals confronting important issues that continue for research on teaching, always championing the warranted assertion,

always defending the usefulness of research to the practicing field of education. This is one teacher who *did* make a difference in the lives of his students; perhaps that explains Gage's lasting commitment to a theory of teacher effectiveness.

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Lyn Corno

GAGNÉ, ROBERT MILLS 1916–2002

Robert Mills Gagné, an education psychologist best known for his book *The Conditions of Learning*, was born in 1916. He received his BA from Yale University in 1937 and went on to earn a PhD (1940) in experimental psychology from Brown University. During a career of 50 years, Gagné held both academic and research and development positions in military training and in human performance. In 1940 he held a position at Connecticut College for Women. He taught at Princeton University from 1958 to 1962 and from 1966 to 1969 at the University of California, Berkeley. Next he taught at Florida State University from 1969 to 1985. During a hiatus from teaching from 1962 to 1966, Gagné served as director of research at the American Institute for Research in Pittsburgh, Pennsylvania. He died in 2002.

As a graduate student in 1964 it was the privilege of this writer to read *The Conditions of Learning* in manuscript. This book was first published in 1965 and appeared in three additional editions (1970, 1977, and 1985). It became perhaps the most important work in instructional design, laying the foundation for a theory- and research-based approach to the design of instructional materials. Gagné's unique approach was founded first in behavioral psychology and later in cognitive processing. The prescriptions Gagné advocated

were all based on theory supported by research in the psychology of learning. This book and the friendship this writer developed with Gagné throughout the remainder of his life had a profound influence on this writer's career in instructional technology.

Many would acknowledge Robert M. Gagné as the father of instructional design, in which area he made three major contributions. First, regarding cumulative learning theory and learning hierarchies, Gagné advocated starting with the final task to be acquired and asking, "What must the learner do to accomplish this task given only directions?" This hierarchical analysis is repeated for each subsequent task until all the prerequisite skills for a given task have been identified. The resulting learning hierarchy provides a map for the subsequent instruction.

Second, Gagné identified five varieties of learning and the internal (cognitive) and external (instructional design) conditions necessary to promote effective and efficient acquisition of each of these different kinds of knowledge and skill. The categories Gagné identified were modified with each edition of *The Conditions of Learning*. The last list included the following intellectual skills: discriminations, concrete concepts, defined concepts, and rules; cognitive strategies; verbal information; problem solving; motor skills; and attitudes. When these conditions of learning are implemented in instructional materials, research shows that the resulting learning is more efficient and effective. Most instructional designers are also familiar with Gagné's third contribution, his nine events of instruction, and have used them as a guide to designing effective lessons. These events are: gaining attention, informing the learner of the objective, stimulating the recall of prior learning, presenting the stimulus, providing learner guidance, eliciting the performance, giving informative feedback, assessing performance, and enhancing retention and transfer.

Jointly Gagné and this writer proposed the notion of integrative goals, bringing together into an integrated whole the different varieties of learning. This author's own work continued into the early 2000s to build on Gagné's contributions with the identification of first principles of instruction, including problem-centered instructional design. An important collection of Gagné's papers and a brief summary of his life can be found in *The Legacy of Robert M. Gagné* (2000), edited by Rita Richey.

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M. David Merrill

GARDNER, HOWARD 1943–

Howard Gardner, a professor at the Harvard Graduate School of Education, is a developmental psychologist best known for his theory of multiple intelligences. The author of more than twenty books and several hundred journal articles, he has also conducted research in fields ranging from arts education to creativity to socially responsible work.

Born in 1943, Gardner grew up in Scranton, Pennsylvania, the son of German-Jewish immigrants who fled Germany prior to World War II. Gardner was an excellent student as well as a talented pianist. He gave up formal study of the piano as an adolescent in order to focus on academics, but his interest in music and the arts has remained an important part of his life and has also influenced his academic pursuits. Gardner graduated from Harvard College in 1965 where he studied with the renowned Erik Erikson, and then he earned his doctorate at Harvard in developmental psychology, during which time he worked with Roger Brown, Jerome Bruner, and Nelson Goodman, among others. Gardner is one of the founding members and remains a senior director of Harvard's Project Zero, a research group established in 1967 and dedicated to the study of cognition, creativity, and the arts. From 1971 to 1991 he also carried out a research program in neuropsychology at the Boston Veterans' Administration Medical Center. In 1986, he was named the John H. and Elizabeth A. Hobbs



Howard Gardner JAY GARDNER ©2003.

Professor of Cognition and Education at the Harvard Graduate School of Education.

Gardner's earliest books such as *The Arts and Human Development* (1973) and *The Shattered Mind* (1975) draw on his empirical investigations in the fields of developmental psychology and neuroscience. He is best known for his 1983 publication *Frames of Mind: The Theory of Multiple Intelligences*. In this work, Gardner laid out his theory that human intelligence is better understood as a multiple rather than unitary construct. Gardner originally conceived of seven distinct intelligences: linguistic, logical-mathematical, bodily-kinesthetic, spatial, musical, interpersonal, and intrapersonal. In the 1990s he added an eighth intelligence: naturalist intelligence. Gardner's work on multiple intelligences has been controversial in the psychology world, but has been enthusiastically embraced by many in the educational community. Multiple intelligences schools, which shape their mission and curricula around the eight intelligences, have sprung up around the world. Hundreds of books have been written in numerous languages about incorporating multiple

intelligences theory into the curriculum. In 2005, Danfoss Universe, a multiple intelligences science and adventure park, opened in Denmark. For his work, Gardner received a MacArthur Genius Prize in 1981 and became the first American to win the University of Louisville's Grawemeyer Award in Education in 1990. He has also received honorary degrees from more than twenty universities in the United States, Ireland, Italy, Israel, Chile, and Korea.

In 1995 with colleagues Mihaly Csikszentmihalyi and William Damon, Gardner began the Good Work Project, which seeks to identify individuals and institutions that carry out work that is excellent in equality, socially responsible, and meaningful to its practitioners, as well as the forces that support and inhibit such efforts. The project has investigated good work in the fields of journalism, medicine, theater, business, law, education, philanthropy, and genetics; its findings have been described in numerous books and papers (see goodworkproject.org). Books co-authored by Gardner that have come out of the Good Work Project include *Good Work: When Excellence and Ethics Meet* (2001), *Making Good: How Young People Cope with Moral Dilemmas at Work* (2004), and *Responsibility at Work* (2007). In 2005 Gardner and several other researchers developed a Good Work toolkit that includes activities and moral dilemmas designed to encourage high school and university students to think critically about what constitutes high quality and meaningful work. Numerous secondary schools and universities have used the toolkit in a variety of ways to encourage reflection about good work.

In 2000 Gardner, Kurt Fischer, and others colleagues at the Harvard Graduate School of Education developed a master's program in Mind, Brain and Education, thought to be the first such program in the world. Since then, similar programs have been founded both in the United States and abroad. Gardner has also continued to write about the mind/brain. In 2004 he published *Changing Minds*, a work about the seven levers of mind-change. In 2007 he published *Five Minds for the Future*, a policy book about the five types of minds Gardner regards as essential for success in the 21st century. As of 2007 he continues to write and speak about the theory of multiple intelligences as well.

SEE ALSO *Intelligence: An Overview; Multiple Intelligences.*

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Scott Seider

GENDER BIAS IN TEACHING

A common response from teachers when asked about gender inequity in classrooms is that they treat all their students the same. There are two problems with this statement. First, students are diverse and have different learning issues, thus treating all students in the same way means that some students will have a better learning experience than their peers. Second, teachers may be ignoring their unconscious gender biases towards their students, their schools and themselves. If ignored, these gender biases, which may have developed from cultural norms, may lead to bias in the classroom.

Gender bias occurs when people make assumptions regarding behaviors, abilities or preferences of others based upon their gender. Because there are strong gender role stereotypes for masculinity and femininity, students who do not match them can encounter problems with teachers and with their peers. For example, the expectation is that boys naturally exhibit boisterous, unruly behavior, are academically able, rational, and socially uncommunicative, whereas girls are quiet, polite, and studious. Girls are also expected to possess better social skills than boys and to excel at reading and the language arts. So girls who present discipline problems for teachers, or quiet, studious boys, may encounter a lack of understanding from peers and teachers. Within the classroom, these biases unfold in students' practices and teachers' acceptance of certain behaviors from one student or another based upon the students' gender. Also, bias due to a person's gender is not mutually exclusive of other social categories such as race, ethnicity, class, religion, and language. For example, some teachers may

perceive African American or other Black girls as loud and uncontrollable because the girls do not exhibit the feminine behaviors associated with White women, such as quiet, self-effacing and malleable.

Gender bias can occur within subject areas and school activities. For example, in subjects such as mathematics and the sciences, there are different participation patterns for girls and boys. Gender bias promulgates a myth that boys are naturally better at mathematics and science than girls. The implications are that if girls succeed in these subjects it is due to their hard work, not their intelligence, whereas boys' success is credited to their natural talent. There are some signs that gender bias in schools may be decreasing in some areas. The percentage of girls participating in science has increased and achieved parity with boys in biology, chemistry and algebra. However, subjects that are prerequisites for college majors such as engineering or physics remain dominated by men. Only 25% of high school students enrolled in physics are female. Moreover, there has been little increase in the percentage of women in engineering programs.

Males are also more likely than females to be in remedial programs, and students' race also impacts these patterns. For example, African American males are more likely than White or female peers to enroll in remedial reading and mathematics courses. And non-White students have a higher representation in vocational and non-college preparatory courses than their White peers. Teachers are critical components in challenging gender bias in schooling, but they also can be major contributors to it as well, through their pedagogical practices, curriculum choices, and assessment strategies.

GENDER BIAS IN TEACHERS

Teachers' unconscious gender biases can produce stereotypical expectations for students' success and participation in the classroom. Teachers view male students' domination of the classroom and their time as typical masculine behavior. However, these biases have consequences for the students and the classroom climate. More than two decades ago, researchers identified and named groups of students who dominated the teacher's time and the classroom resources as "target students" (Tobin & Gallagher, 1987). Target students were typically white and male. They answered most of the teacher's questions and also asked most of the questions. This behavior pattern was particularly insidious in mathematics and science classrooms because teachers did not expect girls to have competent knowledge in these subject areas. Classroom observations documented that target students typically called out answers to the teacher's questions, thus denying other students the opportunity to engage in dialogue

with the teacher or get to grips with the subject matter. Furthermore, because boys are perceived as having natural talent in science, teachers asked boys harder and more complicated questions than girls. If girls attempted to answer more difficult questions than boys and faltered, teachers often repeated the question and asked that another student, typically a boy, provide the answer. However, if a boy failed to answer correctly, teachers reframed the question or broke it into a series of simpler questions that could help the student find the answer. Teachers' unconscious stereotyped gender bias that boys are smarter than girls, especially in mathematics and the sciences, meant they were willing to work with boys to reach the answer because they perceived boys were capable of achieving that goal but girls were not. Conversely, teachers of subjects perceived as feminine will spend more time engaged with girls.

Teachers' gendered perceptions of students' ability is also reflected in the type of praise and expectations they have of their students. Teachers often give girls less meaningful and less critical praise than boys. Boys' work is described as unique or brilliant, while girls' work is often undervalued, critically ignored, and praised for its appearance. This aspect of teachers' behavior is particularly detrimental to girls because it means they do not receive feedback on their work that could help them develop deeper understandings of concepts (Liu, 2006).

Teachers also use target students to maintain the tempo and pace of classroom instruction. For example, in a lecture or whole class discussion when a teacher is posing questions to the class, he or she may encourage target students to call out answers in order to keep the lesson moving, rather than wait for the other students to process the question and provide an answer. This short "wait time" may be detrimental to learning. More than three decades ago, researchers found that if teachers waited three to five seconds before accepting a student's answer, more students became engaged in the classroom and also improved their understanding of the content. Moreover, the longer wait time meant that teachers began to ask more cognitively challenging questions. However, the existence of target students in classes who often call out answers without direction from teachers meant that fewer students, especially girls, engaged in the lessons. In the absence of proactive teacher intervention, these patterns in which males dominate classroom interactions also occur in mixed-gender, small groups.

Target students dominate classroom interactions and exchanges at all education levels. In the early 2000s, researchers identified these same patterns of engagement in a professional development program for science teachers. When alerted to the invasive behaviors of the male teachers in the cohort, faculty began using overt breach-

ing strategies to stop the target students calling out answers, dominating the human and materials resources of the classroom, and showing disrespect to their peers (Martin, Milne & Scantlebury, 2006).

Teachers' gender bias towards students can also extend to their response to students who challenge their authority. Such risk-taking behavior in boys is expected and at times praised, but assertiveness in girls is viewed negatively and labeled unfeminine. Similarly, boys who do not exhibit stereotypic masculine behaviors may be ridiculed (Renold, 2006).

Teachers use gender expectations as a means of maintaining classroom control. For example, teachers will seat undisciplined boys next to girls as a classroom management strategy. Further, teachers use the gendered expectation that girls' nurturing characteristics will lead them to place others' needs before their own. In other words, teachers often ask girls to assume mothering roles towards students who have fallen behind with learning because of inattentiveness, absenteeism through truancy, or in-school disciplinary procedures, and often those students are male.

PEDAGOGICAL CHOICES AND ASSESSMENT PRACTICES

Girls and boys have different educative experiences in classrooms. Target students can dominate lecture-style classes, and most students prefer to learn in groups, using hands-on activities. Group work can engage more students, but teachers must monitor the interactions between students in those groups to ensure all students are participating and that one student is not dominating the group. Students, especially girls, dislike lectures, worksheets and 'busy' work assignments, preferring to study subjects and topics that they perceive as relevant to their lives. However, girls are often relegated to passive roles in the class and in performance-based assessments. Whereas boys use equipment and complete the tasks, girls read the instructions and record results (Scantlebury & Baker, 2007).

Although publishers have reduced gender bias in textbooks, girls are often depicted in passive roles with boys as active participants. Teachers can help to counteract this bias by reviewing classroom texts from a gender perspective and analyzing the hidden curriculum promulgated by these books. Moreover, they can also counteract this message about girls' passivity by highlighting girls' and women's achievements. They can also asking students to critically examine texts for these subtle gender stereotypic messages.

Teachers often use girls as a civilizing influence on male students. Disruptive boys are reassigned to sit near or with girls. Yet little thought is given to the impact that

this strategy has on girls' learning or students' attitudes towards the classroom environment. Rather than expecting boys to exhibit self-control and regulation, when teachers use this practice it reinforces the stereotype that boys are undisciplined, whereas girls are cooperative and orderly. It also implies that boys need looking after, and the girls are cast in a maternal role to do just that.

Gender bias can also occur with the style and type of assessments teachers use. For example, teachers often use multiple-choice questions as the primary format in assessments. Girls are not encouraged to explore risk-taking behaviors and often do not venture a guess on a multiple choice test, even if they are not penalized for incorrect answers. Girls are therefore less likely to complete multiple-choice exams than their male peers because if boys are uncertain or do not know, they will guess an answer. However, when high-stakes tests use a variety of question types, for example, short answer, problem solving, and multiple choice, often gender differences in student achievement disappear (Kahle, 2004).

EFFECTS OF GENDER BIAS

Gender bias can impact students' attitudes towards learning and their engagement with the subject. If affected by gender bias, girls will tend to believe that any success they have is due to hard work rather than any innate talent or intelligence. Boys may be encouraged to believe that success in science and mathematics should come easily to them because of their gender. Some males report dropping out of college science and mathematics programs because they no longer perceive these subjects as easy. Overall, teachers have lower expectations for girls' academic success compared to boys, and their attitudes are shown through the type and quality of the student-teacher interaction. The type and quality of critique teachers give their students can also have an impact. Teachers' comments on girls' work focuses on its appearance but with boys' work teachers focus on the content. Girls often do not receive substantive comments or criticism from teachers from which they could improve their ability to learn. During the many hours spent in classrooms, girls receive less time and attention from teachers than their male peers. Teachers usually ask girls easier questions than they ask boys. Typically, girls receive fewer opportunities to engage in classroom discourse, use equipment and assert their knowledge in classrooms.

REDUCING GENDER BIAS

Gender bias in education is a series of microinequities whose impact is cumulative and often ignored. Girls are rewarded and praised for compliant behavior. Teachers do not challenge girls with questions and rarely offer criticisms of their work. Teachers can reduce and challenge gender bias through an examination of their peda-

gogical practices and by posing simple questions about their practices. For example, which students do they frequently interact with? Are target students evident in their classroom? If so, how does the teacher deal with those students? What questioning techniques does the teacher use to engage students? Does the teacher ask complicated questions to girls as well as boys? Does the teacher use a variety of pedagogical and assessment practices? Which students are engaged with the curriculum?

Another way of reducing gender bias would be for teachers to videotape their classes and review their interactions with the students. Or they could invite a colleague to watch their teaching and record which students are being asked questions and what type of questions. However, teachers must also prepare for the consequences of changing their practices. Girls are conditioned to receiving less of the teacher's attention, and they do not usually cause discipline problems if they are not receiving their fair share, but boys can react negatively to losing the teacher's attention, causing disruption to lessons and becoming discipline problems. Moreover, research has also shown that boys avoid written work and often have poor communication skills when asked to work in single-sex groups.

However, the gains in reducing gender bias in education may disappear with the requirements of high-stakes testing required by No Child Left Behind (NCLB). NCLB requires that states report academic achievement data in most social categories, except gender (Kahle, 2004). This may result in less attention being placed on gender bias and less data that might reveal it. Continued monitoring of gender bias is necessary to minimize its impact on students' opportunities for learning and achievement.

SEE ALSO *Cultural Bias in Teaching.*

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GENDER IDENTITY

Gender identity refers to an individual's identification with a particular gender category; the term encompasses the sense of belonging, attitudes, and values associated with that gender. It can be considered one part of an individual's greater identity or the enduring sense of who one is and what one wants to do. Gender identity is different from sex, which is determined by physiological characteristics of a male or female; it is also different than gender, which is a social determination of what it means to be a man or a woman. In other words, an individual may be biologically female and viewed by society as a woman but may not necessarily identify strongly with the roles, attitudes, and values that most people in society associate with being a woman.

MODELS OF GENDER IDENTITY

Much of the work on gender identity borrows heavily from research on gender roles and gender schema theory, associated with Sandra Lipsitz Bem. In Bem's theory, strong sex role identification leads to the acquisition of attitudes and behaviors in line with that role. Within this theory, individuals of either gender can take on masculine or feminine roles. Moreover, some individuals display a combination of masculine and feminine roles, while others do not identify with either set of roles. Bem would refer to the former group as androgynous and to the latter group undifferentiated.

Similarly, Janet Taylor Spence refers to differences between instrumental traits and expressive traits, which are similar in concept to Bem's masculinity and femininity, respectively. Spence argued, however, that such a unidimensional view was not enough to fully capture gender identity. She advocated instead for a multidimensional view of gender identity, with each dimension having unique developmental components and correlates. Further work on such a multidimensional conceptualization, by Susan Egan and David Perry, identified four factors based on previous gender research: knowledge of membership in a gender category, feelings of compatibility with gender, feelings of pressure to act in accordance with the gender's roles, and ingroup bias toward the gender. Knowledge of membership refers to the individual identifying of oneself as a man or a woman. Compatibility refers to the extent an individual feels like a typical

member of one's gender and even the extent to which one feels content with the gender assignment. Pressure refers to the extent to which an individual perceives parents, peers, and self as wanting the individual's self to conform to gender stereotypes. Finally, ingroup bias refers to the extent to which individuals prefer the gender with which they identify opposed to the other.

DEVELOPMENTAL CHANGES IN GENDER IDENTITY

Much of the research on the development of gender identity focuses on the development of gender constancy or sustained knowledge of one's sex. Between the ages of two and a half years and six years, children develop a sense of gender constancy. This means that by the age of six, children are able to answer the question, "are you a boy or a girl?" and realize that this answer does not change over time or with differences in appearance (e.g., a boy who wears a pink dress is not suddenly a girl).

Views on the development of additional characteristics of gender identity vary depending on whether one takes a unidimensional or multidimensional perspective on the construct. With a unidimensional view, the understanding of sex roles comes from the discovery of gender constancy, as children learn what is and is not appropriate for their gender. This view of learning and internalizing sex roles is addressed thoroughly using social cognitive theory. It is more difficult to summarize the development of specific dimensions of gender identity in the multidimensional perspective because each dimension has its own trajectory of growth and correlates.

Regardless of which perspective one takes when discussing gender identity, its development remains a salient issue among adolescents. Traditionally, during adolescence individuals begin coming to terms with their overall identities. As adolescents begin assessing who they are and what their roles in the world will be, they have questions regarding the extent to which they are aligned or not with gender-stereotypic behaviors. Just as research shows the importance of a strong general identity in positive psychosocial development, a strong gender identity is also associated with positive psychosocial outcomes. Gender identity need not be sex-stereotypical to be strong; rather, individuals with strong, positive gender identities are confident in who they are and have social support for their identity.

GROUP DIFFERENCES IN THE DEVELOPMENT OF GENDER IDENTITY

The general pattern of gender identity development may differ across groups. Most notably, several theorists have focused specifically on the development of gender identity

among women. The work of Carol Gilligan on identity development in females, while not specifically related to gender identity, has several implications in this area. Gilligan's theory states that as girls enter adolescence, they must come to terms with the silent role of women in the social world. Often, this is accompanied in adolescence by a time when girls silence their thoughts and identity. Several theorists have similarly proposed models, specifically for the development of gender identity among women, referred to as feminist or womanist identity theories. These theories focus on the importance of reconciling negative social views of women with individual attitudes and values.

In addition, several studies have concentrated on the extent that race and ethnicity moderate the development of gender identity. Much of this work focuses on African American children and adolescents and has found that negative stereotypes associated with being a Black boy or girl are a risk to positive gender identity development. Some researchers have amplified these general findings by asserting more specifically that stereotypes of the perfect boy or the perfect girl are often White; therefore, the negative outcomes among racial-minority adolescents come from a desire to oppose this standard. Positive identity development is achieved by guiding these adolescents toward more prosocial ways of opposing this standard of perfection.

Another line of research focusing on racial/ethnic variation in the development of gender identity addresses the relationship between gender identity and positive psychosocial outcomes. One such study found that several dimensions of gender identity related to positive psychosocial development for White adolescents were not related for African American adolescents. Among Hispanic students, stronger gender identity was related to negative development for females but related to positive development for males. More research in this area is needed to understand why these differences occur.

GENDER IDENTITY AS RELATED TO SCHOOL OUTCOMES

Compared to the literature on gender differences in school outcomes, research specifically related to gender identity is lacking. However, the consideration of gender identity is important for more fully understanding observed gender differences in many school-related outcomes.

One line of research relating gender identity to academic outcomes focuses on achievement motivation, and in particular on self-efficacy and stereotype threat. First relating to self-efficacy, some research shows that students with more masculine or androgynous orientations have higher levels of general and academic self-efficacy than do students with feminine or undifferentiated orientations, regardless of gender. Other studies suggest that this rela-

tionship between gender identity and self-efficacy may be more subject-specific. For example, some research has found that feminine-oriented students hold higher self-efficacy in writing.

The consideration of gender identity in relation to achievement motivation also has implications for research on stereotype threat or the decrease in achievement when faced with the possibility of confirming a negative belief about one's ingroup. Studies find that female students' mathematics performance diminished when confronted with a threatening gender-related stereotype. Together, research on self-efficacy and stereotype threats approach gender differences in performance as due to enhanced efficacy or anxiety resulting from the requirement of characteristics that are supposedly like or unlike the individual. Improving performance then becomes a matter of persuading students that they can succeed in any subject regardless of their gender.

Additional research focuses on the interaction between students' gender identities and their identities as students. According to research in this area, students view the perfect male and female students differently. The ideal female student is beautiful and does not have to work too hard at being smart; the ideal male student is loud and funny. At the same time, ideal male and female students are good at different subjects, with the ideal male student excelling in the sciences and the ideal female student excelling in the arts. Male students hold the most gendered views of good students and are less likely to report liking non-conforming students. This line of research has implications for understanding both how the social context of schools shape gender identities and how students with non-conforming gender identities perform and are accepted in school.

SEE ALSO *Gender Role Stereotyping.*

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Carolyn Barber

GENDER ROLE STEREOTYPING

Gender role stereotyping occurs when a person is expected to enact a series of norms or behaviors based upon their sex. Gender is a social construction, and other social categories such as race, ethnicity, class, religion, and language also influence that construction. In most European and North American societies, gender roles divide through male and female behavioral norms. Certain types of behaviors are categorized as masculine or feminine. However, gender as a continuum is social and relational, rather than categorical. In other words, gender only exists as a comparative quality (if people are “less masculine” than others, they are also “more feminine” than those same others, even if their biological sex is the same). Thus gender role stereotyping occurs when individuals are expected to enact certain practices or behaviors because of their gender.

Although girls’ schooling experiences vary depending upon their socioeconomic status, geographic location, ethnicity, and/or disability (AAUW, 1998), many schools, and other educational institutions, reinforce and support gender stereotyped roles. Moreover, schools operate through the interactions of groups and individuals, and how students and teachers construct gender in the classroom impacts the learning environment. Two decades after Title IX of the Elementary and Secondary Education Act legislation

banned sex discrimination in education programs and activities, public schools still exhibited bias against girls. In 2005, comments by the then-president of Harvard University Lawrence Summers suggesting that innate sex differences may contribute to fewer female faculty in the sciences resulted in national and international discussions on how cultural factors are more likely to explain women’s participation in science than biological differences between females and males.

The gender role stereotypes that schools help to reproduce include the notion that girls are caring, nurturing, quiet, helpful, considerate of others, and place others’ needs before their own. Academically able girls’ achievements are attributed to their hard work, whereas successful boys are considered naturally gifted. In contrast, underachieving male students are considered lazy, whereas underachieving girls are regarded as not capable. Boys are viewed as rational, logical, unemotional, and strong and are also expected to be outgoing, smart, and naturally academically talented. Thus in schools, gender role stereotypes attribute males’ academic success to innate intelligence and girls’ achievements to hard work. Moreover, these gender differences are explained through biological differences without any consideration of the impact of social environment on students’ learning, achievement, motivation and attitudes.

GENDER ROLE STEREOTYPES AND STUDENT TEACHER INTERACTIONS

Gender role stereotypes also influence classroom interactions between teachers and students. First, students who dominate the classroom, answering and asking most of the questions, and using the available resources, are called target students. Regardless of the schooling level, target students are typically White males. Teachers predominantly ask White male students more and harder questions than any other group of students because these students are viewed as inherently smart. If a target student fails to answer a question, teachers will often reword or reconstruct the question, breaking a difficult question into a series of simpler questions to attain the answer. If other students are unable to answer a question teachers typically move on, usually to a target student.

Overall, boys are more likely than girls to answer teachers’ questions. Often they call out answers, a risk-taking behavior expected of males, and seek the teacher’s attention. In contrast, girls are more likely to receive criticism rather than praise for such risk-taking behavior. Teachers reward girls for being compliant, quiet, and helpful, which are stereotypic feminized behaviors. These behaviors in girls are also associated with White culture. Thus African American girls, whose socialization encourages assertive behavior,

are often at odds with teachers who deem practices such as asking questions before being acknowledged, and non-compliance, as unfeminine.

INFLUENCE OF GENDER ROLE STEREOTYPES ON SCHOOL SUBJECTS

The accepted and encouraged assertive behavior in males that produces target students also enables boys to control other resources. For example, in science classes boys dominate equipment and relegate girls to roles such as data recorder, reading instructor, or cleaning up the work area. Girls' stereotyped views of science as a masculine endeavor may mean they prefer these passive roles. However, laboratory work can be an important facet of learning science and if girls are disengaged or relegated to peripheral roles they may not fully focus on the subject matter.

Recent data shows that there are equal numbers of girls and boys enrolled in high school science classes, with the exception of physics and Advanced Placement science courses (Scantlebury, 2006). Girls prefer studying subjects that they perceive as having value, being connected to people or other living things and having relevance in their lives. Often science is taught without an emphasis on how the subject connects to the "real" world. Boys are viewed as less able than girls in reading and the language arts, subjects that are stereotyped as feminine.

MOTIVATIONAL AND BEHAVIORAL CONSEQUENCES OF STEREOTYPING

The acceptance of gender-stereotyped roles as normal behaviors, with boys being rewarded for assertive behavior, uniqueness, and risk-taking, and girls for nurturing, conformity, and placing others' needs before their own, is often invisible to students and teachers. Moreover, participants in classrooms do not notice how the subtle inequities that are the outcomes of these behaviors impact students' motivations and behaviors. For example, the expectation that girls place others before themselves has consequences regarding their attitudes towards success in school. Girls' motivation for succeeding in school is often related to pleasing others, such as parents and teachers, rather than themselves. They report doing well in classes because of a personal, positive connection with their teachers. However, that personal connection is often missing in first-year, college-level classes when they become merely one student in classes of several hundred. As young college women they may struggle with their studies because there is no one person to achieve for, and they are not used to achieving for themselves.

Girls' preference for a positive, personal connection with their teachers can also influence their course selection. For example, young women may avoid advanced mathematics or science because they dislike the teacher. Another consequence of gender stereotyping for girls is learned helplessness. When girls struggle with learning material, teachers often give them the answer, promulgating a status of learned helplessness. In other words, because they are given the answers, girls learn that they are not capable of learning.

For females, placing others first is an important characteristic of a caring, nurturing person. A consequence of this practice is girls' fear of success. Girls often may not succeed in their academic achievements because to do so may be viewed as unfeminine, which may reduce their attractiveness to boys.

For males whose achievement is attributed to their natural intelligence, problems arise when this natural ability is no longer a guarantee of success. They perceive themselves as failures and often change majors instead of addressing their fear of failure by re-examining study habits and patterns.

Gender role stereotyping impacts students' perceptions of their abilities and their achievements. Similarly, research has shown that teachers' and parents' expectations of students' abilities, achievements and behaviors are influenced by gender role stereotyping. Gender role stereotyping is usually subtle, and often unrecognized or unchallenged. The assumption that girls should assume feminine traits in school such as caring for others, and quiet and unassertive behavior, can mean that they set aside their own learning needs for others. For boys, the masculine gender role stereotype suggests that they should have natural talent to achieve, and that they are expected to exhibit rationality and logic as well as loud, domineering behaviors.

Gender role stereotypes remain strong influences in society, schools and the daily life in classrooms. Yet inequities because of gender issues are often rendered invisible to students and teachers by their very pervasiveness in classrooms. A major challenge for educators is to establish classroom environments that do not favor one group of students to the detriment of another group, and recognize that gender role stereotypes remain a major influence on schools' organization, teachers' practices and students' attitudes and behaviors.

SEE ALSO *Gender Bias in Teaching; Stereotype Threat.*

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GIFTED EDUCATION

In the most recently released federal report, as of 2007, titled *National Excellence, A Case for Developing America's Talent* (O'Connell-Ross, 1993), a quiet crisis is described related to the education of gifted and talented students in the United States. The report asserts: "Despite sporadic attention over the years to the needs of bright students, most of them continue to spend time in school working well below their capabilities. The belief espoused in school reform that children from all economic and cultural backgrounds must reach their full potential has not been extended to America's most talented students. They are underchallenged and therefore underachieve" (p. 5).

DEFINING GIFTEDNESS

For many years, psychologists and psychometricians, following in the footsteps of Lewis Terman in 1916, equated giftedness with high IQ. In the early 2000s, this legacy is beginning to dissipate, but in some states, giftedness is still defined as an IQ of 130 or above, and this type of score is required for identification of gifted students. Research, however, from 1975 to 2005 supports a broadened conception of giftedness (Sternberg & Davidson, 1986; 2005). Most of these researchers define giftedness as a combination of multiple qualities; in addition to intellectual factors, such features as motivation and creativity are considered key qualities in many of these broadened conceptions of giftedness.

Bloom and his associates at the University of Chicago engaged in a study of the development of talent in children, examining the processes by which young people under 35 who reached the highest levels of accomplishment in academics, the arts, and sports developed their capabilities. Bloom and his associates found that the following factors play a role in the development of talent: the home environment, which develops the work ethic and the importance of doing one's best at all times; the encouragement of parents in a highly approved talent field; the involvement of families and teachers; and the presence of achievement and progress, which are necessary to maintain a commitment to talent over a decade of increasingly difficult learning (Bloom, 1985, pp. 508-509).

The importance of development throughout the lifespan of the individual is reinforced by most developmental and educational psychologists who study giftedness, as is the domain-specific nature of giftedness. Gifted individuals are seen as those who can excel usually in one domain, providing that the environmental factors enable this excellence to develop.

Joseph Renzulli's (1978) three-ring definition of gifted behavior is a widely recognized example of a multifaceted and expanded conceptualization of giftedness. Renzulli (1978; 1986; 2005) defines gifted behaviors as composed of three components as follows.

Gifted behavior consists of behaviors that reflect an interaction among three basic clusters of human traits above average ability, high levels of task commitment, and high levels of creativity. Individuals capable of developing gifted behavior are those possessing or capable of developing this composite set of traits and applying them to any potentially valuable area of human performance. Persons who manifest or are capable of developing an interaction among the three clusters require a wide variety of educational opportunities and services that are not ordinarily provided through regular instructional programs (Renzulli & Reis, 1997, p. 8).

The U.S. government subscribed to a multifaceted approach to giftedness as early as 1972 when the Marland Report definition was passed (Public Law 91-230, section 806) (Marland, 1972). This U.S. Department of Education definition has dominated most states' definitions of giftedness and talents. As of 2007 the federal definition, cited in *National Excellence*, the national report on the status of gifted and talented education, is as follows:

Children and youth with outstanding talent perform or show the potential for performing at remarkably high levels of accomplishment when compared with others of their age, experience, or environment. These children and youth exhibit high performance capability in intellectual, creative, and/or artistic areas, possess an unusual leadership capacity, or excel in specific academic fields. They require services or activities not ordinarily provided by the schools. Outstanding talents are present in children and youth from all cultural groups, across all economic strata, and in all areas of human endeavor. (O'Connell-Ross, 1993, p. 26)

Though many school districts adopt this or other broad definitions as their district's operational definition, most focus solely on intellectual ability when both identifying and serving students, and few provide programs for students with talents and gifts in the areas of creativity, the arts, leadership, and specific academic fields.

Common themes that emerge in any discussion of how to define giftedness include the need to identify the domain that serves as the basis of one's definition, whether individual or societal; the essential role that cognitive abilities and motivation play in giftedness; the importance of the developmental course of one's talents for whether or how they are expressed; and the inevitability of how one's abilities emerge and interact with educational, societal, and chance factors.

ASSESSMENT AND IDENTIFICATION OF GIFTEDNESS

Assessment and identification of gifted and talented students occurs using various methods and instruments that vary from state to state. Students are usually identified for gifted programs based on assessments of their abilities and achievement, and their creativity and motivation are often considered as well. In most school districts, an attempt is made to use multiple criteria for identification of students involving nationally normed standardized tests, as well as other measures of academic achievement, creativity, and motivation.

Classroom teachers usually nominate students for gifted programs, and children are usually referred on an ongoing basis. In addition to teacher nomination, many districts accept nominations from the student (self-referral), the parent, a peer, or from others, such as a psychologist, community members, principal, or a gifted students' coordinator. The following are usually used for assessment: group aptitude or achievement tests; various assessments of creativity or motivation; individually administered tests; auditions or performances; displays of work; and teacher or parent checklists or rating scales.

Identification of students for gifted and talented programs is usually completed using a comprehensive assessment of the child's abilities and potentials rather than simple IQ testing. The rationale for assessment typically centers on the need for developing an understanding of a child's relative strengths and how these relate to educational settings and matching children's strengths with appropriate educational programs.

There are usually three stages in the identification process. The first is nomination, which includes gathering student data from a variety of sources, including teacher, parent, and peer nominations; grades; portfolios; observations; review of student records; and outstanding products or performances. All students are involved in the pre-assessment pool to ensure equal access to screening and further assessment by all district children, including culturally or linguistically diverse children, children from low socioeconomic backgrounds, children with disabilities, and children for whom English is a second language.

The second stage is usually screening when the data gathered from the pre-assessment stage is examined to

<p>Behavioral manifestations of giftedness according to Renzulli's "Three-ring" definition of gifted behaviors</p> <p>Above average ability (general)</p> <ul style="list-style-type: none"> • high levels of abstract thought • adaptation to novel situations • rapid and accurate retrieval of information <p>Above average ability (specific)</p> <ul style="list-style-type: none"> • applications of general abilities to specific area of knowledge • capacity to sort out relevant from irrelevant information • capacity to acquire and use advanced knowledge and strategies while pursuing a problem <p>Task commitment</p> <ul style="list-style-type: none"> • capacity for high levels of interest, enthusiasm • hard work and determination in a particular area • self-confidence and drive to achieve • ability to identify significant problems within an area of study • setting high standards for one's work <p>Creativity</p> <ul style="list-style-type: none"> • fluency, flexibility and originality of thought • open to new experiences and ideas • curious • willing to take risks • sensitive to aesthetic characteristics <p>SOURCE: Adapted from Renzulli & Reis, 1997, p. 9.</p>

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

determine if additional assessment is necessary. In making decisions about additional assessment, existing test data for students is not the sole determining criterion. School personnel examine all available information about a student to determine if an evidence of possible giftedness exists for that student, and they conduct necessary additional assessment.

The third stage is final identification, when additional assessment has been completed, the data obtained throughout the stages of identification are evaluated, the identification decision is made, and student's educational needs are determined. The most important part of identification is to consider the purposes for identification and the match with the resulting program.

CHARACTERISTICS OF GIFTEDNESS

Multiple lists of characteristics of giftedness exist but the most common characteristics are summarized below using Renzulli's definition of giftedness in Table 1.

PROCEDURES TO MEET THE NEEDS OF GIFTED AND TALENTED STUDENTS

Renzulli and Reis (1997) recommend the development of a continuum of services to challenge the diverse learning

and affective needs of gifted and talented students. This continuum provides services that range from general enrichment across all grade levels, to curriculum differentiation opportunities for both enrichment and acceleration, to advanced classes and individualized research, as well as counseling and other services to meet affective needs. Two considerations exist when a district-wide continuum of services for academically and artistically gifted and talented students is developed.

The first consideration is organizational, relating to where and when students will be provided with services to meet their advanced learning needs and how and when different grade level students will be grouped together in or across different schools. For example, gifted and talented students can be grouped by instructional level in both elementary and middle schools. They can be cluster grouped in one or more content areas across classrooms and assigned to classes with teachers who have had professional development and use strategies to meet their learning needs. Separate classes can be provided for gifted students at any grade level. Interventions to attempt to reverse underachievement can be incorporated into counseling options either during or after school at the high school level. Students can have opportunities for advanced project work after school or during a time that their curriculum has been compacted. The second consideration in the development of a district-wide continuum of services relates to curriculum and learning opportunities, as decisions must be made about what will be taught and why and whether acceleration opportunities will be made available. Other questions to consider include whether the regular curriculum will be extended with enrichment or whether it will be compacted and replaced with teacher-selected advanced content and whether students will have the opportunity to pursue their personal interests using independent study.

Both of these considerations should be addressed as a continuum of services is developed. If organizational structures are the only component addressed in a district-wide continuum of services, little thought will have been extended to essential instructional and curricular decisions. For example, if students are grouped into a separate class for gifted students without any advanced or accelerated curriculum or instruction, little justifiable reason exists for that instructional grouping. If a large percentage of gifted students are underachieving and are not able to participate in advanced classes or are dropping out of school, an expansion of a district continuum of services should be considered to include more affective and counseling services.

Establishing opportunities for enrichment across the grade levels and differentiation in all classrooms are one way to begin the development of a continuum of services

that range from some level of service in the regular classroom setting to a separate school or center for gifted learners. School-based gifted programs should offer a diverse set of learning opportunities. Resource room programs enable teachers to send out students from their regular classrooms to spend time with other high potential students to enable them to work on in-depth, advanced independent study projects and group projects in their interest areas. In some districts, students have the opportunity to travel to a center one day each week to work with other identified gifted and talented students on advanced curriculum or to pursue individual interests.

Curriculum compacting and differentiation is also suggested to accommodate the learning needs of advanced students. In a national study on compacting, the use of compacting to differentiate curriculum and eliminate previously mastered work was used with hundreds of gifted and high-ability students. Compacting is one component of the Schoolwide Enrichment Model (SEM) (Renzulli, 1977; Renzulli & Reis, 1985, 1997) that is widely implemented as an enrichment program used with academically gifted and talented students. This talent development approach provides enriched learning experiences and higher learning standards for all children through three goals; developing talents in all children, providing a broad range of advanced-level enrichment experiences for all students, and follow-up advanced learning for children based on interests. This SEM focuses on enrichment for all students through engagement, in enjoyable, challenging learning experiences and enhancement of students' interests.

Renzulli Learning, a 2006 innovation to challenge gifted and talented learners in classrooms and in separate gifted programs, is an online system designed to use strength-based assessment and differentiated learning experiences for gifted and talented students. The online assessment, which takes about 30 minutes, results in a printed profile that highlights individual student strengths and is accompanied by a differentiation search engine that selects hundreds of resources that relate specifically to each student's interests, learning styles, and product styles.

VARIATIONS IN GIFTEDNESS

Unfortunately, the majority of young people participating in gifted and talented programs across the country continue to represent the majority culture, most likely because identification and selection procedures may be ineffective and inappropriate for the identification of these young people (Frasier & Passow, 1994). Limited referrals and nominations of students who are minorities or from other unrepresented groups affect their eventual placement in programs. Test bias and inappropriateness

have been mentioned as reasons for the continued reliance on traditional identification approaches.

In addition to students from economically disadvantaged populations, variations in gifted students include students from minority and cultural groups, as well as gifted students with various disabilities such as learning disabilities, visual and hearing impairments, and physical handicaps. Special programs, strategies, and identification procedures have been suggested for many of these groups; however, much progress still remains to be made to achieve equity for these underrepresented groups. Baum (1990) has identified four important approaches for handling gifted students with learning disabilities: encourage compensation strategies, encourage awareness of strengths and weaknesses, focus on developing the child's gift, and provide an environment that values individual differences.

Underachieving gifted learners, especially young people with high ability, whose performance fall noticeably short of potential, present the most bewildering and perhaps the most frustrating of all challenges to teachers and parents. One cause of underachievement in gifted or high potential students is the inappropriate curriculum and content which some of them encounter on a daily basis. The hundreds of hours spent each month in classrooms in which students rarely encounter new or challenging curriculum, the boredom of being assigned routine tasks mastered much earlier, the low levels of discussion, and the mismatch of content to students' ability lead to frustration on the parts of many of the brightest students. Reis and McCoach (2000) identified specific characteristics of gifted underachievers and recommended numerous strategies that can be used to reverse underachievement of gifted and talented students. This research may provide helpful insights for educators regarding the performance of some of their underachieving gifted students.

SEE ALSO *Intelligence: An Overview; Special Education.*

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Sally M. Reis
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GILLIGAN, CAROL 1936-

Carol Gilligan, the author of *In a Different Voice*, is noted for her work in moral reasoning, gender differences, and feminine psychology. She was born in New York City in 1936, the daughter of William Friedman, a successful lawyer, and Mabel Caminez Friedman, a humanitarian. After attending the prestigious Walden School throughout grade school and high school, she studied literature at Swarthmore and graduated *magna cum laude*. She went on to Radcliff University to earn a master's degree in clinical psychology. At age 28 she earned her PhD in social psychology from Harvard with a dissertation entitled "Responses to Temptation in Analysis of Motives."

NOTABLE COLLABORATORS

Gilligan taught as an adjunct professor at the University of Chicago while her husband finished medical school. Years later, she returned to Harvard to work with Erik Erikson. She appreciated Erikson's concern that social scientists should contribute to the social issues of the day. However, she was frustrated that he, like so many other researchers of the day, felt that the feminine perspective had to be ignored because of the complications of mixed gender studies. In working with Lawrence Kohlberg, Gilligan recognized the seriousness of ignoring the feminine perspective. She noted



Carol Gilligan © JERRY BAUER.

that although Kohlberg's research on moral development and his stage theory of moral development, justice, and rights was impressive, the conclusions could only be applied to the population of privileged boys and men that Kohlberg's sample represented. After establishing her theory of gender differences in moral reasoning, Gilligan collaborated with Lyn Mikel Brown in developing the Harvard Project on Women's Psychology and Girls' Development and in writing the book *Meeting at the Crossroads: Women's Psychology and Girls' Development*. Brown has since become recognized as an expert on feminine psychology, particularly aggression in girls.

MAJOR CONTRIBUTIONS TO THE FIELD OF EDUCATIONAL PSYCHOLOGY

Gilligan has made two major contributions to the field of educational psychology. First is her discovery of a moral reasoning based on the ethics of care, which complements Kohlberg's morality based on the ethics of justice. Her second contribution is identifying the self-silencing of a young person's authentic voice in surrender to the expectations of society.

The recognition of a morality of care and responsibility grew out of Gilligan's work with Kohlberg. Gilligan recognized that the participants in Kohlberg's norming groups were all privileged males. This meant that any viewpoints of female participants would be compared to a collective male perspective. Gilligan noticed that when a woman, in analyzing moral dilemmas, voiced a judgment based on caring for others, her response was rated lower than a man's response based on justice. Gilligan noticed a pattern in the women's responses that was divergent from the pattern of male responses. The males in the study were focused on justice, an adherence to law emphasizing the rights of individuals. The females in the study were focused on compassion, an awareness of relationships emphasizing a responsibility toward others. Although later researchers have not found the gender differences in moral reasoning that Gilligan did, the concept of an *ethic of care* is well accepted and found in moral reasoning regardless of gender.

Gilligan discovered and validated over many years that girls tend to lose their authentic voice, the true expression of their ideals, during puberty. At age 11, a girl will tell her point of view no matter how controversial, but by age 15, she has learned to suppress it. Gilligan attributes this tendency to the young woman's confrontation with the "patriarchy," the male-dominant society. In studies with boys, Gilligan has found that boys also suppress their authentic voice but at a younger age.

MAJOR IMPACT

The major impact of Gilligan's work on psychological research is the inclusion of women as participants in studies generalized to a mixed-gender population. This has led to increased interest in feminine psychology and the inclusion of gender differences as an important part of all psychological studies. Gilligan's work has brought about a revolution in psychological research so complete that it is hard to remember a time when studies with only males as the participants were used to generalize to women's situations.

SEE ALSO *Moral Development*.

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Ray Brogan

GOAL ORIENTATION THEORY

Goal orientation theory is a social-cognitive theory of achievement motivation. Goal theory originated early in the 20th century but became a particularly important theoretical framework in the study of academic motivation after 1985. Whereas other motivational theories (e.g., attribution theory) examine students' beliefs about their successes and failures, goal orientation theory examines the reasons why students engage in their academic work. Although goal orientation theory is predominantly studied in the domain of education, it also has been used in studies in the domains of sports psychology, health psychology, and social psychology.

TERMINOLOGY

In order to understand the basic properties of goal orientation theory, it is important to understand how goals are conceptualized in the research literature (Pintrich, 2000). First, in this framework, goals fall in two major classes. These classes have been referred to by various names in the literature, but for the sake of simplicity, two terms are used in this entry. The first type is called a mastery goal. Students hold mastery goals (also referred to as being mastery-oriented) when their goal is to truly understand or master the task at hand; students who are mastery-oriented are interested in self-improvement and tend to compare their current level of achievement to their own prior achievement. In contrast, the second type is called a performance goal. Students hold performance goals (also referred to as being performance-oriented) when their goal is to demonstrate their ability compared to others. Students who are performance-oriented are

interested in competition, demonstrating their competence, and outperforming others; they tend to use other students as points of comparison, rather than themselves.

Second, mastery and performance goals are each divided into approach and avoid goals. In terms of mastery goals, mastery-approach oriented students are interested in truly mastering an academic task; in contrast, mastery-avoid oriented students are interested in avoiding misunderstanding the task. In terms of performance goals, performance-approach oriented students are interested in demonstrating that they are more competent than other students (i.e., have more ability than others); in contrast, performance-avoid oriented students are interested in avoiding appearing incompetent or stupid. Below are examples for each type of goal orientation:

Mastery approach: Jennifer's goal in French class is to become fluent in the language because she is interested in the language and wants to be able to converse with others and read French literature.

Mastery avoid: Jason's goal in French class is to avoid misunderstanding the grammatical lessons presented by his teacher.

Performance approach: Haley's goal in French class is to demonstrate to her teacher and to other students that she is better at speaking French than many of her classmates.

Performance avoid: T.J.'s goal in French class is to avoid appearing incompetent at speaking or reading French.

It is important to note that students can hold multiple goals simultaneously; thus it is possible for a student to be both mastery-approach oriented and performance-approach oriented; such a student truly wants to learn and master the material but is also concerned with appearing more competent than others.

In addition, some researcher have operationalized performance goals somewhat differently and referred to them as "extrinsic goals" (Anderman & Johnston, 1998; Pintrich & de Groot, 1990). When students hold an extrinsic goal, their reasons for engaging in academic tasks are to either earn a certain reward (e.g., a good grade) or to avoid a punishment.

Third, students' goals can be conceptualized at differing organizational levels. Personal goals refer to students' individual, personally held goals; the types of mastery and performance goals described above are examples of personal goals. In contrast, classroom goal structures refer to students' beliefs about the goals that are emphasized by their teachers in their classrooms. Most researchers distinguish between a classroom mastery goal structure and a classroom performance classroom goal structure; however,

most do not make the approach/avoid distinction with classroom goal structures. When students perceive a classroom mastery goal structure, they believe that instruction in the class is characterized by emphases on improvement, learning new material to a level of mastery, and self-comparisons; when students perceive a performance goal structure, they believe that the class is characterized by competition, an emphasis on grades and relative ability, and outperforming others.

Some researchers also discuss school-level goal structures. A school can be perceived by students as being mastery oriented (i.e., the culture of the school focuses on learning, improvement, and task mastery) or as being performance-oriented (i.e., the culture of the school focuses on grades, achievement, competitiveness, and outperforming others).

MAJOR RESEARCH METHODS AND MEASUREMENT TOOLS USED TO TEST GOAL THEORY

Much research examining goal orientations has used self-report survey instruments. Students are asked to complete surveys that assess students' personal goals, and their perceptions of classroom and/or school goal structures. Some researchers collect survey data at one point in time in order to get a snapshot of students' goal orientations, whereas others collect survey data at multiple time points, in order to examine changes in goals and perceived goal structures.

There are many existing survey-based measures of goal orientations. One of the most commonly used measures is the Patterns of Adaptive Learning Survey (PALS; Midgley et al., 1998). The PALS contains measures of students' personal goals, as well as their perceptions of classroom goal structures. These measures have been used with a wide range of age groups, including young children, adolescents, and college-aged students. Other measures, such as the AGQ of Elliot and colleagues (Conroy, Elliot, & Hofer, 2003) and measures developed by Dweck (e.g., Dweck, 1999) also can be used to measure students' goal orientations across a variety of domains. Most survey measures of achievement goals assess students' reasons for engaging in academic tasks; however, Nichols and his colleagues conceptualized their measures of goal orientations in terms of how students feel about learning (Nicholls, 1989).

Some researchers have used other methodologies to examine goals. For example, Patrick, L. Anderman, and their colleagues developed an observational instrument that can be used by observers to assess goal structures in classrooms (Patrick, Anderman, Ryan, Edelin, & Midgley, 2001). Turner, Meyer, and their colleagues have examined transcripts of teacher-student discourse to

examine how goals are communicated to students by teachers (Turner et al., 2002).

INDIVIDUAL AND CONTEXTUAL INFLUENCES ON DEVELOPMENT OF GOALS

Motivation researchers who study goal orientations acknowledge that both students' individual characteristics and contextual influences affect the types of goals that students adopt in various learning environments. Studies indicate that the environments in which students learn influence students' goal orientations in important ways.

Individual Differences Studies that have examined gender differences in goal orientations have produced mixed results. Many studies that have examined gender have found that males tend to report being more performance-oriented than do females (L. H. Anderman & E.M. Anderman, 1999; Roeser, Midgley, & Urdan, 1996); however, other studies have found no gender differences (e.g., Midgley & Middleton, 1997).

Fewer studies as of 2008 have examined ethnic differences in goal orientations. Results from studies that have been conducted are inconclusive. Much additional research in this area is needed. In one large-scale study, Midgley and Middleton (1997) compared goal orientation using a sample of European American and African American adolescents. Although no differences were found for performance-approach or avoid goals, African American adolescents reported somewhat higher mastery goals than did European American students. In a longitudinal study, Freeman and her colleagues found that across eight waves of data collection, African American students reported overall being more mastery oriented and more extrinsically oriented than did European American students (Freeman, Gutman, & Midgley, 2002). In a qualitative study of African American students' goal orientations, Edelin (1998) found that when students were asked to discuss their achievement goals during interviews, most of the students talked about holding extrinsic goals. Interestingly, students occasionally mentioned mastery goals, but rarely mentioned performance goals (i.e., outperforming others).

One area that has received additional attention in the literature is the relation of students' beliefs about intelligence to goal orientations. Dweck and her colleagues indicate that students who hold incremental beliefs about intelligence (i.e., they believe that intelligence is modifiable) tend to adopt mastery goals. In contrast, students who hold entity theories of intelligence (i.e., they believe that one's intelligence is a fixed entity that can not be changed) tend to adopt performance goals (Dweck, 1999).

ARE PERFORMANCE GOALS BAD?

Are performance goals bad? If studies have shown that performance approach goals are related to higher achievement, whereas few studies have shown a direct relation between mastery goals and achievement, then shouldn't teachers structure classrooms so students are challenged to reach optimal achievement as measured against "average?" While it appears clear that performance avoidance goals result in few benefits, mounting evidence indicates performance *approach* goals may have adaptive value e.g., they have been positively associated with task value, academic self concept, effort, and achievement (Harackiewicz, *et al.*, 2002).

In a series of studies, Elliot, Shell, Bouas Henry, and Maier (2005) divided students into groups of performance approach, performance avoidance, or mastery conditions. The result? When students believed their work would result in future opportunities to reap rewards, students in the performance approach group out achieved those in the mastery group. And when they thought there was no future contingency hanging on their work? They performed *just as well* as those in the mastery group. In other words, there appeared to be no penalty for being in an environment that encouraged performance approach indeed, there appeared to be benefits.

In another study, Barron and Harackiewicz (2003) examined achievement goals in a small undergraduate psychology classroom that promoted critical thinking, writing, oral presentation skills, and participation a setting the authors felt would have been conducive to a mastery orientation. Students who adopted higher levels of performance approach goals at the outset were more likely to earn a higher grade but, to also have less interest by the end of the semester, whereas those adopting mastery goals tended to demonstrate increased interest. In order to succeed in this setting, students taking a performance approach orientation would have had to go beyond mere memorization of facts and adopt deeper processing strategies. The results of this study suggest that it could be that performance approach and mastery goals serve two ends for the student achievement *and* interest.

However, others have questioned the benefits of encouraging performance approach goals as they may not

be effective across educational settings. If students are encouraged to evaluate their performance against norms, then inevitably some will be left out. For every student who achieves above the norm, one falls below it. Under such circumstances, those who already have a sense of academic efficacy will be motivated to engage in academic tasks those who have experienced failure may avoid them. Midgley, Kaplan, and Middleton (2001) noted that performance goals may be most advantageous if one is male, older, and in a competitive class where mastery goals are also encouraged, adding that school settings already tend to be predominantly performance oriented. Since the time of their writing, *No Child Left Behind* has been signed into law it is not likely classrooms have become any more mastery oriented during the intervening years.

So, are performance goals bad? While it appears that performance approach may be adaptive for students in some situations, certainly further study is needed. One thing that appears to be clear is that the greater learning context needs to be considered in answering this question including teachers' and students' long and short term goals for learning, the school and larger societal settings, and the individual characteristics of the student.

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Michael S. Yough

Contextual Influences Research suggests that in addition to student characteristics, social contexts are also influential in determining students' goal orientations. More specifically, the instructional practices that are used in classrooms and schools have an impact on the types of goal orientations that students adopt (Maehr & Anderman, 1993; Maehr & Midgley, 1996; Roeser et al., 1996; Turner et al., 2002). In a given classroom, if a teacher talks about and truly focuses on mastery, improvement, and self-comparisons, then students are quite likely to adopt mastery goals and to perceive a mastery goal structure in that classroom; in contrast, if a teacher constantly talks about grades, test scores, and who is doing the best (or the worst) in class, then students are likely to adopt performance goals and to perceive a performance goal structure in that classroom.

In addition, practices that are used by the school as a whole can influence the adoption of mastery or performance goals. For example, many schools place much emphasis on the importance of the honor roll. In many schools, students' names are placed on the honor roll when they receive certain grades (e.g., an A average). Additionally, in many schools, the honor roll hangs on a highly visible bulletin board or is projected on a television monitor, where it is viewed daily by students, teachers, and visitors. When schools emphasize ability differences in this and similar ways, students are likely to adopt performance goals and to perceive that the school is performance-oriented.

Parents can also influence students' goal orientations. Parental emphasis on the importance of grades and high test scores may lead offspring to become performance-oriented students. In contrast, parental emphasis on learning and mastery encourages offspring to become mastery-goal students.

RELATIONS OF GOALS TO EDUCATIONAL OUTCOMES

Mastery and performance goals are related to various educational outcomes in important ways. When students adopt either mastery or performance goals, predictable outcomes often result.

Research frequently indicates that mastery goals are related to adaptive outcomes (see Anderman & Wolters, 2006, for a review). When students report being mastery oriented, they persist longer at academic tasks, they are more engaged with their work, they use more effective cognitive processing strategies, they report lower levels of self-handicapping behaviors, and they choose to continue to engage with tasks in the future when those tasks become optional (e.g., choosing to enroll in an additional course after the completion of a current course). Interestingly, few studies indicate that the adoption of mastery

goals is related directly to increased academic performance (i.e., higher grades or test scores). As of the early 2000s, many researchers had studied mastery-approach goals but had not examined mastery avoid goals.

The connections between performance goals and various educational outcomes are more complex. Prior to the mid 1990s, researchers often measured performance approach and avoid goals within the same scales, thus confounding these measures; later measures clearly distinguished between approach and avoid performance goals.

In general, results indicate that performance avoid goals are not related to adaptive outcomes; more specifically, studies indicate that performance-avoid goals are related to poor academic performance, low levels of academic engagement, and avoidant behaviors such as self-handicapping (Urda, Ryan, Anderman, & Gheen, 2002).

Studies examining the connections of performance-approach goals to various educational outcomes yield somewhat mixed results. Some research indicates that the adoption of performance approach goals is related to persistence at academic tasks, whereas other studies do not indicate a relation between performance approach goals and persistence. Similarly, some studies indicate that performance-approach goals are related to the use of adaptive cognitive and metacognitive strategies, whereas other studies do not yield these findings. In addition, some research indicates that the adoption of performance-approach goals is related to maladaptive outcomes, such as the avoidance of help-seeking (Ryan, Hicks, & Midgley, 1997). Despite these mixed results, several studies do indicate that there is a positive connection between course grades and performance-approach goals in college students and sometimes in younger students (see Anderman & Wolters, 2006, for a review).

Studies examining the relations of classroom goal structures to educational outcomes yield similar results. Perceptions of a mastery goal structure are generally related to adaptive outcomes, whereas perceptions of performance goal structures are often related to maladaptive outcomes. Studies examining the relations of perceived performance goal structures to academic achievement yield mixed results, with some studies indicating that performance goal structures are related negatively to achievement (E. M. Anderman & Midgley, 1997), and other studies indicating that mastery goal structures are either unrelated to achievement or related positively to achievement (Midgley & Urda, 2001).

THE DEBATE ABOUT PERFORMANCE GOALS

Debate in the educational psychology literature regarding performance approach goals has focused on revisions to

goal orientation theory (involving approach and avoid goals) in the late 1990s. Some researchers argue that performance approach goals are adaptive and can be beneficial for students, particularly when they are paired with mastery goals (Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002). In contrast, other researchers argue that there are few benefits to performance approach goals (Midgley, Kaplan, & Middleton, 2001). These debates have important implications for the design of educational environments and for school reform. As noted by Roeser (2004), part of this debate emanates from the fact that some goal theory researchers (e.g., Midgley et al.) primarily have been concerned with issues of reforming school learning environments, whereas others (e.g., Harackiewicz et al.) have been concerned with developing theoretical models to enhance and explain individual student motivation. Interestingly, despite the debate about performance goals, the vast majority of goal theory researchers converge on the benefits of mastery goals for educational outcomes.

IMPLICATIONS FOR EDUCATORS

Nearly two decades of research from about 1985 into the early 2000s on achievement goal orientations offered educators a number of practical implications for classrooms. As educators think more critically about the types of goals that teachers and schools foster in their students, they may be better able to shape the motivational patterns adopted by children and adolescents in school settings.

One of the basic tenets of goal orientation theory is that students' goals, as well as classroom and school goal structures, can be changed. Goals can change across different social contexts. In addition, teachers and administrators can deliberately alter instructional practices to affect the social contexts of schools and classrooms.

Maehr, Midgley, and their colleagues engaged in extensive work in the early 1990s, using goal orientation theory to guide school reform. Specifically, in a series of studies of both elementary and middle grades schools, they demonstrated that the instructional practices used in schools could be changed, using goal orientation theory as a guiding framework, to make practices focus more on mastery and improvement and less on performance and ability differences. A team of researchers (including both university faculty and graduate students, several of whom had experience as classroom teachers) met with a team of school-connected adults (i.e., teachers, administrators, and parents) to critically examine the practices of the schools using goal orientation theory. These collaborative teams worked to identify practices that encouraged either mastery or performance goals. Then, over a three-year period, the teams worked to eliminate some of the

instructional practices that focused on performance goals and to enhance and increase the strategies that fostered the adoption of mastery goals. Results indicated that these changes could be successfully implemented in school settings and that student motivation was enhanced as a result of these changes (Maehr & Midgley, 1996).

Several researchers have suggested that educators can use TARGET a means of examining and realigning instructional practices according to goal orientation theory. Developed by Joyce Epstein (1989), the TARGET acronym refers to six aspects of the learning environment that are strongly related to academic motivation: tasks, authority, recognition, grouping, evaluation, and time. Several researchers have demonstrated that instructional practices can be restructured using TARGET as a guiding framework (Ames, 1990; Maehr & Anderman, 1993). Tasks can be examined and altered so that they encourage students to focus on mastering the task, regardless of the performance of other students on the task. Authority refers to how much control students have over tasks: Students will be more likely to adopt mastery goals when they have at least some choice/control over some aspects of their work. Recognition refers to how and why students are acknowledged in the classroom (i.e., for their personal accomplishments or for their performances compared to others).

Grouping refers to how students are organized socially for instruction; if students are grouped by ability, this may support the endorsement of performance goals in some students, whereas if students are grouped according to their interests, they may be more likely to adopt mastery goals. Evaluation simply refers to how students are assessed; evaluations can be based on mastering a task or on how quickly or accurately one student completes a task compared to others. Finally, time refers to how time is used in classrooms; some educators use time and structure their classes so that students can master tasks and spend the necessary time on complex tasks, whereas others structure time more rigidly and may limit the amounts of time that students can spend on tasks. If students feel rushed when working on a complex task, they may become more performance oriented and start comparing their performance to that of other students.

SEE ALSO *Social Goals*.

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Eric M. Anderman

GOAL SETTING

Goal setting is an important component of students' motivation, self-regulation, and achievement in academic settings. A goal is a behavior or outcome that one is consciously trying to perform or attain. Goal setting refers to the process of establishing that behavior or outcome to serve as the aim of one's actions. Goals can exert positive effects in achievement settings by directing learners' attention to important activities and away from distractions and by mobilizing their effort and persistence directed toward goal attainment. Given the centrality of goals to classroom learning, it is important that students set goals that are likely to have desirable effects.

TYPES OF GOALS

Simply having a goal does not automatically benefit a student's academic performance. Researchers such as Bandura (1986) and Locke and Latham (1990, 2002) have identified various goal properties and have investigated how different goals link with achievement outcomes.

Goals may be cast as absolute or normative. An absolute goal has a fixed standard, such as reading one chapter in a book in one hour. A normative goal is relative to the attainments of others, such as being the first one in class to finish an assignment.

Goals can be distinguished according to how far they extend into the future. Goals may be relatively close at hand (proximal) such as reading one chapter tonight, or more long term (distant) such as reading one chapter by the end of the current week. Proximal goals lead to higher motivation directed toward goal attainment than do long-term goals (Bandura, 1986). Proximal goals are especially beneficial for children because they have short time frames of reference and are not fully developmentally capable of representing long-term outcomes in thought.

Goals also can be distinguished according to the specificity of their performance standards. Goals that incorporate specific standards (e.g., complete 20 problems in one hour) are more likely to enhance motivation and learning than are general goals (e.g., do your best) because specific goals better describe the amount of effort needed to succeed. Motivational benefits are not as great

with general goals because almost any level of performance satisfies the standard (Locke & Latham, 2002).

An important goal property is difficulty, or how hard it is to attain the goal. In general, difficult goals (e.g., read a 30-page chapter tonight) boost motivation better than do easier goals (e.g., read five pages tonight), because students persist longer and expend greater effort when they pursue difficult goals. However, goal difficulty and motivation do not bear an unlimited positive relation with one another. Students are not motivated to attempt goals that they believe are impossible to attain. Difficult goals do not raise motivation and learning in the absence of the skills needed to attain them. Goals are motivating when learners view them as challenging but attainable (Locke & Latham, 2002).

Another way to differentiate goals is according to students' level of commitment to attain them. Goals do not affect performance in the absence of commitment (Locke & Latham, 1990). The goal properties identified above can help foster commitment. Students typically are more committed to attempt goals when they are specific, proximal, and moderately difficult, than when they are general, distant, and either overly easy or difficult.

Finally, goals can be distinguished by what students ultimately are trying to accomplish. A process or learning goal refers to what knowledge, behavior, skill, or strategy students are trying to acquire. An outcome or performance goal denotes what task students are trying to complete. While working on algebra homework, a student may have a goal of learning how to solve two equations in two unknowns (process) or a goal of finishing the homework assignment (outcome). Although both types of goals can motivate behavior, they can have different effects on learners' beliefs and cognitive processes. As Pintrich has shown, process goals focus attention on the skills needed to learn. Students often evaluate their progress in learning, and the belief that one is learning can enhance motivation. In contrast, outcome goals focus attention on completing tasks. These goals can lead learners to compare their work with that of others, which can lower motivation among students who are not making adequate progress.

GOAL SETTING EFFECTS ON ACHIEVEMENT OUTCOMES

To explain why goals affect achievement behaviors, researchers have advanced different theories. Locke and Latham (1990) proposed that the key components are goal choice and commitment. Goal choice includes the goal people are trying to obtain and the level at which they are trying to attain it. Goal commitment refers to how enthusiastic people are about a goal or how determined they are to achieve it. Locke and Latham identified several factors

that affect goal choice and commitment, including personal-individual factors such as skill level and previous performance and social-environmental factors such as group norms and the nature of authority and feedback. Because this theory was developed and tested in organizational settings, it places strong emphasis on external factors.

Bandura's social cognitive theory (1986) posits that human functioning results from reciprocal interactions among personal factors (e.g., cognitions, emotions), behaviors, and environmental conditions. There are two primary cognitive sources of motivation (personal factors): goals and expectations. Goals help to focus and sustain effort toward task completion. As people work on tasks they compare their performances with their goals. Positive self-evaluations of progress raise self-efficacy (discussed below) and sustain motivation. The perception of a discrepancy between present performance and the goal can create dissatisfaction and raise motivation for goal attainment.

Bandura's theory identifies two types of expectations. Outcome expectations are beliefs about the likely consequences of actions. Based on their past experiences and observations of models in their environments people form beliefs about the likely consequences of given actions. People are likely to act in ways that they believe will lead to desired outcomes. Outcome expectations can motivate behavior over long periods when people believe that their actions will eventually result in success.

Efficacy expectations, or self-efficacy, refers to personal beliefs about one's capabilities to learn or perform actions at designated levels (Bandura, 1997). Self-efficacy is not the same as an outcome expectation. Students may believe that studying diligently for an exam will produce a high grade (positive outcome expectation) but may doubt their capabilities to study diligently (low self-efficacy). Often, however, self-efficacy and outcome expectations are related. Students with high self-efficacy for doing well in school expect to receive good grades for their coursework. Both types of expectations can affect motivation.

Bandura (1997) noted that people gauge their self-efficacy from their performances, observations of models, forms of social persuasion, and physiological indexes (e.g., heart rate). Actual performances offer the best source of information; successes generally raise and failures may lower self-efficacy. Students receive information about their capabilities by observing others perform. Observing similar others succeed can raise observers' self-efficacy. Social persuasion, such as when a teacher tells a student "I know you can do this," can raise self-efficacy, but this increase will not last long if students perform poorly. Physiological symptoms can be informative of self-efficacy. When students



Effective athletic training places a strong emphasis on both proximal and process goals. ©RICHARD HAMILTON SMITH/CORBIS.

notice that they are less anxious studying for an exam, they may feel more self-efficacious about performing well on it.

Bandura's social cognitive theory (1986) contends that learners set goals that they feel self-efficacious about attaining and believe that when attained will result in positive outcomes. They evaluate their goal progress as they work on the task. Their self-efficacy and motivation are strengthened when they believe that they are making progress toward their goals. Self-efficacy is further enhanced when learners attain their goals, as well as their motivation to set and pursue new goals.

Goal setting also is a key component of self-regulation, or the process by which students activate and sustain cognitions, behaviors, and affects systematically oriented toward the attainment of goals. Zimmerman's three-phase model of self-regulation (2000) includes forethought, performance/volitional control, and self-reflection. The forethought phase precedes performances and refers to processes that set the stage for action. The performance/volitional control phase includes processes that occur during learning and affect motivation and action. During the self-reflection phase, learners reflect

on their performances and determine whether changes in behaviors or strategies are needed.

Goals and self-efficacy are active throughout the model. In the forethought phase, learners set goals and have a sense of self-efficacy for attaining them. As they work on the task they mentally compare their performances with their goals to determine progress. Their self-efficacy is sustained when they believe that they are making goal progress. During self-reflection learners determine whether their present approach is effective. If they feel self-efficacious for succeeding but believe that their present strategy is not working well enough, they may alter their strategy by working harder, persisting longer, deciding to use a different method, or seeking help from others. These self-regulatory processes promote learning, motivation, and self-efficacy.

GOAL SETTING RESEARCH IN EDUCATION

Goal setting research in education has established the importance of specific, proximal, and moderately challenging goals as beneficial for motivation and learning. Schunk has conducted several studies investigating these

variables. In these studies, elementary school children received instruction on arithmetic operations and opportunities to practice solving problems. In one study some children received a specific goal denoting the number of problems to complete, whereas others were given a general goal of working productively. Compared with the general goal, the specific goal promoted higher self-efficacy and mathematical achievement.

Bandura and Schunk conducted a similar study investigating goal proximity. Over several sessions children received instruction that explained and demonstrated subtraction operations and opportunities to practice solving problems. Proximal-goal children were asked to complete a portion of the instructional material during each session; distant-goal children were told to complete all of the material by the end of the last session. Proximal goals raised motivation during the sessions, as well as children's self-efficacy and subtraction achievement, better than distant goals.

Schunk's research also has addressed goal difficulty during school learning. In one study, children received long-division instruction and practice opportunities. All children received the same instruction and practice time. Some children were given a more difficult goal (higher number of problems to complete), whereas others received an easier goal (lower number to complete). Difficult goals led to higher motivation during learning, self-efficacy, and skill acquisition.

Goal progress feedback provides information about progress toward goals and can promote self-efficacy and motivation when students cannot derive progress information on their own. It often is difficult for children to know whether their reading comprehension or their written expression is improving. Research by Schunk and Rice with children with reading difficulties showed that giving children feedback on how well they were learning to use a comprehension strategy improved their reading comprehension self-efficacy and achievement. Schunk and Swartz obtained comparable results in writing achievement and found that self-efficacy and achievement gains generalized to different types of writing assignments and maintained themselves over time.

Researchers have addressed how process and outcome goals affect motivation, learning, and self-regulation. In the Schunk and Rice study, children were taught a comprehension strategy. Some received a process goal of learning to use the strategy to answer comprehension questions, whereas others were given an outcome goal of answering questions. The process goal, coupled with progress feedback on how well the children were using the strategy, promoted self-efficacy and achievement the best. With college students, Schunk and Ertmer found that a process goal of learning computer applications led

to higher self-efficacy, self-judged learning progress, and strategy use, compared with an outcome goal of performing the applications.

Research by Zimmerman and Kitsantas found benefits from shifting from process to outcome goals. High school students were taught a writing revision strategy. Some students received a process goal (following steps in the strategy) or an outcome goal (number of words in sentences). Others initially were given a process goal but then were advised to shift to an outcome goal. Learners who changed goals as their revision skills developed demonstrated higher self-efficacy and skill than students who pursued either the process or the outcome goal.

IMPLICATIONS FOR EDUCATORS

Goal-setting research in school settings shows that students' learning, motivation, and self-regulation can be improved when students pursue goals that are specific, proximal, and moderately difficult, receive feedback on their goal progress, focus their attention on learning processes, and shift their focus to outcome goals as their skills develop. These points have implications for educators who desire to use goal setting systematically.

Much educational planning is based on proximal, specific, and moderately challenging goals. Teachers typically plan daily lessons around specific student learning outcomes. Content difficulty usually is low initially to ensure that students acquire skills but increases as students become more proficient.

Students may need to be taught how to set goals that are proximal, specific, and moderately difficult. Many students are not realistic about the steps involved in completing a project or about how much time is required to complete those steps. Goal-setting research suggests that the key to completing a long-term task is to divide it into short-term goals. Educators who work with high school students who have to write a research paper can help them subdivide this task into proximal and specific steps, such as deciding on the topic, doing library and Internet research, outlining the paper, and writing the first draft. Timelines can be established for the subgoals. As students gain experience with goal setting, they will be able to set realistic goals on their own.

Educators can help students focus on process goals by providing feedback that stresses processes, such as how well students are using a strategy, budgeting their time, and completing subgoals. However, as the research by Zimmerman and Kitsantas showed, outcome goals can be highly motivating and lead to skill gains once students have acquired some competence. Teachers can shift students to focusing on outcome goals that are self-referenced such as how well students are doing currently compared with how they did previously, rather than socially referenced such as

how well they are doing compared with how classmates are doing. These social comparisons will not raise self-efficacy among students who perceive that they are performing worse than their peers.

Finally, goal setting theory and research underscore the importance of developmental factors. Because children have short time frames of reference, immediate goals are motivating, whereas long-term goals are not. Short, focused lessons reflect this idea. With development, students are better able to cognitively represent long-term outcomes. Teachers can work with students to help them break long-term goals into short-term subgoals, establish timelines, and assess their progress toward their goals. Teachers also can assist students in evaluating their capabilities to engage in these tasks, which will help to develop their self-regulatory competencies. Students who graduate from high school with a mindset that includes the importance of setting goals and assessing progress will be well prepared to meet future educational and life challenges.

SEE ALSO *Expectancy Value Motivational Theory; Self-Efficacy Theory; Self-Regulated Learning.*

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Dale Schunk

GRADING

Grading is an evaluative practice that assigns letters, marks, numbers, or descriptions that indicate the level of student performance. It is carried out to provide meaningful feedback to students and parents about what a student has learned. Grading requires professional judgments and evaluations of student work. As such, grading practices can vary significantly from one teacher to another. There is also considerable variability in what is included in determining grades (i.e., student achievement, effort, participation, cooperation). These differences have been documented with research that shows that, in the main, teachers' grading tends to include a hodgepodge of various factors (Brookhart, 1994; McMillan, 2007). There is little consistency in grading practices across school and teachers, even within the same school, resulting in the use of different inputs and judgments.

PURPOSE OF GRADING

Grades have been used to serve three purposes: (1) ranking students, (2) reporting what students have learned and are able to do, and (3) providing feedback to improve learning and motivate students (Brookhart, 2004). In the past, one of the main reasons for grading students was to show how a student's performance compared to that of other students. This kind of comparison is called *norm-referenced*. With this approach, higher grades (As and Bs) are awarded to students who perform best in comparison with the performance of other students, and lower grades (D and F) are given to students whose relative standing is the worst. Students in the middle are "average," with a C grade. This approach has been called *grading on the curve*.

Knowing which students are the best or highest is an important function of schooling, but many contend that the competitiveness among students that results is detrimental to learning and interpersonal relationships (O'Connor, 2002). If ranking is used exclusively, students are more interested in outdoing one another than learning, and this encourages the designation of "winners" and "losers." Most importantly, grades determined by ranking may not indicate how much students have learned. It is possible that students learning little are given high grades because their performance is better than students who learn very little.

The primary reason for grading is to give students, parents, and teachers information about the achievement of goals, objectives, and standards (Marzano, 2006; McMillan, 2008; Stiggins, 2008). Grades are awarded based on student performance that is compared to pre-established levels of competence. This kind of grading has been called *criterion-referenced*, *standards-based*, *mastery*, or *absolute*. The focus is on what students know and can do rather than relative standing. Theoretically, all students can obtain the highest grade, and all students can also get a low grade.

A key component of standards-based grading is the determination of what determines designations such as mastery, proficient, or passing. This requires clarity in the criteria that are used to judge student performance and depends on who establishes the criteria. An important development is the use of several levels of performance or benchmarks that can be used to give specific feedback and to rank students (Guskey, 2008; Guskey & Baily, 2001). This kind of grading results in a much more supportive learning environment that fosters positive relationships among students and teachers.

FEEDBACK TO STUDENTS

Grades can be used to provide feedback to students about their performance by showing the ways in which proficiency was demonstrated, and what is needed for a higher grade. This is important for student learning because students have a better understanding of why they received the grade. When provided in sufficient detail, feedback can tell students where there were mistakes, areas of strength and weaknesses, and what subsequent steps are needed to improve their understanding. Feedback is usually provided with prepared narratives that accompany grades, and/or with specific, individualized teacher comments. When feedback is specific, individualized, ongoing, and immediate it has the greatest impact on student learning. In using what is called *formative assessment* feedback is an essential component to help students become more proficient as they learn. General comments such as “good job” or “very good” are not very helpful.

A key distinction with feedback is whether it is primarily evaluative or descriptive (Brookhart, 2004). *Evaluative feedback* is provided in the form of rewards, praise, and positive expressions and non-verbal messages. For young children (grades K-2) these may take the form of stickers, “smiley faces,” or treats. For older students (grades 3-12) evaluative feedback is given primarily through letter grades. *Descriptive feedback* is structured to provide the student with information that relates specifically to the learning objectives or standards. This consists of specific, targeted praise and verbal and written messages that show students what they have learned and

what remains to be learned, sometimes with an emphasis on student self-assessment and suggestions for further learning.

Many teachers use both kinds of feedback (Brookhart, 2004; McMillan, 2007). For early grades (K-2) students are usually rated with a simple scale, such as satisfactory/unsatisfactory or needs improvement/partially proficient/proficient. When these ratings are used there is usually further information that is more specific. Older students typically receive letter grades, though the trend is for giving more descriptive feedback in addition to letter grades. The standards-based trend in American education has emphasized evaluative grading of all students, regardless of age (McMillan, 2008). Students of all ages can learn to use descriptive feedback to improve learning.

GRADING AND STUDENT MOTIVATION

In one way or another, grading affects student motivation. If grades are viewed as extrinsic rewards students tend to be motivated more by doing what is needed to obtain the reward (or avoid the punishment) than by improving their understanding of the content. In contrast, when the reinforcement focuses on improving knowledge, understanding, or skills, getting the extrinsic reward is viewed as secondary to the intrinsic reward of learning and motivation. This is a mastery orientation. Students with this type of motivation see the value in what is learned, prefer challenging tasks, stay engaged longer, display independent learning, and have positive attitudes toward learning.

EFFORT AND IMPROVEMENT

A longstanding issue in grading is whether to use student effort and improvement as factors that effect final ratings and letter grades. Effort is often assessed by participation, completion of work, extra credit, and teacher observation. It is problematic to include effort as part of a grade that purportedly represents achievement, primarily because it is difficult to measure accurately, and because if included in grades it distorts the meaning of the grade. But effort is important in learning, so it needs to be considered. The recommended approach to assessing effort is to grade and report it separately from achievement (Brookhart, 2004; Guskey & Bailey, 2001; Stiggins, 2008).

Improvement is also difficult to incorporate into grades. While actual learning is represented by how much students' achievement changes, grades typically do not include this factor. However, improvement is often considered in an anecdotal manner and may affect the grade,

especially for students who initially demonstrate low performance.

In summary, grading is important for several reasons and will continue to be used. Teacher judgment is always an important factor; there is no completely objective approach. The relationship of grading to learning and motivation is important. Standards-based education models have promoted grades that reflect primarily student achievement, with little or no reflection of effort or improvement. The validity and fairness of grading depends on the match between what grades are claimed to represent and what is actually included in the grade. Feedback is an essential aspect of grading that can have positive benefits for both learning and motivation.

SEE ALSO *Classroom Assessment*.

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James H. McMillan

GRAHAM, SANDRA (HALEY)

1945-

In 1982 Sandra Haley Graham completed her doctorate in educational psychology at the University of California, Los Angeles. Before coming to Los Angeles, Graham graduated from Barnard College (B.A., 1969) and from Columbia University (M.A., 1970). Graham then taught junior high school in Newton, Massachusetts, for three years. Curious about the behavior and academic orienta-

tion of some of her junior high school students, she began to consider the unique socio-cultural experiences and needs of minority children, particularly African American boys.

At UCLA Graham worked with social psychologist Bernard Weiner on attribution theory. Graham's early research used attribution theory as a framework to understand individual, contextual, and interpersonal factors influencing children's achievement motivation. Her research examined how others consciously and unconsciously may send messages to students that may undermine their own sense of self. Graham recalled having such an experience as a college freshman during final exams week. She got a note from the professor urging her to attend an extra help session, and immediately Graham began to doubt herself, wondering why the professor had singled her out for help. She realized at that point that unsolicited offers of help can undermine a person's self-concept by communicating a message of perceived low ability. In *Communicating Low Ability in the Classroom: Bad Things Good Teachers Sometimes Do* (1990), Graham describes how praise and well-intentioned yet unsolicited assistance communicates perceptions of low ability that may reduce children's beliefs in their own efficacy and undermine achievement motivation.

Graham was a pioneer in examining the relationship between the social context and behaviors and how they are linked to children's academic engagement. Research has consistently supported that even the most capable and supported students likely will not achieve their potential if they are not engaged in their academic lessons. Graham noticed that during her work in classrooms that many students who were not engaged academically had behavior problems and were identified as aggressive by their peers and teachers. More troubling, she noticed that these students' predicaments were only negatively amplified by the time spent in principals' offices. Continuing her focus on children's attributions, Graham incorporated into her repertoire an examination of the determinants of aggression among minority male youth. Consistent with her hypothesis, Graham found a link between attribution, affect and action in that aggressive males were more likely than non-aggressive males to assume that a peer's negative behaviors were intentional, become angered, and respond with aggression of their own.

Graham recognized that in order to address the needs of an increasingly diverse population, diversity must be represented and valued in the literature. This lack of diversity was the impetus for her article "Most of the Subjects Were White and Middle Class: Trends in Published Research on African Americans in Selected APA Journals" (1992). This work highlighted the lack of ethnic representation in research of the time and was a call for more representation in research.

Graham never lost sight of her ultimate goals for her research. Her next tasks involved bridging theory and practice by designing and conducting a hostile-attribution retraining program in collaboration with her former student Cynthia Hudley. This line of intervention work included Best Foot Forward, a 32-lesson curriculum focused on enhancing social and academic motivational skills. The social skills component was comprised of two sections, impression management and attributions of intent. The academic motivation component was divided into sections covering intermediate risk taking, goal setting, task focus, and failure attributions. This curriculum has had an overall positive impact on aggressive participants: There were increased adaptive responses to conflict and decreased hostile attributions. Academically, participants made fewer external attributions for failure and evinced more adaptive goal setting. Additionally, teacher ratings of cooperation/motivation and persistence increased significantly for intervention participants. This work highlights the value of theory-guided, multi-method, student-focused research in education.

Graham's research has included topics ranging from students' achievement values, affirmative action, peer victimization and harassment, to the cognitive competence of juvenile offenders. Her 2006 work with Janna Juvonen focused on a longitudinal investigation of the importance of school and classroom ethnic compositions for students' social-psychological adjustment and peer relationships both within middle and high school as well as across the school transition. The body of research from this data identifies requirements for optimal learning and socialization for all students, ethnic minority and non-minority alike. Findings support that ethnic diversity in classrooms and schools reduces students' feelings of victimization and vulnerability as a result of a balance of power among ethnic groups. Contrary to what one might expect, in non-diverse classrooms, victimized students who are members of the ethnic group that is the numerical majority are particularly vulnerable for maladaptive and destructive self-appraisals.

Graham received an Independent Scientist Award funded by the National Institute of Mental Health and an Early Contribution Award from Division 15 (Educational Psychology) of the American Psychological Association. She is a former Fellow at the Center for Advanced Study in the Behavioral Sciences in Stanford, California. As of 2008, Graham was a professor in the Graduate School of Education and Information Studies at the University of California, Los Angeles.

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GUIDED PARTICIPATION

Guided participation refers to the process by which children actively acquire new skills and problem-solving capabilities through their participation in meaningful activities alongside parents, adults, or other more experienced companions. Guided participation emphasizes the active role of the child in learning and cognitive growth and the complementary role of parents and other caring adults in supporting, assisting, and guiding the child's intellectual development. Support includes both explicit verbal and non-verbal guidance as well as more subtle direction through the arrangement and organization of children's interactions with the environment. Guided participation occurs throughout the course of childhood as children progress from a peripheral and dependent role to one of increased autonomy and responsibility while they strive to master the challenges posed by the surrounding social and cultural milieu (Rogoff, 1990, 1998; Gauvain, 2001).

Casual observations of parents interacting with their young children typically offer many examples of guided participation. In the grocery store 3-year-old Alberto holds the shopping list for his mother and studies a box of Cheerios as he sits in the shopping cart. Alberto's older brother, who is 7, is searching for a can of soup that says "tomato." When he has found the soup and they move on to the next aisle, his mother will have another job for each of them. Alberto's mother is skillfully engaging her boys with the shopping, and the children are enjoying themselves in an activity with their mother, feeling competent with the tasks she sets for them as they learn about their social world.

The term guided participation was introduced by the neo-Vygotskian, Barbara Rogoff, in her book *Apprenticeship in Thinking* (Rogoff, 1990) to clarify the nature of children's cognitive development within the framework

of sociocultural theory. Vygotsky claimed that the ability to engage in higher mental functions, the distinguishing feature of human psychology, is rooted in social interaction. Thinking emerges from early social interactions in which the child works with others to solve problems. To insure children's success, more experienced partners direct their assistance to the child's *zone of proximal development* or potential development. This is defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86.). This approach differed from prevailing views of cognitive development since the focus was not on what the child could do alone, but was future oriented, focusing on what could be done with help from others.

The notion of zone of proximal development offered a new way of thinking about verbal interactions and cognitive growth. Because language plays an important role in structuring social interactions language and communication patterns serve as one type of "scaffold" supporting the child's developing capabilities. A number of researchers looked for evidence demonstrating that appropriate talk on the part of adults supports children's problem-solving success (Berk & Winsler, 1995; Diaz, Neal & Amaya-Williams, 1990; Wood, Bruner, & Ross, 1976).

Guided participation expands upon adult talk as a scaffold by broadening the social context and emphasizing the role of the child in relation to the adult. Gauvain (2001) notes that in this view, "the child is not merely a learner, or a naïve actor who follows the instructions or prompts of the more experienced partner. Rather, the child is a full participant, albeit a participant of a specific type characterized by individual and developmentally related skills, interests and resources" (p. 38). Children's participation in the organized routines and practices of the social community as well as engagement in more didactic experiences are all essential to cognitive development.

Some of the most compelling illustrations of guided participation are evident in parents' interactions with young children. These show that guided participation includes two focal processes: "creating bridges" to make connections to new ideas and skills and "structuring children's participation" in activities by creating opportunities for their involvement and through social support and challenge in activities and roles valued in their community (Rogoff et al., 1998).

While examples of adult-child interactions can be found anywhere people interact in meaningful activity, schools are critical contexts for guided participation. Particularly good illustrations can be found in child-

centered or learner-centered classrooms where children are actively engaged in learning activities that have been carefully planned by the teacher, as the following example shows.

Sasha is one of the less skilled writers in her first-grade class. She has completed a drawing and the teacher would like her to write something underneath the completed picture but she doesn't seem to know how to start. Sasha's teacher uses a technique that relies on graphic mediators to support children's early writing attempts. "Let's write something about your picture," the teacher says. Sasha replies, "They are eating at McDonalds." The teacher writes the five words Sasha has dictated on a strip of paper she has placed under the picture. "Do you see what I wrote? I wrote exactly what you said!" The teacher then takes another strip of paper and draws five horizontal lines along the edge, one for each of Sasha's words. Then she re-reads the sentences, pointing to the lines. Sasha will copy the sentence, one word on each line.

As Sasha becomes more confident of her writing the teacher will decrease the support she provides. Rather than provide the model, the teacher may simply draw the lines, one for each word, to help Sasha remember her sentence and to guide the spacing of her words. With further practice Sasha will be able to write a sentence independently. Sasha's teacher has supported her participation in the writing activity through sensitive and individualized guidance, adjusting the help she offers in response to the needs she observes in Sasha. Sasha and her teacher working together illustrate a child learning in the zone of proximal development.

THE CHILD IN A SOCIAL CONTEXT

The sociocultural view of the Vygotskians and neo-Vygotskians (including the notion of guided participation) differs from more familiar American and western European approaches to learning and development. This is most evident in the assumptions about the nature of the individual as a learner and the nature of the environment in which learning occurs. Classical learning theories such as behavioral analysis or social learning theory emphasize a strong distinction between the learner and the environment. According to these mechanistic perspectives, individual learning results from some action of the environment on the individual. For example, the learner is rewarded for new behavior or the learner responds to a model in the environment. The learner is passive, awaiting direction for the environment. Conversely, the environment can be fully planned, and if done correctly, fully shape and direct behavior.

A second view, also at odds with the Vygotskian notion of guided participation, is the organismic approach of many developmental psychologists, including Jean Piaget (1896

A COMPARISON OF GAGNÉ'S COMPONENT SKILLS APPROACH WITH GUIDED PARTICIPATION APPROACH TO LEARNING

Both Gagné's component skills approach and Rogoff's guided participation approach focus on learning through varied instruction. However, influenced by behaviorism and information processing theories, Gagné suggests that the skills needed for a task could be analyzed and taught as separate components in a hierarchical order from lower skills to higher ones. Indeed, he defines instruction as "the set of planned external events which influence the process of learning and thus promote learning" (1974, p.5). Yet, it still maintains the concept of knowledge acquired by learner, which Rogoff's notion of guided participation shares. Bringing Piaget's cognitive learning and Vygotsky's sociocultural learning theories together, Rogoff views instruction as an interactive process in which the learners participate in the activity guided by sociocultural values and systems. A more skilled peer or adult who jointly participate in the process gradually transfers the responsibility of activity to the learner. Yet, there is no external sequential instruction planned and applied either by instructor or learner. Because guided participation approach is drawn from cross cultural community contexts, it has been widely applied to natural learning settings in early childhood and occupational learning fields, whereas Gagné's component skills approach has been utilized by instructional and curricular design in both educational and technical military settings.

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Zeynep Isik-Ercan

1980). From this vantage point, changes within the developing child are critical for understanding changes in children's behavior. These "within child" changes include physical as well as mental structures, and until they are formed learning is constrained. For example, children's

expressive language capabilities result from developing physical characteristics, and these are largely separate from environmental or experiential factors.

Both of these orientations assume that the individual and the environment are separable, a notion at odds with guided participation. Rather than focusing on the learner and the guiding "other" as independent, with one being active and the other passive, from a guided participation perspective, both the child and the environment (particularly the social environment) are active. The individuals and the social context in which they function are always linked, and the appropriate focus is the dyadic interaction within the real world. How learning processes work can be understood only by contextualizing the learning activity (see Gauvain, 2001, and Rogoff, 1990, for excellent discussions).

ORIGINS OF GUIDED PARTICIPATION CONCEPT

The construct of guided participation is grounded in the work of Russian psychologist Lev Vygotsky and the approach to cognitive development attributed to him in the early 20th century. This approach is known as the sociocultural perspective. Vygotsky and his colleagues were deeply influenced by the Marxist foundations of the new Soviet Union. One of the early goals of the Soviet regime was to bring literacy to the masses. Language and literacy are both tools of culture, and their use transforms mental capabilities. Vygotsky and his contemporaries were interested in understanding the impact of this effort as well as other aspects of the social environment on children's learning.

Although Vygotsky himself did not use the term guided participation, it shares several key notions with his work. The early socioculturalists were interested in the processes of social mediation and mind. They downplayed the idea of the individual knower separated from a social context; instead, they emphasized the role of the dyad or social group embedded in "activity." At the time, the field of psychology was still in its infancy and very little was known about the mind, society, and the influences of culture upon thinking.

The work of the Russian psychologists was barely known to western European and American scholars. Some of their work was censored within Russia and much of it was not translated into English until the 1970s and 1980s. At the same time American psychologists were looking for alternative ways to conceptualize cognitive development. The shortcomings and limitations of Piaget's model of cognitive development were becoming evident to some. New findings from cross-cultural psychology were raising new questions about the universality of cognitive structures, an idea at the

core of Piaget's theory. However, it was not clear how new findings in cross-cultural psychology should be interpreted. Cognitive psychology, rooted in information processing, was also becoming popular, but many researchers were unhappy with the excessively mechanistic, "machine-like" models of human functioning the early information processing models offered.

At the same time that Vygotsky's later work was appearing in the United States other cultural approaches to the study of human behavior were emerging. Some of this work was being conducted by anthropologists. This work was done outside university laboratories and relied instead upon ethnographic and field-based methodologies. These approaches focused on studying behavior as it is situated or as it occurs in the context of the real world. Knowledge was viewed as a highly valued social practice rather than something "in the head" (Lave, 1991). The workplace and communities, and the practices, routines, and talk that occurs within them were an important focus of study because they reveal the understandings and representations of participants (Heath, 1991; Wertsch, 1985).

An illustration of this is the work of Jean Lave. Lave worked in Africa, studying everyday cognition among workers in a tailor shop. She studied the rich repertoire of cognitive skills deployed by tailors in their work at the shop and studied the processes by which novices learn their craft. Tailors are trained through an apprenticeship. The apprentices learn their craft in a busy shop, not in a learning environment separated from world (as is school). They are surrounded by masters and other apprentices all engaged in the target skills at varying levels of expertise. They are expected to participate in activities that contribute directly to the production of actual garments, advancing quickly toward independent, skilled production (Collins, 2006, p. 32).

Lave & Wenger (1991) emphasize the movement of the learner from a peripheral position to a central position in activity. As Collins notes, guided participation and coaching are especially powerful forces for learning in the tailor shop. In the tailor shop, learners were mastering complex tasks that occurred with a web of memorable associations, all in highly meaningful contexts. Learning and teaching were highly situated and highly focused on the specific skills needed for the task.

Apprentices learn domain-specific skills through observation, coaching, and practice. The apprentice then attempts to execute the process with guidance and help from a master through a process of coaching. Collins explains this as follows:

A key aspect of coaching is guided participation: the close responsive support which the master provides to help the novice complete an entire task, even before the novice has acquired every

skill required. As the learner masters increasing numbers of the component skills the master reduces his or her participation, providing fewer hints and less feedback to the learner. Eventually, the master fades away completely when the apprentice has learned to smoothly execute the whole task. (Collins, 2006, p. 48)

ILLUSTRATIONS OF GUIDED PARTICIPATION

Some educators and cognitive psychologists have extended the ideas of Lave and Wenger (1991) to the design of instructional models useful in elementary and secondary education (Collins, 2006). Developmental psychologists have focused on issues in children's learning and cognitive development, often with a focus on parent-child interactions and the influences of these processes on higher mental capabilities (Cole, 2006; Gauvain, 2001; Rogoff, 1998; Wood, 1998).

Rogoff notes that while Vygotsky was primarily interested in the development of the mind through interpersonal interaction, he placed a great deal of emphasis on the relationship between language and thinking. Rogoff argued that the child was capable of developing thinking even when the culture placed less emphasis upon language and writing. She demonstrated this in her research with Mayans in Mexico, many of whom did not write or engage in excessive amounts of verbal interaction (Rogoff, 1998).

Gauvain (2001) notes that guided participation offers a fuller account of the child's active role in cognitive change, along with the significance of social interactional context. Guided participation can include notions such as scaffolding, coaching, and tutoring, but it also extends to broader views of supportive context for learning and development beyond the adult or more experienced partner. Such a context includes the myriad ways in which adults structure experiences for children and hence enable children to move from positions of peripheral involvement to full involvement within the community (Lave & Wenger, 1991).

Finally, an essential component of guided participation is the notion of *intersubjectivity*. This is the process by which two individuals achieve a joint focus on a problem. Intersubjectivity must be mutual, but even young infants participate in the process. Research shows that infants as young as 3 months can shift focus and visual engagement with their mothers. This type of interaction provides the starting point for intersubjectivity (Bruner, 1985; Tronick, 1982). While adults can establish general goals for children, and the adult can direct and scaffold children's performance, fine tuning and adjustment to the mutual needs of the particular individuals participating in the

interaction is needed for optimal learning and meaning making.

CONTRAST WITH TRADITIONAL VIEWS OF LEARNING

The first way guided participation differs from traditional views of learning concerns the assumptions about the nature of the learner. Learning in the traditional sense assumes that the learner can be clearly differentiated from the environmental setting. Instead, it is assumed that children's activity is intimately linked with the social context in which it is occurring. Guidance can be provided in many different ways, close at hand (e.g., the parent leading the child through a game) or more distal, as when a teacher has carefully selected and arranged materials for small groups of children to use in a learning center. In both cases, the adult begins with a general plan, but then adapts and fine tunes the plan in response to the child. The adult works to achieve a level of intersubjectivity with the child. This allows the adult to adjust and fine tune to meet the child optimally. One metaphor is to view the learner as following a path to an endpoint or destination specified by the adult. The child discovers the path. The adult posts trail markers if and when they are needed along the way. The adult cannot post the markers before the journey because the precise path the child will try to pursue is not known.

Second, unlike traditional views of learning, it is assumed that the meaning of behavior for the child will change over time. First efforts may look like play, or childish imitations. Yet these early attempts are the first steps towards mature, independent, self-directed activity. With time, and the appropriate environmental support, children will be able to carry out the behavior more independently. Later, children will carry out the behavior with a different understanding of why they are doing it, why it works, and how it is understood by others.

For example, children's first attempts at writing may be scribbles on a page, following a period of observing others writing with crayons on paper. Later, children will understand that these marks on paper can be used to communicate with others. Initially the action of "writing" is an exploration of the physical world (crayons on paper) and a way to become part of the group of other children marking on papers with the adult. In another year or two, the children will sit at their tables and writing, but it will have an entirely different meaning. Perhaps they will be writing their names.

Third, while traditional views approach learning as a strictly cognitive process, guided participation unifies the cognitive, social, and emotional dimensions of behavior. The focus is the whole person; the social and the emotional cannot be separated from the cognitive (see

Rathunde & Csikszentmihalyi, 2006). The interpersonal relationship between the partners supports the give and take necessary for children to appropriate and acquire new competencies. While the more knowledgeable partner sets broad goals for the interaction, adaptations to the needs of the individuals must be made. Again, this is particularly evident in parent-child interactions with young children.

PREVALENCE OF GUIDED PARTICIPATION CROSS CULTURALLY

Rathunde & Csikszentmihalyi (2006) note that the basic processes of guided participation are universal. In all cultural settings, parents and children must arrive at a mutual interpretation of a situation that allows intersubjectivity, or a common focus of attention and shared presuppositions. This is substantiated by findings from cross-cultural research comparing parent-toddler dyads from four cultural settings: Utah; Mayans in Mexico; Turkey, and India. Results demonstrate striking similarities, as well as distinctive differences, across these settings (Rogoff, Mistry, Goncu & Mosier, 1993; Packer, 1993).

The benefits of guided participation are grounded in maintaining the child/learner in the zone of proximal development (Rathunde & Csikszentmihalyi, 2006; Vygotsky, 1978). A number of studies confirm that guided participation is beneficial to children's development. They note that parents' use of guided participation has been linked to infants' and toddlers' communicative competence, to improvement in children's seriation skills, and to greater exploration of novel objects by 3- to 7-year-olds. Wood and Middleton (1975) note that when mothers adjusted their instruction to their children's needs by guiding at a slightly challenging level and adapting their behavior based upon their children's successes, children performed more successfully on a complex building task. Importantly, it was not the number of interventions the mother made but the quality of the interventions that was important (Rathunde & Csikszentmihalyi, 2006, p. 498).

Some illustrative examples of guided participation are evident in the research reported by Rogoff and her colleagues (Rogoff, Mistry, Goncu, & Mosier, 1993) comparing U.S. mother-child dyads with Mexican Mayan mother-child dyads. All mother-child dyads were observed in their homes as they interacted with selected materials, such as a baby doll, nesting dolls (a set of wooden dolls that were seriated in size and fit one inside the other) and play dough. Past work has shown that middle-class U.S. parents and others with similar schooling experiences appear to place a greater emphasis on explicit, declarative statements, in contrast to tacit,

Guided Participation

procedural, and more subtle forms of verbal and non-verbal instruction which are more evident in other cultures.

These differences were evident in a comparison of the mother-child pairs Rogoff and her colleagues studied. They describe a 20-month-old and mother from both communities. Both were first-born boys who played with the nesting dolls in a skilled and interested manner. Both included a counting routine as they interacted with their mothers. For both communities, the interaction was extreme in similar ways: Counting routines are not usual with this toy in either community, and both mothers seemed more concerned with their children's performance than other mothers from their communities. As Rogoff and colleagues (1993) note, the most extreme differences between these two dyads concerned status roles. The American mother would get on the child's level, playing with or teaching her child. The Mayan mother also assisted the child but maintained a difference of status. They also differed in responsiveness and in the subtlety of their verbal and non-verbal communication. The difference is consistent with the American child "being treated as the object of teaching and the Mayan child being responsible for learning" (Rogoff, 1993, p. 246). The researchers comment that Mayan mothers showed readiness to aid in their children's efforts to learn whereas the American caregivers acted as teachers and playmates (see Rogoff et al., 1993, pp. 246-247 for full examples).

EXAMPLES OF INSTRUCTIONAL APPLICATIONS

Guided participation is most evident in interactions involving an adult or other skilled individual with an individual child or a small group of children. Examples can be found across a variety of areas including some early childhood programs (Golbeck, 2001). Detailed discussion for programs in specific practices include *Tools of the Mind* (Bodrova & Leong, 1996), one museum-based science education project (Gelman, Massey & McManus, 1991), several mathematics programs (e.g., Lampert, Rittenhouse & Crumbaugh, 1996; Cobb, Wood & Yackel, 1993), and a technique called reciprocal teaching (Palinscar, Brown & Campione, 1993) which has been used in early reading instruction and elsewhere.

In their discussion of *Tools of the Mind* (an early childhood curriculum), Bodrova and Leong (1996) identify the "structuring of situations" as an illustration. The teacher (or other adult expert) structures tasks into different levels or sub-goals. Sub-goals are broken down further or changed as the child and adult are engaged in interaction or in exploring the zone of proximal development. Guided participation occurs as the adult and child

work together on a problem. The expert may repeat directions or model actions several times. If the teacher is teaching counting, she may limit the number of objects to count or choose objects of only one type to help simplify or structure the task. When the child cannot count ten objects the teacher may drop back to counting only five objects. Such structuring helps the child perform at the highest level of the zone of proximal development. The changes the teacher makes cannot be fully planned ahead of time. They occur in response to the child and the assistance the child needs at a particular point in time.

A CLASSROOM ILLUSTRATION

The following is an example of a guided participation approach to teaching within the context of a preschool classroom. Four children and their teacher are sitting at a table in the writing center. They are working together on a book for a child in the class who is in the hospital. Every child will contribute a page and then the pages will be bound together. The children differ in age, previous writing experience, language development, vocabulary knowledge, and fine motor capabilities. The teacher has helped the children individually define writing goals, and the children have told the group of their writing plans. Because the teacher knows each child's independent capabilities she knows how she might extend their writing and help them reach their optimal performance. These children all know one another quite well and they look to one another for help, at least occasionally. The most accomplished writer is proud to help others in this context.

As the teacher chats with the children she is attending closely to their work. One child consistently fails to allow enough room on the paper for his writing. She makes a mark on his paper and suggests he start at that point. She points to the left edge of the paper, near the mark, and says that if he starts near this side he will have plenty of space to write. Another child is a much more sophisticated writer than the others. He requests help spelling. The teacher tells herself she must get a dictionary within reach of the writing center. Another child is frustrated with the writing process. The teacher was about to suggest he make a drawing to illustrate his written message, planning to have him return to the writing after he completes a drawing. But before she got the words out, another child turned to him expressing interest in his work and asked him what he was writing to their friend in the hospital. The frustrated child calmed down and said he was writing about the new truck in the block area. He returned to writing the word "truck" which he was copying from an index card written earlier by the teacher.

One more child is sitting on the teacher's lap. This child is developmentally delayed and functions at the cognitive and emotional level of a toddler. This child has had far less writing experience than the other children. He watches the others. Then the teacher hands him the crayon and they make eye contact. She points to a paper she has placed within his reach, and he drags his crayon across the paper in a slow, careful scribble. He smiles and looks at the teacher. She smiles warmly and says, "We will put this in the book too."

In this example, the teacher is working with the children to create opportunities for guided participation in different ways and at different levels of proximity to the children. She has organized the environment and has helped children identify a broad goal (making the book). This is an important and meaningful activity. She helps individual children define goals for themselves within this larger task. She has arranged the writing center with appropriate materials and brought together a small group of children, creating a social environment of peers as well as herself. She is reaching out beyond the classroom and school world with this activity by reminding the children about their classmate's situation. (They will talk more about the hospital and what it is like to be in the hospital later in the day.) The teacher is also individualizing guidance by sitting at the table watching the children's activity, coaching them as needed and keeping notes on their progress.

SEE ALSO *Cognitive Development: Vygotsky's Theory; Sociocultural Theory.*

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Susan L. Golbeck

H

HARD OF HEARING

SEE *Deaf and Hard of Hearing*.

HELP-SEEKING

Students commonly seek help in classrooms and elsewhere when they have difficulty learning new material or completing assignments. They ask questions of teachers during whole group activity, of peers when working in small groups, and of family members when completing homework assignments. The help-seeking process in instructional contexts involves cognitive and emotional challenges that are most often public and that arise from the need for students to constantly learn more difficult curricular material. Thus it is important to understand the process and the factors that influence whether students ask for help, as well as responses to such requests, which can determine whether students continue to struggle or ultimately succeed. The explication of help-seeking begins with drawing critical distinctions between seeking help in ways considered more versus less adaptive. The term adaptive help-seeking refers to an action, namely, requesting assistance that both increases the likelihood of immediate success, such as solving a math problem, and that decreases the need for help subsequently (e.g., by learning now to solve such problems). Adaptive help-seeking also can provide short-term stress reduction and the long-term development of healthy self-system resources, such as self-efficacy, self-reliance, and perceived control, which are important for coping with future academic difficulties (Skinner & Zimmer-Gembeck, 2007).

Resources required for adaptive help-seeking (also described as instrumental, strategic, or autonomous; Butler, 1998; Karabenick, 1998; Newman, 2000) include:

1. cognitive competencies knowing when help is necessary and knowing how to formulate linguistically a specific question that yields exactly what is needed;
2. social competencies knowing which instructors and classmates are more knowledgeable and can potentially help them and knowing how and when to approach helpers and how and when to thank them;
3. affective-motivational resources academic and social goals, self-beliefs, and emotions that allow the student to tolerate difficulty and uncertainty and the ego strength required to withstand possibly negative perceptions in the eyes of classmates; and
4. contextual and interpersonal resources classroom and home affordances such as teachers' goals, grading system, collaborative activities, rules of student-teacher engagement, and teachers' and parents' expectations for the student that support the student's cognitive and social competencies and affective-motivational resources.

Help-seeking can also be viewed as a social strategy of self-regulation that is part of the resources of cognitively, behaviorally, and emotionally engaged learners (e.g., Butler, 1998; Karabenick, 2003, 2004; Karabenick & Knapp, 1991; Karabenick & Newman, 2006; Nelson-Le Gall & Resnick, 1998; Newman, 2000). Any learning strategy or tool can be used more or less effectively. Less adaptive help-seeking (also described as expedient, excessive, or executive) is

characterized as effort-avoidant and unnecessary (Nelson-Le Gall & Resnick, 1998); students requesting this sort of assistance typically put forth little effort, ask for help immediately or, for example, want others to supply the answers just before their homework is due. Because learning is not the objective, this form of help-seeking can encourage dependency. Just as seeking help that is excessive may not be in students' long-term best interests, avoiding seeking help when that help is truly necessary also can be non-adaptive (Marchand & Skinner, 2007). The distinction between more and less strategic, or adaptive, forms of help-seeking must be kept in mind when a teacher examines the personal characteristics and features of the learning context that influence its use

FACTORS THAT INFLUENCE THE INCIDENCE AND FORMS OF HELP SEEKING

Help-seeking has been extensively examined through the lens of achievement goal theory, which distinguishes between mastery-focused and performance-focused approaches to learning (Butler, 1998; Butler & Neuman, 1995; Karabenick, 2003, 2004; Pintrich, 2000; Ryan, Hicks, & Midgley, 1997). Consistently, mastery-oriented students, whose goal is to develop competence, are more likely to seek adaptive help or to work independently when that would be more effective (Butler, 1998). Performance-oriented students, who are concerned about appearing incompetent, are less likely to seek adaptive help. If such students do seek help, it is often for expedient or executive reasons to avoid work rather than to learn and improve (e.g., Karabenick, 2004).

Students' achievement goals at any point in time are a function both of past experiences and features of the contemporaneous learning context. Achievement goal structure refers to how students construe their classrooms and courses of study in terms of the contextual emphasis on mastery and/or performance goals (Midgley, 2002). Studies using hierarchical modeling have consistently found that students' perceptions of their classes' achievement goal structure influence their tendencies to seek or to avoid seeking help (Midgley, 2002). In elementary school classes, which students collectively judge as more focused on mastery, students are less likely to avoid seeking needed help (Turner, Midgley, Meyer, Gheen, Anderman, Kang, et al., 2002). Although young children are concerned about not appearing incompetent by asking for help, not until middle school do such concerns influence whether they will make a request (Newman, 2000). Presumably as a consequence of increased evaluation pressures that begin with the transition to middle school, performance goal-related classroom characteristics, in addition to perceived classroom mastery goals, affect middle school students' tendencies to seek or to avoid

seeking help (Ryan, Gheen, & Midgley, 1998). By the time students are in college, evidence suggests that classroom performance goals are more relevant than are mastery goals. Students in classes with a focus on performance-avoid goals, in which students are more concerned about not looking incompetent, are likely not to seek needed help; or, if they do seek help, they are likely to be motivated by expedient reasons (Karabenick, 2004).

Cultural factors, in particular, the degree of stress on individualism versus collectivism (Triandis, 1994) can also influence whether and in what situations students seek help. Learners in the United States especially are socialized to idealize individualism and deplore dependency (Fischer & Torney, 1976), values that typically add to the threat posed by help-seeking. In early theories of achievement motivation, seeking help was considered incompatible with individualistic values and, more specifically, an achievement motive (Nelson-Le Gall & Resnick, 1998). Learners in collectivist societies presumably are not as subject to the same prohibitions and should accordingly be less reluctant to seek help. This prediction was verified in that students raised in collectivistic-oriented Israeli kibbutz cultures were more likely to seek help than those socialized in individualistic-oriented cities (Nadler, 1998). Such cultural influences extend to learning and performance in the workplace as well. Evidence indicates that collectivistic (as opposed to individualistic) norms facilitate help-seeking due to the perceived safety that results from collectivist organizational norms (Sandoval & Lee, 2006).

When teachers examine the effects of culture on help-seeking, however, it is important for them to avoid essentialist generalizations. Doing so entails taking into consideration specific characteristics of tasks and learning contexts, such as whether the help is sought in public (as in classrooms), in relative privacy (after class or in faculty offices), or in complete privacy (e.g., delivered by a computer) (Karabenick & Knapp, 1988a). Thus, the cultural differences found by Nadler (1998) depended on whether students worked on tasks individually or in groups. In another example, Japanese collectivistic acculturation stresses cooperation, dependency, and empathy, which facilitate college students' seeking assistance from peers outside the classroom. Due to culturally induced deference to authority in the form of relationships with instructors, however, college students are hesitant to ask their instructors questions in class (Shwalb & Sukemune, 1998). Situational influences have also been demonstrated with U.S. and Australian college students. According to Volet and Karabenick (2006), the more that students are culturally different from their peers, the less likely they are to approach them for needed academic assistance. Importantly, this cultural effect was moderated by classroom factors: The negative relation between

cultural difference and help-seeking was less strong when instructors supported intercultural interaction among the students in their classes. This is but one way in which teachers can promote help-seeking in culturally diverse settings.

FOSTERING ADAPTIVE HELP SEEKING IN THE CLASSROOM

Help-seeking in the classroom is a social transaction (Newman, 1998a). Teachers establish and students internalize patterns of classroom discourse. It has been argued that teachers who respond to requests for help with hints and contingent instruction rather than direct and controlling answers help students both to accomplish difficult tasks and to learn that questioning is an invaluable academic strategy. In contrast, teachers who take on the role of expert (e.g., who present to the class an explanation without discussion and then expect students simply to practice) are likely to support overly dependent executive/expedient help-seeking. Moreover, when teachers personally demonstrate that uncertainty can be tolerated and perhaps even transformed into intellectual challenge students are likely to realize it is normal not to be able to solve all problems independently. It is expected that when teachers scaffold learning experiences and socialize the normalcy of academic difficulty, need for collaboration, and expectation of answers to their questions, students internalize a personal sense of empowerment and voice (Nelson-Le Gall & Resnick, 1998).

Ideally, students learn in their classrooms the value, usefulness, and skills of questioning that are important for monitoring, diagnosing, and fixing misconceptions. The frequency with which teachers call on students, the amount of time they wait for a response, and the amount and type of praise they give vary from student to student (Eccles & Wigfield, 1985). Teacher feedback helps students know when they need help. Giving no more assistance than is necessary may help students learn the difference between adaptive and non-adaptive (i.e., expedient) help-seeking. Encouraging students to go back to an incorrect problem and try to re-solve it may convince them of the importance of determining if they need further assistance. Additionally, it may be instrumental in students' coming to appreciate the function of questioning and help-seeking in the ongoing process of self-monitoring and learning (Newman, 1998a).

ESTABLISHING CLASSROOM GOALS

Teachers are responsible for establishing classroom goals. When both classroom and personal goals emphasize learning and developing competence, students are especially likely to

seek help adaptively, whereas when both types of goals emphasize performance, students are reluctant to do so. When students who are concerned about grades and looking smart are placed in a learning-goal classroom, they may tend to overcome and compensate for their personal tendencies to avoid help. Thus, by being attuned to individual students' personal goals, teachers can assist those who otherwise might give up in the face of adversity (Newman, 1998b). Teachers can also try to accommodate students' social goals (e.g., social affiliation, social status) that influence help-seeking (Ryan et al., 1997). The task of goal-coordinator is not easy, as multiple personal and classroom goals can complement or conflict with one another. Circumstances become even more complex when one considers that teachers' approaches to teaching, in terms of their own achievement goals, can influence how supportive they are perceived to be by students (Butler, 2007). Responsive teachers try to support student autonomy while at the same time satisfying their own personal achievement-related and social goals and need for autonomy within the constraints of public school settings (Butler, 2006).

In classrooms in which teachers share with children their time, energy, and nurturance, students tend to be attentive, effortful, self-expressive, and interested in learning. Teachers who are interpersonally involved with students and attuned to their goals typically establish classrooms that facilitate adaptive help-seeking. When teachers and students are aligned, teachers are especially able to take the student's perspective and understand his or her thinking regarding academic tasks and, based on this understanding, appropriately guide the student's learning. Teachers who are perceived as friendly and caring tend to demonstrate democratic interaction styles, with lines of communication open to students; they listen, ask questions, inquire if students need help, make sure students understand difficult material, and provide help in a non-threatening way (Wentzel, 1997). When they experience this type of communication, students learn that teachers are trustworthy helpers. Low achievers, who often have poor self-perceptions of ability and low self-esteem, typically are reluctant to seek academic help in class (Karabenick & Knapp, 1988b, 1991). For these students, especially, teachers who believe their responsibility is to attend to students' social and emotional as well as academic needs can counter student disengagement (Ryan et al., 1998).

POSITIVE AND NEGATIVE TEACHER INVOLVEMENT

Teacher involvement forms the basis of students' beliefs and feelings about the benefits and costs of help-seeking. Early elementary-age students generally feel comfortable approaching their teacher for assistance because of global,

affective traits of the teacher such as niceness and kindness. By the middle of elementary school, students tend to view teachers as helpful when they show an awareness of their problems and give them advice, time, energy, and encouragement to ask questions in class (Newman & Schwager, 1993). In classes in which teachers are perceived as supporting collaboration, student questioning, teacher fairness, respect and caring, middle and high school students are especially likely to seek adaptive help. The same is true at the college level (Karabenick & Sharma, 1994). Just as positive teacher involvement can foster help-seeking, negative involvement can do just the opposite. As early as grade 2, students often are fearful of teachers' negative reactions (e.g., "I think she might think I'm dumb") if they ask for help (Newman & Goldin, 1990). Perceived costs are heightened when teachers are unwilling to help (e.g., "if you had paid attention, you wouldn't need to ask that question"). Children weigh relative benefits and costs of help-seeking, with the integration process becoming increasingly complex over the school years, whereas older students increasingly struggle in deciding what to do when they need academic assistance (Newman, 1990).

In sum, a critically important task for teachers is to help students become self-regulated learners. Clearly, students must learn how to cope with academic difficulty. Teachers can enhance students' personal beliefs about the usefulness of help-seeking as a strategy of self-regulated learning. As noted earlier, when teachers stress the intrinsic value of learning in their classrooms and emphasize understanding and improvement rather than just getting good grades or avoiding bad grades, students are most likely to seek help in an adaptive way. Sensitive and responsive teachers buffer students from factors, such as potential embarrassment, that typically inhibit them from seeking the help they need. How teachers coordinate multiple forms of achievement and social goals, how they accommodate students' personal and interpersonal needs, how they structure task activity, and how they actually engage students through instruction can affect help-seeking and maximize the likelihood of student success.

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HIGH SCHOOL, TRANSITION TO

SEE *School Transitions: High School*.

HIGH STAKES TESTING

High stakes testing is so named because the test outcomes are used to make important, often life-altering decisions. Such decisions may include the denial of a high school diploma, the repetition of a grade, the labeling of students and schools in pejorative ways, the withholding of funding, and even the closing of a school. Students who may do well in school all year but fail a high stakes test may be required to attend summer school and take the test again or spend another year in the same grade. Local newspapers routinely publish the results of high stakes tests, which can cause a range of reactions from pride to shame among students, school staffs, and parents.

ORIGINS

High stakes testing in schools had its origin in the 1980s with the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983) issued by the Reagan administration. The report stated that public schools in the United States lacked rigorous standards and were failing. It also attacked the social promotion of students. The Business Roundtable (BRT) initiated a campaign to return curriculum to the so-called basics (such as phonics), require schools to meet high standards, and be held accountable. These reforms were to be guided by experts from the business world who understood the economy (Johnson, Johnson, Farenga, & Ness, 2008).

When the Louisiana state legislature appointed a School Accountability Advisory Committee in 1998, the state became the first in the nation to inaugurate high stakes testing with harsh consequences. Fourth- and eighth-graders were targeted for testing, and students who did not score at predetermined performance levels were to spend another year in the same grade. Low performing schools were to be sanctioned with increasingly severe measures. Within a few years, 7 states based grade promotion on a statewide test score, and by 2008, 24 states were anticipated to require passing a statewide test to graduate from high school (Education Week, 2006). Additional consequences of test results include monetary rewards to high-test-performing schools in 16 states; turning allegedly failing schools over to private managers in 14 states; sanctioning, with varying penalties, low-performing schools in 28 states; and allowing closure of low-performing schools in 10 states (Johnson & Johnson, 2006).

Public Law 107-110, called the No Child Left Behind (NCLB) bill, was signed into law on January 8, 2002, by President George W. Bush. All children, regardless of physical or mental challenges, race, socioeconomic status, or English language proficiency are to have an equal and significant opportunity to attain a high-quality public education. NCLB mandates the annual testing using each state's achievement test of every child in grades three through eight. The law requires that by 2014, every child

must achieve proficiency in reading and math as measured by the high stakes tests, but it leaves the definition of proficiency to each state. NCLB links standardized test performance to sanctions for public schools that fail to make adequate yearly progress (AYP) by each subgroup of students based on special needs, minority status, English language proficiency, and socioeconomic status. Sanctions include the requirement that every school make public the achievement scores of each student subgroup. Schools that do not achieve AYP must help their students, who wish to do so, transfer to another school and pay the students' transportation costs. Schools are required to provide special tutoring for low-performing students, typically done through contracts with private tutoring firms. In extreme cases, sanctions may call for the replacement of an entire school staff (Schrag, 2007). No Child Left Behind has become synonymous with high stakes testing even though other elements of the law focus on teacher qualifications and professional development.

ARGUMENTS OF HIGH STAKES TESTING PROPONENTS

High stakes testing, as exemplified by NCLB, is highly controversial. Proponents of NCLB claim that the law has focused a spotlight on the plight of underserved, mostly minority, high poverty students. Holding schools accountable for all children, pinpointing failing schools, and allowing poor children to have access to amenities such as private tutoring, is sensible and just. The testing allows teachers to discuss low-performing students and subgroups and generate instructional improvements (Gunning, 2008). Proponents of high stakes testing believe that high standards and high stakes tests are essential to motivate students, teachers, and administrators to work ever harder to boost achievement. High stakes testing, proponents believe, will ensure that high school graduates will have the academic skills requisite for success in the workplace. For high stakes testing to be effective, the consequences of low achievement must be severe—hence, the use of sanctions such as repeating a grade, withholding a high school diploma, or school closure.

ARGUMENTS OF HIGH STAKES TESTING CRITICS

Critics of high stakes testing contend that NCLB mandates for proficiency in reading and mathematics have meant the de-emphasis or elimination of art, music, oral language, history, science, physical education, and even recess in many public schools, especially in low-performing, underserved schools. Creativity, innovation, critical thinking, discussion, and debate are things of the past in these schools, having been replaced by lock-step, repetitive test-preparation activities. The Center for Education Policy

(Dillon, 2006) reports that 70% of the nation's school districts have eliminated courses to make more time for math and reading.

High stakes test opponents argue that test scores are more likely related to socioeconomic status than to school test preparation. Standardized tests punish poor, minority, special education, and non-English-speaking students in underfunded schools who must compete with middle class and wealthy students in well-funded schools on the same high stakes tests. Children who never have traveled, have few books and resources in their homes, are hungry, ill-clad, in pain or in poor health, and who live with violence cannot be expected to make the same progress or be at the same test level as children whose life circumstances are the opposite. With high stakes testing, less privileged students must endure unwarranted stress and humiliation while being denied a well-rounded education such as that enjoyed by students in affluent or private schools (Johnson et al., 2008).

Measurement issues have been another cause for concern about high stakes testing. Group standardized tests inaccurately assess individual strengths and weaknesses, and the results are unreliable. Flaws in test design and scoring have created serious problems and have led to the recall of test results in Massachusetts, Nevada, and Georgia. A scoring error on PRAXIS, a teacher certification exam, failed 4,100 prospective teachers nationwide (Johnson & Johnson, 2006).

There is ample evidence that what is measured on state high stakes tests often does not transfer to other measurements or situations (Amrein & Berliner, 2002). Learning that does not transfer from one situation to another frequently is shallow learning.

A comparison of percentages of students achieving proficiency on state tests with the federally administered National Assessment of Educational Progress (NAEP) shows wide disparities by state. On the Mississippi state test, nearly 90% of test takers were judged proficient, but on the NAEP, fewer than 20% were shown to be proficient. In Missouri, the gap between the state and NAEP results was only 2% (Wallis & Steptoe, 2007). Such disparities illuminate the lack of transfer but also the variability in state standards and state test expectations.

Lower state standards and lower target scores to determine proficiency give the appearance that a state is doing well. In 2005, 19 states reported that 80% or more test takers scored at the proficient level on the state tests. In contrast, in only one state, Massachusetts, did more than 40% of test takers score at the proficiency level on the NAEP. Critics question what proficiency under NCLB really means. High stakes testing is corrupting American education according to Berliner and Nichols (2007), who provide examples of administrators and teachers cheating by falsifying test data.

When school staffs' reputations, salaries, and job retention are related to student test performance, such corruption sometimes happens.

Other criticisms of high stakes testing and NCLB include the increasing numbers of school dropouts as schools focus on the middle range of students to the neglect of the lowest performers (Viadero, 2007). High stakes testing has been pushed on ever younger children, including preschoolers and, under the Bush administration, Head Start children. State and federal mandated testing has led to a financial bonanza for corporations in the testing, tutoring, and publishing industries as billions of dollars are spent to raise test scores.

High stakes testing has prompted extraordinary practices. In Florida, where test secrecy is sacrosanct, a 12-year-old who gained access to a test was charged with a felony (*Education Week*, 2004). In Louisiana a multiple-district pep rally for the state test included 800 band members, 400 cheerleaders, and a flyover by Navy pilots (Nelson, 2003). The New York City school district inaugurated a plan to pay students up to \$500 for doing well on mandated tests (Medina, 2007).

While proponents and opponents of high stakes testing do battle with each other, the testing continues, and as of 2008, No Child Left Behind remains the law of the land. Only time will tell if the education pendulum swings away from the standards, testing, and accountability movement.

SEE ALSO *Accountability*.

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HOME-SCHOOL DISSONANCE

Students experience home-school dissonance when their integrity and adequacy are threatened by real or perceived differences between home/self and what is valued within the school context. Home-school dissonance includes both cognitive and affective components. It incorporates an awareness of real or perceived discrepancies between home culture—a reflection of who one is and what is valued in the school context and the negative emotional reaction that accompanies this awareness (Kumar, 2006). Phelan and colleagues (Phelan, Davidson, & Yu, 1998) defined these discrepancies as borders between students' selves—thoughts, feelings and adaptation strategies—and the worlds of home, school, and peers, all located within students' larger community. Each "world" is characterized by values, beliefs, expectations, actions, and emotional responses that may be consonant or dissonant across contexts. Not all differences necessarily lead to feelings of conflict and dissonance. It is the threat to self posed by perceived cultural differences and discrepancies, not the differences *per se* that arouses dissonance.

ANTECEDENTS OF HOME SCHOOL DISSONANCE

Home-school dissonance is often a consequence of contact between the school culture, reflecting mainstream culture, and home or community culture. Dissonance results from the differing demands placed on students as they negotiate the norms, values, and behavior expectations of both contexts (Kumar, 2006; Phelan, Davidson, & Yu, 1998). Many immigrant and minority children, and adolescents from ethnically and economically diverse backgrounds, perceive differences between home and school cultures as insurmountable (Suarez-Orosco & Suarez-Orosco, 2002). Others may negotiate the boundaries between the two even when norms, values, and behavior expectations are dissonant—though this may come at great psychological cost (Gibson, 1991; Arunkumar, Midgley, & Urdan, 1999; Phelan, Davidson, & Yu, 1998).

Adolescents' feeling of home-school dissonance is a function of the degree of polarization in values and normative expectations between contexts (Ward, Bochner, & Furham, 2001). Adolescents' subjective culture including, among others, beliefs about parents' academic and behavioral expectations, occupational aspirations, and normative attributions for school success and failure shapes their behavioral choices and motivational orientation toward learning and achievement. Immigrant and minority adolescents may find such choices problematic when family culture does not align with what is considered normative in mainstream culture.

Home-school dissonance often arises because adolescents feel that qualities they possess are devalued in school and society (Graham & Hudley, 2005). For example, the cultural markers associated with African American youth dress, music, and language are often equated with poor performance (Ladson-Billings, 1995) and classroom misbehavior (Spencer, 1999). Along similar lines, several European countries look upon *hijab* (head scarves worn by Muslim girls and women) with disfavor and preclude students from wearing *hijab* in schools. Sometimes students belonging to groups that are numerical minorities in school or whose phenotypic characteristics differ from mainstream society feel marginalized because they do not "fit in" with peers and others (Brewer, 2003).

By studying acculturation patterns of immigrant minorities to host societies, researchers highlight the importance of intercultural relations within the school context to understand adolescents' experiences of home-school dissonance (Montreuil & Bourhis, 2004). Group membership is the lens through which individuals in a culturally pluralistic society view one another. Thus when students categorize themselves as minority or others within the school context, the probability of stereotyping, ethnocentrism, intergroup clashes, and competition increases (Tajfel & Turner, 1979). Mainstream members are more likely to adopt a segregationist orientation toward immigrants whose culture differs considerably from the mainstream. Ethnic group relations in schools parallel ethnic and minority immigrant group inclusion or exclusion within American society (Montreuil & Bourhis, 2004). In fact, cultural minority students in more integrated school environments report greater exclusion and ostracism than students in more homogenous school environments. Friendship patterns in schools are also based on the inclusion or exclusion of a student's racial, ethnic, or national group.

While some experiences of home-school dissonance are tied closely to students' racial, ethnic, religious, and socioeconomic background, others cut across cultural lines. Students often feel marginalized when not performing well in school and when they feel disengaged from an environment designed to promote learning (Kumar, Gheen, & Kaplan,

2002). Kumar (2006) conducted a growth-curve study examining stability and change in adolescents' experiences of home-school dissonance during the elementary-to-middle school transition and found that dissonance increases when students perceive an evaluative classroom environment and move into middle schools that encourage social comparison and competition among students. These findings are supported by interviews conducted with seventh-grade students who reported high home-school dissonance. No two students experienced dissonance for all the same reasons. Interviews indicated that lack of material resources and cultural affiliations promoted feelings of dissonance in many students. Additionally, students described school factors, including emphasis on relative ability in the classroom and the nature of student-teacher relationships, as contributing to home-school dissonance.

Beliefs and behaviors of significant others in both contexts may also trigger feelings of home-school dissonance among students. Teachers' attitudes toward students, together with the ways they communicate expectations, influence students' beliefs about themselves, motivations and behaviors (Oakes, 1985). Evidence indicates that teachers reflect society's deep ambivalence toward minority and immigrant students in their attitudes towards these students (Suarez-Orosco & Suarez-Orosco, 2002). If teachers view cultural minority students as lazy, less intelligent, and more prone to trouble, such expectations may exert a profound effect on students' beliefs about school, motivation and behavior thereby exacerbating feelings of dissonance.

PSYCHOLOGICAL CONSEQUENCES OF HOME SCHOOL DISSONANCE

There is a psychological cost associated with feeling caught between two cultures, marginalized, powerless, and socially alienated (Rosenberg, 1962; Ward, Bochner, & Furham, 2001). High-dissonance fifth-grade students reported feeling angrier, engaged in more self-deprecation, had lower self-esteem, were less hopeful about the future, felt less academically efficacious, and had a lower GPA than low-dissonance students. Additionally, high-dissonance students experienced a greater decline in GPA and smaller decline in anger than low-dissonance students when moving from elementary school to the larger, more complex middle-school environment (Arunkumar et al., 1999). Home-school dissonance, controlling for ethnicity, is also a significant predictor of skeptical beliefs about the value of school (Kumar, Gheen, & Kaplan, 2002) and lower levels of school belonging (Kumar, 2006). Poor intercultural adjustment is associated with depression, anxiety, and poor emotion regulation among students of different ages (Buddington, 2002).

For some adolescents and young adults from immigrant and minority groups the sociocultural differences between classroom and family culture norms interfere with their ability to adjust to school environments (Lafromboise, Hardin, Coleman, & Gerton, 1993). Tharp and his colleagues (Vogt, Jordan, & Tharp, 1993) demonstrated that traditional American classroom structure (independent seat work, whole-class instruction) interfered with Hawaiian students' learning. Changes in classroom structure that incorporated group learning centers and peer collaboration similar to their community's emphasis on sharing, cooperation, and group needs facilitated adjustment to school. Gibson's ethnography (1991) demonstrated that Punjabi adolescents not joining majority-dominated school activities were made to feel culturally inferior by their peers. Ogbu (1987) attributes poor school performance, low motivation, and high dropout rate among African Americans and non-immigrant Latinos as resistance to mainstream institutions. Research also indicates that the aggressive coping attitude of African American youth results from the dilemma posed by competing allegiances and socialization contexts that are daily stressors. This reactive coping mechanism is seen as a response to negative peer and teacher perceptions and an inferred, undervalued sense of self (Spencer, 1999).

Both negative and positive stereotyping regarding group intellectual capacity contribute to dissonance. Experimental studies on stereotype threat demonstrate that awareness of negative stereotypes regarding one's groups' intellectual capacity results in disidentification with academic achievement (Steele 1997) and dropping out of school (Osborne & Walker, 2006), because group members perceive these attributes as stable, internal, and uncontrollable (Reyna, 2000). It is equally likely that the "model minority" stereotype associated with Asian American adolescents often sets them up for failure. Many low-performing, model-minority adolescents feel ashamed of poor performance and inability to fulfill the stereotype. Consequently, they are reluctant to seek academic support, thereby perpetuating their academic struggles (Lee, 1996).

AMELIORATING DISSONANCE IN SCHOOL AND CLASSROOM PRACTICES

Schools and teachers who want to promote the well-being of students at risk for experiencing dissonance need to face the challenge of minimizing the saliency of differences among students and work to foster learning within an inclusive and empowering environment. This can be accomplished at the individual level by requiring teachers and school personnel to examine their own beliefs and behaviors toward culturally diverse students and at the systems level by restructuring school practices in ways that help ameliorate home-school dissonance.

For quite some time educators have stressed the need to encourage teachers to critically examine, and overcome their personal prejudices and biases so that they may be fair and equitable in their dealings with students. As early as 1971 Geneva Gay, a prominent multicultural education scholar, developed a model for educating prospective teachers. The model included three components for multicultural education: *knowledge*, whereby "teachers become literate about ethnic group experiences" (p. 34); *attitudes* "to help teachers examine their existing attitudes and feelings towards ethnic, racial, and cultural differences" (p. 43); and *skills* "to translate their knowledge and sensitivities into school programs, curricular designs, and classroom instructional practices" (p. 48). The 2006 revisions of the National Council for Accreditation of Teacher Education (NCATE) guidelines advocate the deliberate articulation of multicultural values into all the standards that define quality teaching; a focus on the ideals of fairness; the utilization of teaching and learning strategies that permit all students to learn; and the application of knowledge as it relates to students, families, and communities.

The social reconstructionist view of multicultural education takes a systems approach and calls for major school policy reform that will promote equity among students (Banks & Banks, 1997). It urges schools to dismantle policies and practices promoting inequality such as tracking and ability grouping and replace them with policies and practices that empower students to acquire the knowledge and skills necessary to function effectively. This, according to Banks & Banks (1997), requires integration of multicultural curricula into all subject areas; an understanding among teachers that all knowledge is culturally constructed (and thus necessitates the adoption of culturally relevant pedagogical approaches); and the reduction of prejudice and improvement of inter-group relationships in the learning context. In essence, social reconstructionists' vision of education through equity pedagogy and culturally responsive teaching requires redefinition of school culture that students find empowering, validating, and inclusive.

The understanding of school and classroom culture in a way that can help ameliorate home-school dissonance and foster a sense of belonging to school, can be advanced by achievement goal theory, a social cognitive theory of motivation that conceptualizes the relationships between school learning environments and students' motivational, emotional, and academic well-being. Achievement goal theory defines school practices that encourage intellectual development through effort and engagement in challenging activities as "mastery-focused," and describe school practices in which comparison and competition are the norm as "performance-focused" (Maehr & Midgley, 1996). For instance, practices such as public honor rolls or special privileges based upon academic standing send

important messages to students regarding what constitutes success in a given school (Maehr & Midgley, 1996). In a performance-focused school environment, the nature of the task is not the issue; rather, the focus is on student performance, particularly relative to others. Thus, one of the main distinctions between mastery- and performance-focused environments is a focus on self-improvement versus a focus on the self in comparison to others in the environment.

Mastery-focused learning environments are designed to create a community of learners in an atmosphere of mutual respect. An environment that promotes respect for and openness toward others' ideas and ways of thinking is more likely to encourage students and teachers to be less judgmental of others whose ideas, values, and cultural norms are different from theirs. Thus, a mastery-focused academic culture, unlike a performance-focused one, is beneficial for students at risk of experiencing home-school dissonance (Kumar, 2006).

Research across disciplines indicates that home-school dissonance produces negative consequences. Though not all minority students experience home-school dissonance, they are at risk if they perceive insurmountable discrepancies between the two contexts. Nevertheless, mastery-focused school and classroom environments can be created that ameliorate feelings of home-school dissonance and emphasize differences as a source of opportunity. This is best done exposing students to multiple cultural perspectives and contrasting systems of thought and affect, thus creating cognitive flexibility and tolerance.

SEE ALSO *Bilingual Education; Multicultural Education; School Belonging.*

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Revathy Kumar

HOME SCHOOLING

Home schooling is a term used to refer to the education of children by their parents or guardians in a setting other than a public or private school, most often in their homes. Home schooling styles vary substantially; there is no typical home schooling day. Methods of instruction include, but are not limited to the parent directly instructing the child, the child watching a video recording or satellite feed of an actual classroom, completing self-study workbooks or computer programs, some types of online instruction, or reading literature (Clements, 2004). Additional activities may include field trips, volunteering, scouting, organized sports, or taking classes through a home school cooperative in which parents teach groups of students. There is a practice often described as unschooling in which no traditional educational activities are employed, but students are encouraged to learn through life experiences (Clements, 2004). An example might be learning geometry, physics, drawing, and economics through the planning and construction of a structure such as a cabin or small home.

THE EMERGENCE OF HOME SCHOOLING

Parents' right to direct the education of their children is founded on the Fourteenth Amendment to the U.S. Constitution as interpreted in *Pierce v. Society of Sisters*. In 1925, after the state of Oregon adopted a law requiring all children to be educated in public schools, the U.S. Supreme Court ruled in *Pierce v. Society of Sisters* that private schools have the right to exist and that parents have the right to direct the upbringing and education of their children (Bloom, 2003). This decision has been commonly used to support home schooling, as have several legal opinions since (e.g., *Troxel v. Granville*, decided June 5, 2000, as cited in Bloom, 2003).

State legislatures, influenced by repeated legal challenges from home schooling families, gradually changed their laws to permit the practice of home schooling as it grew in popularity during the 1980s. By 1993 home schooling had become legal in all 50 states in one form or another. The increased availability of home schooling as an educational option and reduced stigma toward home schooling since the 1980s partially explains its

estimated annual growth rate of 15 to 20 percent during the 1990s (Lines, 2000). As of 2003 home schoolers constituted approximately 2.2 percent of the total school-age population (National Center for Education Statistics [NCES], 2006). However, attempts to pin down the actual number of home schooled children found that 2 to 3 percent of the school-age population remained unaccounted for in either home school or traditional school reporting, so the number could actually be closer to 5 percent. Because not all states require registration of home school families, the exact number of children being home schooled is difficult to determine (Lines, 2000).

Home schoolers have traditionally been thought to consist primarily of very conservative or very liberal families. Religiosity is significantly associated with both private schooling and home schooling. Evangelical Protestant parents are more likely to home school than are other groups of parents, but do not constitute the majority of home schoolers (Isenberg, 2007). Since the rapid increase in home schooling during the 1980s and 1990s, families from many religious and political persuasions are found among those home schooling (Reich, 2002; Romanowski, 2001). The typical home schooled child comes from a two-parent household in which parents have an above-average level of education, according to the *U.S. Department of Education Trends in Schools from 1993–1999* (NCES, 2003). Compared with private school children, however, home school children tend to come from less affluent and more rural households.

PARENTS' REASONS FOR HOME SCHOOLING

After completing an empirical study investigating parents' reasons for home schooling, Green and Hoover-Dempsey stated, "Homeschool parents appear to decide to home-school not so much because they believe that public schools cannot educate their children but because they believe that they are personally responsible for their child's education and they are capable of educating their children well in ways consistent with their priorities" (2007, p. 278). According to Brian Ray (2006), president of the National Home Education Research Institute [NHERI], primary goals prompting families to home school include the following:

- Teach a particular set of values, beliefs, and worldview
- Accomplish more academically than in schools
- Customize or individualize the curriculum and learning environment for each child
- Use pedagogical approaches other than those typical in institutional schools, enhance family relationships between children and parents and among siblings



In a typical home schooling scenario, the lessons for each child are tailored to that particular child. BRIDGET BESAW GORMAN/AURORA/GETTY IMAGES.

Provide guided and reasoned social interactions with youthful peers and adults

Provide a safer environment for children and youth, given problems in schools with physical violence, drugs and alcohol, psychological abuse, and improper and unhealthy sexuality

The National Home Education Network publication *Reasons to Home School* listed spending more time together as a family as the number one reason to home school. In 1999 and 2003, the National Household Education Surveys Program (NHES) collected responses from a nationally representative sample regarding reasons people choose to home school. The top reasons were “concerns about the environment” of other schools (31%), “to provide religious or moral instruction” (30%), and “dissatisfaction with academic instruction” at other schools (16%, NCES, 2004, p. 2). Isenberg (2007), by combining several sources of data on reasons for home schooling, supported the idea that approximately 30% of parents home school primarily for religious reasons (25% to

52%, depending on the year of data collection) but that educational reasons are more often cited as reasons for home schooling. These include dissatisfaction with current public schools as well as disability or exceptionality of the child being home schooled.

Many parents who choose to home school cite a weakening of emphasis on the teaching of traditional school subjects such as writing and mathematics in public schools and a promotion of certain social constructs such as tolerance. For example, as states enact legislation that mandates teaching tolerance regarding such controversial subjects as homosexuality, parents who object to those subjects being taught to their children become more likely to remove their children from public schools. This exodus from schools, seen as many educators as sheltering children from developing a broader world view, is seen by home schooling parents as a chance to both teach children their own world view and protect their children from indoctrination with competing views.

THE EFFECTS OF HOME SCHOOLING

There is abundant evidence that home school students tend to be quite successful academically and socially. Home schoolers' average test scores have been well above that of their public and private school counterparts on average. In fact, as of 2008, no study indicated lower achievement (Lines, 2000) or poorer adjustment of home-schooled children. However, just as there is difficulty obtaining an accurate number of children being home schooled, there is difficulty ensuring the representativeness of data reporting on the effectiveness of home schooling. It is possible that those parents who are more successful at home schooling are also more likely to respond to surveys, report achievement data, have their children participate in standardized testing, and have children who apply for college admission.

Home Schooling and Achievement. In 1998 Lawrence Rudner of the University of Maryland conducted a study of 20,760 home schooled children who took the Iowa Tests of Basic Skills or the Tests of Achievement and Proficiency. Among the findings were the following:

The median scores for every subtest at every grade (most in the 70th to 80th percentile) were well above those of public and private school students.

Almost 25 percent of home school students were enrolled one or more grades above their age-level peers in public and private schools.

On average, home school students in grades 1 to 4 performed one grade level above their age-level public/private school peers.

The achievement test score gap between home school students and public/private school students widens from grade 5 upwards.

Students who have been home schooled their entire academic lives have higher scholastic achievement test scores than students who also have attended other educational institutions.

Rudner's findings are not atypical. An earlier study by Ray (1997) showed higher standardized test scores among home school students than among the general population. A separate study found that home school children in the state of Washington consistently scored above the national average in reading, language, math, and science. Of course, these are data from children who participated in these assessments. Nothing is known about children who were not tested.

In a survey of adults aged 18 to 24 who had been home schooled, more than 74 percent have taken college-level courses as compared with 46 percent for the general U.S.

population. An overwhelming majority of them report that they are glad they were home schooled (Ray, 2006). In a related study, it was found that, while the potential for success in college did not differ significantly between home school graduates and conventional-school graduates, home school students did earn higher scores on the ACT English subtest (Ensign, 1997).

Perceptions of home schoolers applying for college admission became more favorable between 1993 and 2008. As of 2004, approximately 75 percent of institutions had a home school admission policy, and the vast majority of college admissions officers responding to the survey reported that they expected home-schooled students to do as well or better than non-home schooled students. In fact, no significant differences are typically found between home schooled and traditionally schooled first-year college students on ACT score, GPA, or retention.

The home schoolers' achievements that have gained the most public attention have been spelling and geography bee wins. In 2001, the winner of the National Spelling Bee was the third winner in five years to have been home schooled. Ten percent of the 2001 spelling bee contestants were home schooled (which is significant given that home schoolers made up less than 5 percent of the student population with some estimates as low as 2 percent). In 2000, eight of the finalists had been home schooled, with home schoolers taking the top three places.

Home Schooling and Socialization. The primary concern expressed about home schooling does not involve academic achievement, but tends to be related to students' socialization or more accurately lack of socialization. Those concerned envision home schoolers as being isolated with their parents, having little cultural exposure, little opportunity to interact with other children, and having minimal contact with the world beyond their homes. In truth, for many home schoolers the opposite is true. Some have such an excess of social and extracurricular activities that having time to complete their studies can be challenging. Many, if not most home schooling parents supplement academic material with extracurricular activities such as music lessons, sports, scouting, church activities, and other endeavors that engage children with their peers (Clements, 2004).

Not only are findings about socialization of home-schooled children not negative, several researchers have found an overwhelmingly positive picture of the socialization of home school students (see, for example, Medlin, 2000). Home schoolers are provided opportunities that foster positive interaction and they also are protected from many sources of negative socialization (Lines, 2000; Romanowski, 2001; Shyers, 1992). Richard Medlin of Stetson University found that self-concept was higher for home school students than for public school students, and in a

blind, controlled study comparing 70 home school with 70 non-home school children, the former had fewer behavioral disorders (Lines, 2000).

Home Schooling and Homogenization. One goal of public education is to provide common experiences for children with the goal being some degree of homogenization of citizens. Along with fears about lack of socialization in home schoolers, an additional criticism involves an alleged lack of homogenization of home school children. Some, such as Rob Reich (2002) of Stanford University, believe that children should be exposed to a common set of ideas and have a common set of experiences. He sees a civic peril in insulating children from certain ideas. However, the same argument could be leveled against public schools. The practice of prohibiting the expression of religion in public schools particularly Christianity is an example. It is unlikely that a child whose parents have never introduced him or her to Christian beliefs would learn about them in public school. The argument for exposing the child to a broad range of ideas thus breaks down. Reich goes on to argue that children should learn decency, civility, and respect. However, the perceived absence of these values in the public school environment is a common reason that parents remove their children from public schools in favor of home schooling.

Some Explanations for the Success of Home Schooling. Available data suggest a number of hypotheses as to why home-schooled children excel academically. These include parental involvement, the education level of the parents, and the benefits of one-on-one instruction. Romanowski of Ohio Northern University and Hoxby of Harvard, among others, attribute home schooled students' success to the high degree of parental involvement. There has been a great deal of research supporting the benefits of parental involvement in children's education. In fact, teacher training programs and schools routinely recommend techniques for soliciting parents' involvement within public and private schools for this reason.

A second possible explanation for the academic success of home schoolers is that home-schooled children tend to have more educated parents (Romanowski, 2001). As mentioned, home schooling families tend to have parents with more years of education than public and private school families. Either the value placed on education or the intelligence that enabled those parents to complete more education could contribute to their children's academic success.

An additional reason for the success of home schooling is that one-on-one instruction has traditionally been thought to be more effective than traditional group schooling. In a typical home schooling scenario, a parent may teach only one or may teach multiple children, but the

lessons for each child are tailored to that child. This is of particular benefit to children who learn more rapidly or more slowly than most children in their age group. In group schooling teachers usually teach to the majority which tends to be composed of children achieving at the average rate, leaving slow learners behind and causing rapid learners to lose interest. One-on-one instruction has also been found to be beneficial to children with attention deficits. Having fewer people in the learning environment reduces distractions, thereby helping the student to stay focused on learning.

THE AVAILABILITY OF THE OPTION TO HOME SCHOOL

Research has accumulated over several decades showing numerous benefits of home schooling; however, it is not possible for all families who would like to home school their children to do so. Most, but not all, of these reasons are economic. Families who must have two incomes or families in which a single parent is the only income earner have difficulty home schooling. However, there are non-economic reasons as well. There are families in which the parent or parents do not have the education or temperament to be able to effectively home school (Clements, 2004). For these, a group schooling setting may be their only option.

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Andrea D. Clements

HOMEWORK

Homework can be defined as tasks assigned to students by teachers that are intended to be carried out during nonschool hours. This definition excludes (a) in-school guided study (although homework is often worked on during school); (b) home study courses, and (c) extracurricular activities such as sports teams and clubs.

VARIATIONS IN HOMEWORK

According to Harris Cooper (2007), the most common variation in homework assignments relates to its content or subject matter. Independent of content, homework assignments also vary in their purpose or goal. Practice homework assignments ask students to go over material already presented in class so as to reinforce learning and facilitate mastery of specific skills. Preparation assignments introduce material that will be presented in future lessons. These assignments aim to help students obtain the maximum benefit when the new material is covered in class. Extension homework involves the transfer of previously learned skills to new situations, such as asking students to apply their mathematics knowledge to construct a household budget. Finally, integration homework requires the student to apply separately learned skills to produce a single product, such as reading a book and writing a report on it.

Homework also can serve purposes that do not relate directly to instruction. Homework can be used to (a) establish communication between parents and children, (b) fulfill directives from school administrators, (c) punish students, and (d) inform parents about what is going on in school. Most homework assignments have elements of several different purposes.

Assignments can vary in many other ways, including the skill area covered (e.g., reading, writing, math), the level of difficulty, and the time required for completion. With regard to the latter, the amount of homework students are assigned can best be thought of in terms of (a) the frequency, or how often, homework is assigned and (b) the duration of each assignment, or how long it takes to complete each assignment. For example, two students doing four hours of homework a week might be having very different homework experiences. One might be doing one hour of homework on each of four nights while the other is doing two hours of homework on just two nights.

POSITIVE AND NEGATIVE EFFECTS OF HOMEWORK

The most direct positive effect of homework is that it can improve the retention and understanding of academic material. More indirectly, homework can improve students' study skills and attitudes toward school (by showing how skills that are learned in school have application to activities students enjoy doing outside school) and can teach students that learning can take place anywhere, not just in school buildings. The nonacademic benefits of homework include fostering independent and responsible character traits. Finally, homework can involve parents in the school process, enhancing their appreciation and understanding of what goes on in the classroom and allowing them to express positive attitudes toward the value of school success.

Homework can have negative effects as well. It can lead to boredom with schoolwork if students are required to spend too much time on academic material. Homework can deny students access to leisure time and community activities that also teach important life skills. Parent involvement in homework can turn into parent interference. For example, parents can confuse their child if the instructional techniques they use at home differ from those used by teachers. Homework can lead to the acquisition of undesirable character traits if it promotes cheating, either through the copying of assignments or if the student receives help with homework that goes beyond tutoring. Finally, homework could accentuate existing social inequities. Diane Scott-Jones has argued that children from disadvantaged homes may have more difficulty completing assignments than their middle-class counterparts.



Homework can reinforce concepts taught in the classroom. ANDY SACKS/STONE/GETTY IMAGES.

RESEARCH ON HOMEWORK

Research on homework generally supports the notion that it helps students learn academic material, but with important qualifications. Cooper, Jorgianne Robinson, and Erika Patall have conducted, since 1984, six studies that used two groups of students who were on average as similar as possible by randomly assigning students to groups, statistically controlling for student differences, or matching a student in one group with a similar student in the other group while eliminating students who did not have a good match and then manipulated whether students did or did not receive homework assignments. These studies provide a clear picture that homework can be effective in improving students' scores on unit tests (the class tests that come at the end of a topic unit). Students doing homework in second grade did better on number places, third and fourth grade did better on English skills and vocabulary, fifth grade on social studies, high school on American history, and twelfth graders on Shakespeare. Across five studies, the average (50th percentile) student doing homework had a higher unit test score than 73% of students not doing homework.

A second type of study supports the conclusion that students who do homework perform better on tests. This type simply asked students (or one of the students' parents) how much homework the students did; no manipulation of homework assignments was involved. However, these studies attempted to statistically equate students on other characteristics that might be associated with homework and achievement and therefore might account for any relationship between the two. Because they do not purposely manipulate homework, these studies can never lead to as confident a conclusion about homework's direct effect on achievement. However, they do typically involve large nationally representative samples of students such as the National Educational Longitudinal Study. Also, these studies typically use broader measures of achievement than unit tests, such as cumulative grades and standardized test scores. Twelve such studies have tested more than 30 different statistical models. The other factors that might influence achievement (and time on homework) that were controlled for in the statistical models included numerous student factors (for example, sex, ethnicity, ability, motivation), family factors (for example,

wealth, parent involvement), school factors (for example, subject matter, teacher training, class size), and other student behaviors (for example, TV watching, extracurricular activities and jobs, absences from school). Achievement was measured for all sorts of content areas using all types of achievement measures. In 11 of the 12 samples, the link between time on homework and achievement was positive.

A third type of study that looked at homework involved no attempt to purposively vary homework or to equate students on other characteristics that might explain any relationship. Thus, these correlational studies can make no claims about a causal link between homework and achievement. Though not conclusive, this type of evidence can give important clues about when, where, and for whom homework might be more or less effective. In 35 samples of students used in correlational studies, 27 found the link between homework and achievement was a positive one; in 8, it was negative.

The correlational results were noticeably different depending on the grade level of the students. The average correlation between time spent on homework and achievement was substantial for secondary school students but for elementary school students, it hovered around no relationship at all. There are several possible explanations for this finding. First, cognitive psychologists Dana Plude, James Enns, and Darlene Broudeur suggest that younger children are less able to tune out distractions. It is easy to imagine that the distractions present in a younger student's home would make studying there less effective for them than for older students. Second, a study by Annette Dufresne and Akira Kobasigawa suggests that younger students have less well-developed study habits. Their study showed that older students spend more time than younger ones working on harder items. Older students were also more likely to use self-testing strategies to monitor how much of the material they have learned.

Other explanations for the weak correlation between homework and achievement in early grades are possible. A study by Laura Mulhenbruck, Cooper, Barbara Nye, and James Lindsay found evidence suggesting teachers in early grades may assign homework more often to develop young students' management of time—a skill rarely measured on standardized achievement tests or graded in class. This study also provided some evidence that young students who are struggling in school take more time to complete homework assignments. Thus, while it seems highly likely that age difference in attention span and study habits can be applied to the homework situation, it is also likely that poor-achieving young children spend more time on homework simply because it is more difficult for them.

APPROPRIATE AMOUNTS OF HOMEWORK

Based on these results and the experience of teachers, consensus has emerged regarding rough guidelines for the amount of homework that should be assigned to students in different grade levels. The National PTA and the NEA suggest that homework for children in grades K-2 is most effective when it does not exceed ten to twenty minutes each day. In grades 3 through 6, children can benefit from 30 to 60 minutes per day. Junior high and high school students can benefit from more time on homework and the amount might vary from night to night. These recommendations are consistent with the conclusions reached by studies of the effectiveness of homework.

In conclusion, homework can be an effective instructional device. However, both experience and research suggest that the relationship between homework and achievement is influenced greatly by the students' developmental level. Expectations for homework's effects, especially in the short term and in earlier grades, must be modest. Further, homework can have both positive and negative effects depending on how it is used, with whom, and in what context.

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Harris Cooper

I

IDENTIFICATION WITH ACADEMICS

Identification with academics is related to the notion of domain identification introduced by William James (James, 1890/1981). James argued that every person has an almost infinite number of possible selves, but that individuals focus on a few core domains in defining the self. These core selves that a person identifies with can have a profound influence on everything from self-esteem and motivation to behavior. Other selves are regarded as unimportant. This process of placing more or less importance on certain aspects of the self is called “selective valuing.” While there has been debate on whether these ideas can be empirically validated, many researchers accept them because of their intuitive appeal.

Identification with academics is a special case of domain identification and selective valuing. It refers to the extent to which an individual defines the self through a role or performance in a particular domain, in this case schooling and academics. The concept of domain identification is rooted in the Symbolic Interactionist perspective on self-esteem, which is presented graphically in Figure 1. In general, this model states that 1) individuals get lots of feedback in many different ways almost constantly and 2) if this feedback is received and viewed as accurate/valid, it is incorporated into an individual’s domain-specific self-concept. If this part of self-concept is important, the feedback will affect self-esteem.

According to this model, outcomes in a domain will only affect an individual’s self-esteem to the extent that the individual is identified with that domain. Another characteristic of this perspective is that there are not only

individual differences in identification with a specific domain, but also changes within an individual over time in domain identification (e.g., Tesser, 1988). In other words, one person may view proficiency at tennis as a huge aspect of the self, while another could not care less about how well he or she plays tennis. Over time, as circumstances change, one’s view of how important tennis is to the self might become less or more important.

IMPORTANCE OF IDENTIFICATION WITH ACADEMICS

If having a positive self-view feels good and a negative self-view feels bad (psychologists differ on this point), it follows that healthy individuals are motivated to maintain a positive self view. They are strategic and will value those domains that are most likely to produce positive feedback for the self, and will alter their domain valuing as conditions change, all with the goal of maximizing how positive the self-view is (Steele, 1988; Tesser, 1988).

From a simple reinforcement/punishment perspective, stronger identification should be related to more positive outcomes in that domain. Individuals should be motivated to behave in ways that maximize the probability of positive outcomes (and minimize the negative outcomes) in domains they strongly identify with. For students strongly identified with academics, good academic performance should be rewarding (leading to a more positive self-view, which feels good) whereas poor academic performance should be punishing (leading to a more negative self-view, which feels bad). Similarly, students not identified with academics should have little motivation to succeed in academics because there is no link between academic outcomes and

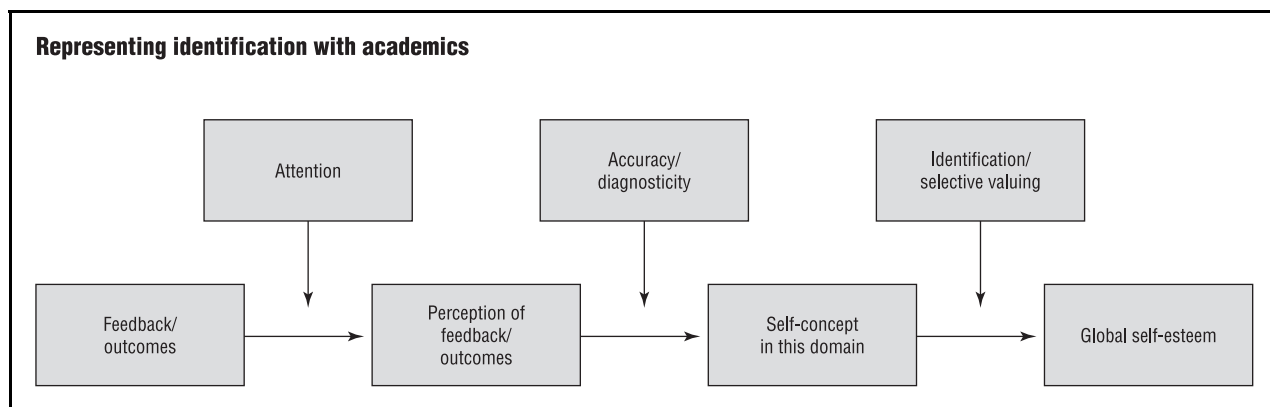


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

self-esteem good performance is not intrinsically rewarding, and poor performance is not intrinsically punishing. For these students, motivation comes from other domains outside academics.

MOTIVATION AND/OR ACADEMIC OUTCOMES

Research supports the notion that identification with academics increases the odds of success in academics (Osborne, Kellow, & Jones, 2007). Figure 2 shows the theoretical relationships between identification with academics and motivation to succeed as well as outcomes in that domain. (Other literatures, such as management and parenting literatures, have noted similar effects.)

Identification with academics predicts academic achievement (Osborne, 1997a; Osborne & Rausch, 2001; Voelkl, 1997), receiving academic honors or being put on academic probation (Osborne, 1997a), engagement in learning/classroom activities (Osborne & Rausch, 2001; Voelkl, 1997; Walker, Greene, & Mansell, 2006), stronger academic self-efficacy (Walker et al., 2006), and even academic dishonesty (K. V. Finn & Frone, 2004). These studies show that stronger identification with academics increases motivation to succeed and the amount of effort students put into learning. Given this, it should not be surprising that these students are also more likely to achieve better outcomes in academics. Importantly, identification with academics has been linked to decreased likelihood of undesirable behaviors, such as cutting class, absenteeism, and dropping out (Osborne et al., 2007).

MEASURING IDENTIFICATION WITH ACADEMICS

There is no consensus on how to measure identification with academics. Valuing, belonging, positive predispositions toward school, and behaviors that signal engagement in learning/schooling are theoretically linked to identifica-

tion with academics, but do not capture the essence of it. Some researchers (Spencer, Steele, & Quinn, 1999) have argued that students who enroll in challenging academic courses and who possess well above average standardized scores are de facto classified as identified, but there are also gifted students who do exceedingly well and then drop out as soon as they can. Additionally, this perspective ignores extrinsic motivations for doing well in school. True identification with academics is a purely intrinsic process (although it can be influenced by external forces). Others (e.g., Aronson et al., 1999) have supplemented these indicators with items that assess the relevance of the domain ("Mathematics is important to me") to students. Other researchers (Morgan & Mehta, 2004; Osborne, 1995, 1997b; Verkuyten & Thijs, 2004) have operationalized this as the relationship between measures of self-concept and academic outcomes. Referring to Figure 1, it is obvious that among students with strong identification, there should be a strong relationship between self-concept and academic outcomes. Yet this approach is severely limited in that it can only speak to large groups, although it may be important for initially establishing the validity of the general concept.

Researchers have published scales intended to measure identification with academics from the perspective presented above (Osborne, 1997a; Osborne & Walker, 2006, Voelkl, 1996, 1997, Finn, 1989). These scales are designed to assess student feelings of belonging (i.e., acceptance of and respect for the self by others in the school, feelings of inclusion) and valuing (i.e., the extent to which the student views schooling as an important institution in society, and the material being learned as important and useful).

INDIVIDUAL AND GROUP DIFFERENCES

As James and many later theorists have argued, individuals differ not only in what domains they identify with,

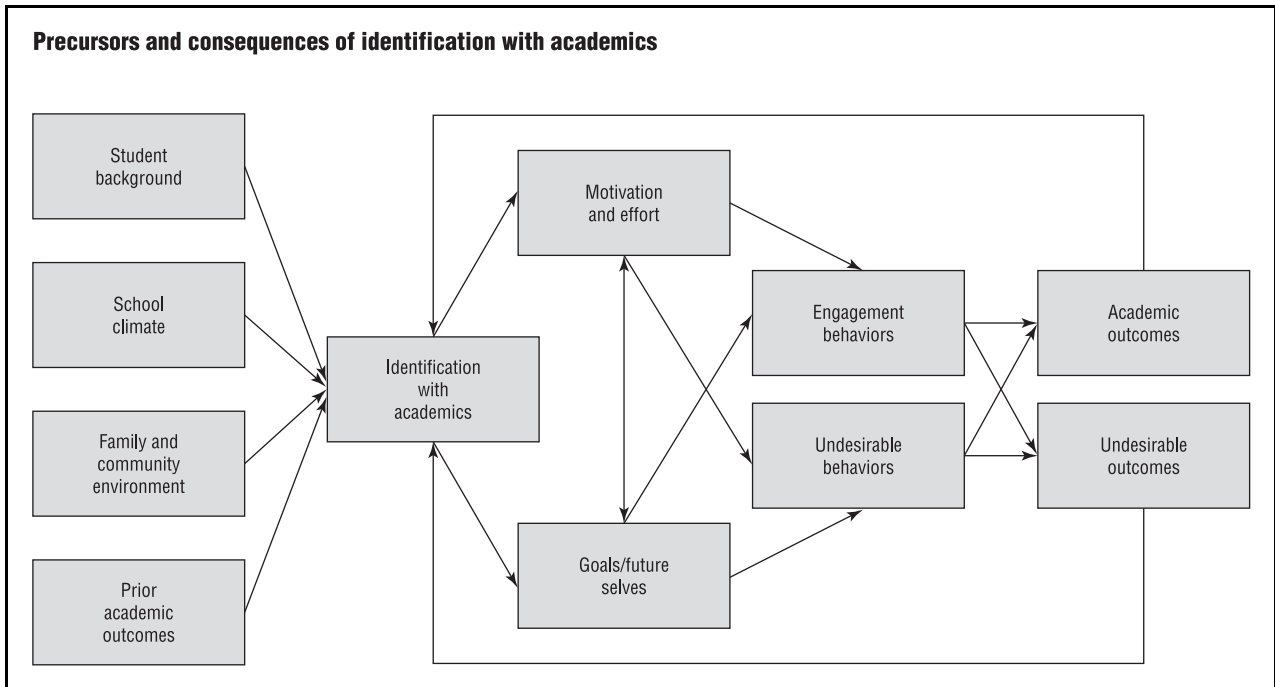


Figure 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

but also how complex the self is (i.e., how many domains they identify with. (For a review of self-complexity, see (Rafaeli-Mor & Steinberg, 2002.) Research strongly suggests that identification with academics is changeable, and as Finn (1989) and others argue, changes long before bad things happen academically (e.g., withdrawal from school). Therefore, there is significant hope that should students begin to disidentify, and if this change is diagnosed early enough, intervention can prevent serious consequences.

Identification with academics is also implicated in important social trends, such as the long-standing achievement gap between Caucasian students and students from disadvantaged/stigmatized groups (e.g., African American, Native American, Latino). Claude Steele's Stereotype Threat hypothesis (Steele, 1992, 1997, 1999; Steele & Aronson, 1995), for example, argues that members of academically stigmatized groups should show higher anxiety in school, and ultimately defensively disidentify with academics (see also Major & Schmader, 1998; Major, Spencer, Schmader, Wolfe, & Crocker, 1998). Research from several cultures and across many years has shown this disidentification effect predicted by Steele at the group level when comparing stigmatized and non-stigmatized groups (Cokley, 2002; Demo & Parker, 1987; Hansford & Hattie, 1982; Morgan & Mehta, 2004; Osborne, 1995, 1997b; Osborne, Major, & Crocker, 1992; Rosenberg & Simmons, 1972; Verkuyten

& Thijs, 2004). Interestingly, when stigmatized individuals (such as African American students) answer questionnaires about identification (valuing of) academics, there is often either no difference between the two groups or the African American students score higher than Caucasian Americans (e.g., Major & Schmader, 1998). On an individual level, parents, teachers, and others in power can reduce stereotype threat and/or enhance identification with academics. The literature gives many options, including (a) increasing positive outcomes, (b) promoting the importance of academic domains, (c) fostering a sense of belonging, and (d) lifting the situational threat. Those interested in this process should consult Osborne et al. (2007) for more on these strategies or Steele (1997) for other ideas specific to stereotype threat.

SEE ALSO *Expectancy Value Motivational Theory; Identity Development; Relevance of Self-Evaluations to Classroom Learning; School Belonging; Self-Esteem; Stereotype Threat.*

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Jason W. Osborne

IDENTITY DEVELOPMENT

Identity is an individual's self definition that focuses on enduring characteristics of the self. In an established identity, the individual is able to explain the origins of these self-defined characteristics and the influences behind those origins. Complete identity includes a clarification of one's morals, ethics, and standards, as well as a commitment to a future occupation. Many development theorists see identity development as a means for an individual to explain the present as a bridge from the past to the future.

MAJOR PROCESSES IN IDENTITY DEVELOPMENT

The major processes that comprise identity development are addressed by Erik Erikson (1902-1994) in his theory of psychosocial development. Most psychologists appreciate Erikson's theory because of its "utility in many professional arenas [such as] clinical, theoretical and empirical" (McKinney, 2001).

Erikson was interested in explaining the development of the healthy personality, based on an enduring ego identity. The healthy ego identity evolves through a process of discovering the self within the various influences of a personal history, societal history, and social contexts. For Erikson this evolving of the ego identity takes place through stages of psychosocial development. In each stage, the psychological make-up of the individual interacts with the demands of the social context in a challenge that either brings about a healthy resolution or an unhealthy alternative. This age-related challenge is referred to as a crisis. Each of these crises represents a “direct reflection of the person’s social maturity and societal expectations” (McKinney, 2001). All of the psychosocial stages are interdependent; the success of each earlier crisis is the foundation for the success of each later challenge.

Although identity is established in adolescence, the successful resolution of each previous psychosocial challenge contributes something to the make-up of the healthy ego identity. Infants learning trust are forming in their minds an enduring representation of the mother. This representation should guide growing children into understanding when to trust others and when not to trust them. Other childhood psychosocial challenges establish autonomy, initiative, and industry. Achieving these previous psychosocial functions facilitates establishing identity in adolescence.

NORMATIVE DEVELOPMENTAL CHANGES

Many theorists would agree that identity development begins with children establishing autonomy, recognizing that they are individuals separate from their mother. Autonomy and self awareness begins in the second year. It can be observed when children talk about themselves, using the concept of the self, when they resist control by parents, and recognize themselves in a mirror. Self concept starts to develop shortly after self awareness is established. Self concept is the rudimentary definition of self based on a collection of disconnected traits. The self concept relies on role models to suggest standards and preferences.

From 3 through 6 years of age, children nurture their self concept by making choices and following through on those choices. They experiment in this stage with doing things on their own. They are often told during this time period that what they have chosen to do is wrong. The shame that they feel in these situations leads to the beginnings of the self-evaluation that is so important in the next stage.

Across many cultures, middle childhood, from age 7 until the onset of puberty, is a time of increased responsibility and privilege. Children begin to learn what their

culture deems important. More than in earlier years, they are involved in peer groups, putting them in a position to constantly compare themselves to others. When that comparison is favorable, they are inspired to work and accomplish more. When that comparison is not favorable, they may feel inferior to classmates. During this period self efficacy develops and becomes significant. Self efficacy is the attempt to assess one’s worth through comparison with others.

According to Erikson, the most important process of identity development takes place during adolescence. During this time, individuals must establish their identity in order to make the transition from childhood to adulthood. Adolescents enter a psychosocial moratorium, which is a period of relative freedom from societal expectations. During this time, they feel free to experiment with different personalities and roles. From Erikson’s perspective, everything that was established about self in childhood is re-evaluated in adolescence. Some of the components of the self concept, self worth, and childhood personality may be retained or rejected in the adolescent’s search for identity. Adolescents have to internalize a comprehensive and consistent set of affirmations regarding their own strengths, weaknesses, values, and career choice. The positive influence of family and friends is important in this process, but the commitment must be made by adolescents as individuals. This process requires much experimentation and exploration, particularly in personality and vocational roles (Santrock, 2007).

The identity established during adolescence represents a major accomplishment. By young adulthood, individuals who have achieved their identity are prepared to adapt and contribute to society. That identity is expected to endure. However, many theorists who study identity achievement recognize that there is still much refinement, re-evaluation, and recommitment of identity in later life.

THE KEY THEORIES OF IDENTITY DEVELOPMENT

Although Erikson’s theory of identity development is widely cited, other theories provide important knowledge about identity and its development. The attachment theories emphasize the value of the trust and security that a child learns from his/her mother in infancy. Social learning theories expand the constructs of self concept and self worth as the basis of self description in late childhood. Cognitive development theory describes the age-related processes leading to a child’s limitation before adolescence and competence during adolescence for establishing identity. Researchers investigating Erikson’s theory of identity development have provided important modifications to the theory.

Attachment Theory. Theorists such as Mary Ainsworth, who studied attachment in infancy, observed and explained concepts similar to those of Erikson. The description of attachment compares to Erikson's description of trust. In his theory, infants who have learned trust grow into children who accept that life has order and purpose. These growing children have a trusting and accepting relationship with their mother. Infants who have learned attachment grow into children who look to the mother for guidance and rely on her as a safe base for exploration. In both cases, these children's personality can be expected to have a basic confidence. Failure in attachment and in trust results in a confused child who is not sure about trusting parents and/or may have little discretion in trusting others.

One difference in the two theories is that Erikson expected trust to be established in the first year. Ainsworth has shown that secure attachment can take as long as 18 months. Another difference is the strength of the influence on later development attributed to the mother-child bond. Ainsworth sees attachment as the most important influence on development. For Erikson, that influence is modified by the resolution of later psychosocial crises.

Social Learning Theory. As noted above, once self awareness is established, the self concept starts to develop. The self concept is the basic representation in children's minds of who they are and what they are like. Social learning theorists emphasize that the self concept is built upon the identification with role models, an assessment of self worth, and a preferred pattern in relating to the external world (Carver & Scheier, 1992).

Children learn to relate to the world through modeling and imitation of others, particularly role models. The same-sex parent is an influential role model for each child. Other role models in early childhood can be anyone the child admires. Children will identify with a role model and shape their behavior and tastes in imitation of that role model. The influences of a role model can affect individuals' personality, ambitions, interest, and tastes well into adulthood (Carver & Scheier, 1992).

Self worth is based on children's assessment of their capabilities in comparison to others. Children may feel that they are superior or inferior to others or may feel that they are capable but that others do not notice. Often the assessment is classified according to different areas of life such as sports, academics, or friendships. However, too many negative self assessments in the different areas may result in an overall feeling of helplessness.

The preferred pattern of relationships, influenced by the self concept, is different for individual children. Children seek social interaction in different ways. Although one pattern may be clearly seen as being more effective, some individuals are more likely to choose a pattern that is person-

ally meaningful. For example, shy children may admire those children with more outgoing personalities but may continue to relate to others in a quiet manner.

The self concept can be a stronger motivator for behavior than an external reward. If children receive punishment in class for misbehaving, the punishment may not discourage them from repeating the behavior. If the children see themselves as rebels, such a self concept would be encouraged by receiving punishment (Carver & Scheier, 1992).

Cognitive Development. The patterns of development that Erikson describes are related to what Jean Piaget (1896-1980) and the cognitive psychologists recognize about age-related strategies of children in reasoning. There are limits in children's reasoning until adolescence. Before adolescence, individuals are not capable of the cognitive reasoning necessary in establishing identity.

Evidence of cognition in infancy shows in babies' recognizing their mother's voice and smell even from birth. This perinatal cognitive ability facilitates the familiarity that leads to trust. Babies are comforted by their mother's voice and feel secure in her presence.

In early childhood, the self concept is constantly changing because of cognitive limitations. Piaget calls the period between 2 and 6 years of age the preoperational stage. Children at this age cannot use logical strategies. Therefore, they tend to focus on only one feature of an object. Also, children at this age do not understand the identity principle that some things do not change essentially even though they change one of their features. Even in describing themselves, children will focus on only one aspect of who they are without qualifying that aspect or relating it to another aspect of self. When preoperational children try to describe themselves, they cannot be sure they will not change.

During middle childhood, children develop the capacity for logical reasoning, but only in situations with concrete examples, which marks this as the cognitive stage of concrete operations. Children are increasingly capable of classifying and cross-classifying objects and characteristics. As they describe themselves in the stage of concrete operations, more qualifying occurs on the different attributes of self. Also, these individuals express an expectation of stability in their characteristics. Establishment of the psychosocial function of industry relies on the use of these newly learned cognitive capabilities. Through classification, children can identify their own strengths and weaknesses while being able to rank peers on their related abilities. Also, children can recognize that being inferior in one area does not make one inferior in another.

During adolescence individuals can reason beyond the concrete. Adolescents have increased capabilities for abstract reasoning. With this ability comes awareness that they have a future for which they need to prepare. This unexpected realization is the beginning of the identity crisis.

Other Identity Theories. Many theorists investigating identity achievement have expanded or modified Erikson's ideas. James Marcia investigated the major influences on identity achievement and identified four possible outcomes or statuses of the identity crisis based on whether the crisis has been met and a commitment has been made.

As with Erikson, Marcia sees the identity crisis as beginning when adolescents recognize the need to establish an identity that can prepare them to meet the challenges of adulthood. Marcia agrees with Erikson that adolescents need to explore the many possibilities in personality roles and career choices as well as lifestyles. Identity achievement is recognized as individuals gain a clear understanding of their own strengths and weaknesses and a clear set of personal standards.

For Marcia, true identity achievement is based on meeting the challenge and making the commitment. Some adolescents try to avoid the crisis; some try to avoid the commitment; some try to avoid both. If either the challenge or commitment is avoided, role confusion takes one of three forms. These three forms of role confusion in addition to identity achievement constitute the four identity statuses proposed by Marcia. Identity achievement is the first status. The second status is foreclosure, when the adolescent avoids the challenge by making a commitment without any exploration. This happens often when individuals surrender to the plans that their parents have made for their life. The third status is moratorium, when the youth perpetuates the exploration and challenge without making a commitment. Moratorium is not necessarily an unhealthy status. Because adolescence continues as long as society allows, the search for identity characterized by the moratorium status may continue into young adulthood. The fourth status is diffusion, when adolescents avoid the challenge and refuse to make a commitment. The danger of this status is that diffused adolescents are weak in resisting negative influences.

According to Santrock (2004), some experts investigating identity development challenge Erikson on several points. First, these experts have found substantial evidence that identity formation does not begin or end in adolescence. They also have found that it takes more time and is less dramatic than Erikson expected.

Later research found that moratorium may last into the college years. However, this finding does not contradict Erikson because Erikson, in his day, felt that more adoles-

cents should attend college as a time of psychosocial moratorium. In contrast to the late 2000s, fewer adolescents attended college in the 1950s when Erikson was forming his theory. The age range he used to illustrate the identity challenge was appropriate for his time.

IDENTITY DEVELOPMENT AND SCHOOL ADJUSTMENT

During grade school years, children are still building their self concept. Choosing the right role models is very important during this time. Also important is developing a sense of industry, knowing what one's capabilities are. The social interaction with peers plays a role in supporting the self concept. School adjustment interacts with the positive development of the self concept.

Children's self concept leads them to associate with peers and influences the way they relate to those peers. In trying to understand their competence, these children compare themselves with others. If that comparison leads to a sense of self competence, the children will want to associate and cooperate with other children more than if that comparison leads to a sense of incompetence. If children define themselves as good students, they will want to live up to that self concept. Children who see themselves as loners will be more content to stay away from other children. A teacher can encourage children to develop a positive self concept.

A major threat to the self concept and self esteem of a school-age child is grade retention. One common reason for holding children back one year in the early grades is that these individuals are too immature for age-appropriate grade placement. However, retention has not been shown to have any long-term benefits and it may actually harm the child emotionally. "Children rate retention as the third most horrible thing they can imagine" (Lawson, 2007, p. 89).

VARIABLES REGARDING IDENTITY DEVELOPMENT PROCESS, GENDER, AND ETHNICITY

The development of gender identity leads to conceptual frameworks of perceived appropriate behavior and interests associated with gender. These concepts are influenced greatly by the same-sex parent who becomes a role model for establishing the appropriate gender role. The gender concepts developed in childhood will influence how identity is composed in adolescence. For adolescents from a minority ethnicity, the development of ethnic identity is an important part of identity achievement. In many cases, the preparation for adulthood is the first time that these adolescents have to confront their feelings about their background. While being exposed to alternative sources of group identity from the dominant culture, adolescents have to maintain

connectedness with their own ethnicity. Researchers have found that those who establish and maintain an ethnic identity tend to have higher self esteem (Santrock, 2004).

Erikson found gender differences in vocational exploration with men more concerned with establishing a career and women more concerned about establishing a family. These claims were supported by research in the 1960s and the 1970s, but subsequent research has not found any support for gender differences. Women in the 2000s are just as likely to be career-oriented as men are (Santrock, 2007).

RISK AND PROTECTIVE FACTORS FOR SUCCESSFUL IDENTIFY DEVELOPMENT

Successful identity achievement is developed through accepting traditional values and expressing them in a contemporary manner. Therefore, adolescents need the influence of parents for traditional values and the influence of friends for contemporary expression. However, too much influence from either parents or friends may interfere with the adolescents' personal commitment.

Parenting styles influence the achievement of identity in adolescence. A parenting style emphasizing high standards and high communication encourages adolescents' exploration in a supportive environment. A parenting style that emphasizes high standards but low communication may interfere with the healthy exploration of identity potential. Permissive parents who do not establish standards for adolescents are encouraging a diffused identity with no clear commitments (Santrock, 2004).

SUGGESTIONS FOR TEACHERS AT VARIOUS GRADE LEVELS

Teachers can enhance children's identity development at all grade levels by taking an interest in the individual students and asking them to describe their impressions of self. This can be done as part of an age-appropriate class assignment. In preschool, during group conversation, the teacher can ask the children to describe their favorite memory. Although their memories will not go back too far, what the children describe will convey the influences of their developing self concepts. In grade school, a writing assignment might relate to the individual children's likes and dislikes, their favorite heroes, or their capabilities. In high school, students can be given a research assignment to explore specific vocations or the world of work in general.

Teachers should watch for signs of learned helplessness in grade school. If children describe themselves as individuals who cannot succeed, they will shirk the challenges of the classroom. A teacher can intervene by encouraging such students one-on-one or by establishing classroom support groups (Woolfolk, 2007).

It is important that children are constantly given the opportunity to succeed at increasingly challenging tasks. Teachers should avoid inappropriate comparison or competition with others. Students should be encouraged to compete against themselves to improve upon their previous accomplishments. The teacher should take the student's failing as an opportunity to point out how many times the child has succeeded (Woolfolk, 2006).

The high school teacher should be careful not to give into stereotyped perceptions of adolescence. Most adolescents, even those who appear to be antisocial, are involved in healthy exploration. The high school teacher should take the attitude that these students are young adults with the expectation that they will behave as adults. Most adolescents will feel free to approach such a teacher with their problems and concerns. Also, treating the young people as adults will lead to their seeing disciplinary actions as a natural consequence for misbehaviors.

SEE ALSO *Erikson, Erik.*

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Ray Brogan

IEP

SEE *Individualized Education Program (IEP).*

IMPRESSION MANAGEMENT

Impression management refers to the process in which individuals attempt to influence the opinions or perceptions others hold of them. Impression management, also referred to as self-presentation, is a goal-directed activity that helps to establish the boundaries of what is considered acceptable behavior; conversely, it also aids in defining

what behavior will be met with disapproval. In the classroom, impression management behaviors allow students to make sense of the complex social stratum and help to inform their social identities.

MODELS OF IMPRESSION MANAGEMENT

Writings on impression management were introduced by Goffman (1959). In his seminal book, *The Presentation of Self in Everyday Life*, Goffman shows that the individual is influenced by his or her environment and the perceived audience. Furthermore Goffman posits that the objective of individuals is to convey an image that is consistent with their desired goal (spoken or unspoken). While Goffman's theory is constructive (impressions can influence how individuals perceive themselves), Jones and his colleagues (Jones & Pittman, 1982; Jones & Wortman, 1972) championed strategic self-presentation. Strategic impression management emphasizes the power dynamics and goals that characterize most social interactions. Jones (1990) suggested that the goals or motives in strategic impression management are aimed at negotiating the power dynamics in social relationships such that the individual's power is never diminished.

Leary and Kowalski (1990) elaborated on the work of Goffman (1959) and Jones and his colleagues. Leary and Kowalski's (1990) model is distinctive, in that it elucidates reasons why people are concerned with others' impressions and why they choose to engage in specific impression management behaviors. Though other conceptualizations of impression management did not draw such a distinction, Leary and Kowalski's model posits that impression management is comprised of two distinct processes: *impression motivation* and *impression construction*. Impression motivation, they argue, is a function of several factors (goal-relevance, value of desired outcomes, discrepancy between desired image and current image) that determine whether or not an individual will engage in impression-related attempts. Goal relevance refers to whether or not one's actions are salient to obtaining prescribed goals. Value of desired goals refers to the importance placed on obtaining a particular goal; the value increases as the number of available desired objects decreases. The discrepancy between the desired image and the current image refers to the individual's perception of the closeness between the image others hold and the image he or she wants others to hold.

The second process, impression construction, is influenced by two intrapersonal and three interpersonal factors. Self-concept and desired image constitute the intrapersonal variables; role constraints, target values, and current or potential social image represent the interpersonal variables. Leary and Kowalski asserted that the

self-concept variable is the chief impetus of a learner's impressions. Accordingly, students will display what they believe is their greatest asset. Thus, if academics do not constitute the best part of their self-concept, impression management for academic diligence will be low. Furthermore, the motivation to impression manage will be influenced by not only what the students think they are, but what they would like to be and not be; this refers to the second intrapersonal variable, desired and undesired identity image. It appears that attempts to impression manage are, in part, a function of the interaction between these two components. As mentioned above, three interpersonal variables also contribute to impression construction. The *role constraint* variable suggests that individuals who act in a manner that is inconsistent with social expectations risk losing the power associated with that position. The second interpersonal variable, *target values*, indicates that an individual will often modify or change his or her image so that it corresponds to an assumed value of a model. Lastly, *current or potential image*, states that impressions are further shaped by learners' perception of how they are presently perceived and how they believe others will see them in the future.

HOW IMPRESSION MANAGEMENT INFLUENCES CLASSROOM BEHAVIOR

Impression management theory provides a useful framework for understanding students' behavior in classroom situations. Studies on impression management generally indicate that academic diligence or effort is likely when individuals perceive their image as consistent with expectations of being academically competent and that the rewards of projecting such an image are greater than its possible repercussions. Research has demonstrated that if the potential repercussions of projecting an academically diligent image are sufficiently threatening, the student is less likely to project that image. The presence of multiple (and often competing) audiences necessitates an individual student's need to consider what image he or she is willing to project. It has become increasingly evident that classrooms are more than just academic environments; they are also social settings in which students must negotiate the demands/expectations of multiple audiences: the teacher and other students. While research has consistently demonstrated that teachers value and reward students who exhibit academic effort, peer groups, especially the "popular crowds," tend to ostracize those students whose identity or image is based largely on academic effort. Thus, while teachers possess legitimate power over the student, popular peers possess referent power, both of which are instrumental in determining the impression a student projects.

DEVELOPMENTAL AND INDIVIDUAL DIFFERENCES

Studies on impression management have also indicated that development affects impression management. One key assumption of the Leary and Kowalski (1990) model (as well as other explanations of impression management) is that the student must possess the ability to analyze potential interactions (including understanding what others value) and the ability to take another's perspective. Selman (1980) labeled these abilities as Level 3 perspective taking and argued that these abilities do not generally manifest until middle and junior high school years. However, a number of researchers have demonstrated that these abilities develop earlier than Selman (1980) argued. In their study of fourth, sixth and eighth grade students, Juvonen and Murdock (1995) found that younger students were able to demonstrate an understanding of the expectations of others. Another significant developmental difference identified by the authors was that older students, and not younger ones, modified their explanations of effort based on intended audience. What this finding seems to suggest is that while younger students are aware of what others expect, their perception that other students' and teachers' values are congruent represents a lack of understanding of the complexity of multiple audiences. Thus, it appears that the impression strategy a student employs is significantly influenced by cognitive development.

Though Juvonen and Murdock (1995) did not observe significant differences between males and females, gender differences in impression management related to academic diligence have consistently indicated that females are more likely than males to present an image that conveys a desire to be seen as conscientious of academic activities (Grabill, Lasane, Povitsky, Saxe, Munro, Phelps, & Straub, 2005). That this finding has been consistently reported is not surprising. Although academic achievement is seen as a masculine trait, this seems to apply only to one's natural abilities; effort (diligence) is largely viewed as a feminine characteristic. Impression management theory posits that since achievement with effort (compared to "natural" achievement) is by and large a feminine quality, most males would prefer to project images that would not call into question their masculinity for fear of disapproval.

Though few studies have explicitly investigated ethnic differences in impression management, it has been argued that many minority students (particularly African Americans) view academic diligence differently from Caucasian students. Several researchers (e.g., Czopp, Lasane, Swigard, Bradshaw & Hammer, 1998; Fordham & Ogbu, 1986) have reported that African American students attempt to conceal their academic selves for fear of social disapproval; instead, many of these students project an impression con-

sistent with "Joe Cool," an image that is less concerned with academic effort. Furthermore, studies have suggested that the impression that some minority students adopt is based on the belief that academic diligence is a mostly "White" phenomenon; thus, to project an academic-conscious image would be perceived as denying one's culture. Though this theory has received considerable attention, additional research is warranted.

IMPLICATIONS FOR EDUCATORS

The ability of educators to recognize and acknowledge the effects of impression management on academic performance has important, yet feasible, implications for their ability to work effectively with diverse student populations. Foremost, educators need to actively and aggressively diversify the teacher pool. Administrators communicate to students their attitudes regarding academic achievement through those persons whom they hire to educate. Thus, there needs to be fair representation of men and women in academically rigorous courses as well as less academically rigorous ones. To that end, all physical education classes cannot be taught by Mr. Jones and not all of the language arts classes should be taught by Mrs. Smith.

Second, teachers are encouraged to reflect on their own attitudes towards students who tend to display academically disidentified behaviors. As research suggests, students' struggles with the problem of multiple audiences, for example, may manifest as academically disidentified (Osborne, 1995) or unconcerned behavior; this manifestation may, in turn, prejudice teacher-student interactions, particularly evaluations. It is possible (and likely) that unexamined attitudes could lead to interactions that result in negative evaluations, thus reinforcing an adversarial relationship with academically minded individuals and fostering a negative association with academic-related activities.

Lastly, teachers need to realize that students do contemplate the challenges of negotiating beliefs and stereotypes related to academic diligence. Teachers might consider purposefully addressing this issue with students in an effort to monitor and correct any detrimental views students may harbor. Also, an added benefit to this practice is that students may become more engaged in the learning process and, as research has indicated, students who are engaged in the learning process tend to evidence more positive long-term consequences.

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IMPULSIVE DECISION-MAKING

Decision-making can range from a highly rational style involving careful consideration of cognitive cues to a very impulsive act-without-thinking process that relies primarily on affective and physiological cues. Impulsive decision-makers are those who operate on the far end of this decision-making continuum. Whereas rational decision-makers carefully consider beliefs about the consequences of their actions when making decisions, impulsive decision-makers often fail to even consider such consequences, relying instead on cues that are often salient in the immediate present. As a result, individuals with an impulsive decision-making style often make decisions without a great deal of thought, fail to plan ahead for a variety of situations, and are more likely to act on impulse as compared to their rational decision-making counterparts (Donohew et al., 2000, 2004).

Impulsive decision-making is not, in and of itself, believed to be a personality trait. It is, however, thought to be a tendency that flows from the trait of impulsivity.

Impulsivity itself is conceptualized in different ways by different researchers in the field. For instance, some researchers treat impulsivity as a unidimensional trait (Grano et al., 2004), whereas others have provided evidence for multiple dimensions of impulsivity, identifying two (Dawe & Loxton, 2004) or as many as four dimensions (Whiteside & Lynam, 2001). The four-dimensional conceptualization of impulsivity includes: 1) urgency, 2) lack of premeditation, 3) lack of perseverance, and 4) sensation-seeking. Additionally, whereas other researchers view impulsivity and sensation-seeking (or thrill-seeking) as a single "supertrait" (Zuckerman & Kuhlman, 2000), some view impulsivity and sensation-seeking as different, albeit related dimensions (Donohew et al., 2000, 2004).

RELATION OF IMPULSIVE DECISION MAKING TO PERSONALITY

While impulsivity is included at some level in many theories of personality, precisely how it fits into such theories, as well as how much emphasis it receives, tends to vary (Whiteside & Lynam, 2001). For instance, Eysenck and Eysenck's (1985) Three Factor Theory of personality focuses on the roles of neuroticism, extraversion, and psychoticism in an explication of personality processes. It considers impulsivity to consist of two components: venturesomeness and impulsiveness, which are thought to correspond to the extraversion and psychoticism factors, respectively.

McCrae and Costa's (1990) Five Factor Model of personality is focused on neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness, each of which is composed of six facets. In this model, impulsivity is represented by a number of facets across the factors. For instance, the neuroticism factor contains an impulsiveness facet and the conscientiousness factor contains both self-control and deliberation facets. Facets on other dimensions, such as extraversion's excitement-seeking facet, also overlap with conceptualizations of impulsivity (Whiteside & Lynam, 2001).

Finally, Zuckerman and colleagues' (1993) Alternative Five Factor Model gives impulsivity perhaps its most prominent role compared to these other theories, combining it with sensation-seeking in a single "supertrait" termed "impulsive sensation-seeking." This model considers impulsive sensation-seeking to be one of five major traits that drive personality. The others are neuroticism-anxiety, aggression-hostility, activity, and sociability. Although early work with this model focused solely on the role of sensation-seeking as a predictor of a variety of behaviors, later work combined sensation-seeking with impulsivity to form this single trait (Zuckerman & Kuhlman, 2000).

IMPULSIVE DECISION MAKING AND ACADEMIC OUTCOMES

One question concerns how impulsivity and impulsive decision-making affect behaviors. A number of studies exist on this topic across a variety of areas, with the overall theme being one of association with maladaptive and problem behaviors. For instance, impulsivity has been found to be related to a variety of antisocial behaviors, delinquency, and a lack of social adjustment (Cooper et al., 2003; Schwartz et al., 1999) and, thus, is a focal point among many theories of crime (Lynam & Miller, 2004). Impulsivity is a key diagnostic criterion for numerous disorders in the Diagnostic and Statistical Manual for Mental Disorders, or DSM-IV (American Psychiatric Association, 2000; Whiteside et al., 2005). Further, impulsive decision-making (and more generally, impulsivity) has been widely studied in the area of health risk behaviors among youth, exhibiting positive associations with alcohol use, drug use, risky sexual behavior, eating disorders, and even body piercing (Cooper et al., 2000, 2003; Dawe & Loxton, 2004; Donohew et al., 2000, 2004; Greif et al., 1999; Hoyle et al., 2000; Zuckerman & Kuhlman, 2000).

In the specific realm of education, impulsivity has been found to relate to, and may adversely affect, a number of key academic outcomes. Indeed, the educational process is a long-term, goal-oriented task. Given this fact, theoretically it might be expected that such an undertaking would be adversely affected by impulsivity, given that impulsive individuals exhibit a tendency to act on immediate demands instead of making decisions based on long-term goals (Spinella & Miley, 2003).

The research as of 2008 in the area of impulsivity and academic outcomes does, in fact, bear out this correlation. Impulsivity has been shown to be related to educational underachievement in a number of studies (Cooper et al., 2003; Lynam & Miller, 2004; Spinella & Miley, 2004; Weithorn, Kagen, & Marcus, 1984). In fact, those who are impulsive are more likely to fall behind their peers and achieve lower grades compared to those who exhibit a more rationale style. For instance, Meade (1981) found that first grade students with a low socio-economic status who exhibited impulsive behavior had lower grades and lower achievement scores than their peers, even when IQ was held constant. Among older students, another study found impulsivity and college students' grades to be inversely related, with higher impulsivity relating to lower grades (Spinella & Miley, 2003). Some researchers have even gone as far as to suggest that there is a positive association between impulsivity and academic failure (Vigil-Colet & Morales-Vives, 2005).

In addition, although limited research has been conducted on the association between impulsivity and academic cheating, some studies have examined the link

between the two (Anderman & Cupp, 2006; Kelly & Worell, 1978; Miller et al., 2007). For instance, in one study, college students were given the opportunity to falsify scores in order to obtain course credit. Among the female participants, the students who cheated were significantly more impulsive than were the non-cheaters. Another study demonstrated a positive association between impulsivity and academic cheating among a large sample of high school students (Anderman & Cupp, 2006). These researchers have suggested that impulsive students experience difficulty with self-regulation, which leads to decreased self-control, and, in turn, increased cheating.

Finally, there is a large literature in the specific area of Attention Deficit Hyperactivity Disorder (ADHD). ADHD is itself characterized by impulsivity, inattention, and hyperactivity (American Psychiatric Association, 2000; Hoza, Owens, & Pelham, 1999). In the context of ADHD, impulsivity can manifest itself in a number of ways, including interrupting others, blurting out answers, not listening to instructions before beginning a task, and not waiting for a turn. A criterion of ADHD is that such difficulties impair functioning in academic, occupational, or social settings (American Psychiatric Association, 2000). Academic underachievement has also been identified as a primary long-term outcome associated with ADHD (Manuzza et al., 1993), with up to 80% of students with ADHD exhibiting problems in academic performance (Cantwell & Baker, 1991). Though impulsivity is a part of ADHD, impulsivity and impulsive decision-making can occur exclusive of ADHD (Furman, 2005). Thus, both impulsive ADHD and impulsive non-ADHD students may be at risk of similar poor academic outcomes (Merrell, & Tymms, 2001).

SUGGESTIONS FOR PRACTITIONERS

One challenge is identifying strategies to be used by those who work with impulsive youth. A primary obstacle which impulsive students struggle with is their lack of metacognition, that is, their ability to be reflective and think about thinking. Therefore, it is important to help impulsive students learn to think about making decisions instead of acting before thinking. Another general consideration is the fact that impulsive students do not consider alternatives effectively; therefore, it is important for those working with such students to emphasize the consideration of alternative options and alternative ways of thinking in decision-making (Margolis et al., 1977).

Moreover, many strategies for reducing students' impulsive behaviors have been reported in the literature. Cognitive and/or behavioral strategies are popular approaches given that students' problems with impulsivity are in regards to their thinking and behaviors (Baer & Nietzel, 1991). Self-instruction training, in which students

learn to guide themselves through tasks by asking and then answering a series of questions, is a commonly used treatment (Baer & Nietzel, 1991). For example, in one self-instruction procedure, the impulsive student learns to size up the demands of a task, cognitively rehearse the task, guide their performance through self-instruction, and where appropriate, give self-reinforcements (Meichenbaum & Goodman, 1971).

Finally, the need for effective in-classroom interventions for impulsive students has also been identified. Given that there is a connection between impulsivity and a lack of metacognition, in-classroom interventions may help in this area (Bornas & Servera, 1992). In-class training, as opposed to out-of-class training, may be important in helping students to generalize learned skills to the classroom environment. Having students use strategies that are taught in real learning contexts may be important (Bornas & Servera, 1992), as is having peers model appropriate behaviors (Margolis et al., 1977). In addition, impulsive students may benefit from a classroom atmosphere that is mastery-oriented (Anderman & Cupp, 2006).

SEE ALSO *Sensation-Seeking*.

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INDIVIDUAL VS. GROUP ADMINISTERED TESTS

Psychological and educational assessment of students has been prominent since the early 1900s. The results garnered from these assessments have been used for a myriad of purposes, such as identifying children who (a) are suspected of having learning difficulties, (b) qualify for gifted programs or programs requiring specific talents (e.g., enrollment in a music or arts program), or (c) may be suffering from emotional distress (e.g., depression, anxiety). Further, group-based data focusing on a chosen index (e.g., standardized achievement scores, school drop-out rates) have also been compared across school districts and/or across states to examine learning outcomes. In common among all assessment processes is the gathering of data to make informed educational and mental health decisions (Neukrug & Fawcett, 2006).

The term *assessment* includes a broad array of methods. Sattler (2001) outlined four main types, or pillars, of assessment, each of which is complementary and adds unique information not found in the other methods. These pillars

include (a) interviews with parents, teachers, and children, (b) observations of the child's behavior, and (c) informal assessment procedures such as reviewing class work, school records, or personal documents, for example, diaries, drawings, and self-report logs. The fourth and most frequently used method is the administration of norm-referenced tests (most notably intelligence and achievement measures) for diagnostic purposes. Such tests compare a child's results, in standardized form, against an established norm group. Considering the emphasis that teachers, parents, and schools often place on the results of norm-referenced tests, this entry focuses on this particular assessment method.

The results derived from norm-referenced tests often have been used to establish or support many legislative and educational policies (see Cohen & Swerdlik, 2002). The ramifications of these policies to schools, students, and the larger community underscore the need for tests to demonstrate sound psychometric properties (i.e., evidence of reliability and validity) and appropriateness for their intended use (Anastasi, 1988; Moreland, Fowler, & Honaker, 1997). A key factor in this regard is the manner in which tests are administered. Indeed, from the beginning of psychological testing much attention has been devoted to ensuring that test scores are invariant regardless of whether they are administered individually or in a group setting (Geisinger, 2000; Kline, 2005). Although stringent measures have been taken to control method variance, each format contains inherent advantages and disadvantages. This entry reviews the most salient aspects of each format.

A BRIEF HISTORY OF TESTING

The history of psychological testing is one marked by necessity followed by innovation (Geisinger, 2000). Although the lineage of psychological measurement dates back at least 4,000 years (Thorndike & Lohman, 1990), the first modern test of intelligence was created at the turn of the 20th century, in response to problems reported by French public schools experiencing a sharp increase in student enrollment. The overcrowded conditions prompted a decision to remove children from the regular education classroom who were not learning at a satisfactory level. The 1905 work of Alfred Binet (1857–1911) and Theophile Simon led to the construction of a test containing a series of brief mental tasks, which could be individually administered to children ages 3 to 11. Revisions to this original test included expanding the age range to adulthood, increasing the number of items comprising each test, providing standard directions for administration, and introducing the concept of mental age, which was the chronological age of a group of typically developed children who performed at the same level as the examiner (Aiken, 2006).

A short time later, American psychologists made significant revisions to the original Binet-Simon scale. These changes included arranging the items in order of difficulty and assigning points for the level of correctness of an examinee's response. The most durable of these changes was provided by Lewis Terman and colleagues, who gathered extensive normative data on the Binet-Simon scale from hundreds of children in the Stanford, California, area. From this data, numerous revisions were made, most notably the inclusion of an intelligence quotient or IQ—a quantitative score that was defined as the ratio of the child's chronological age and mental age (Neukrug & Fawcett, 2006). Later known as the Stanford-Binet Intelligence Test, Terman's revised test served as the standard of testing for the first two decades of the 20th century (Aiken, 1996) and ushered in both the intelligence testing movement and the clinical testing movement (Boake, 2002; Cohen, Swerdlik, & Smith, 1992). The original Binet-Simon scales and their subsequent modifications also served as the prototype for most modern intelligence tests.

Group testing also was developed to address a pressing concern. The involvement of the United States in World War I prompted the need for a group-based cognitive test that could quickly determine if recruits were fit for military service and to identify those who could be trained as officers. Although considered crude by 21st century standards, two multiple-choice "intelligence" tests were created and administered to almost 2 million recruits. The Army Alpha was designed and administered to recruits who were literate and proficient in English, while the Army Beta was administered to foreign-born recruits or those who could not read with proficiency. Although both versions underwent significant revisions, their basis served as the foundation for most group-based intelligence tests used today. Further, these early tests served as the prototype for group tests examining other constructs (e.g., achievement, specific aptitude, psychopathology) across various environments (e.g., schools, mental health clinics) (Neukrug & Fawcett, 2006).

ADVANTAGES AND DISADVANTAGES OF INDIVIDUAL TESTING

Individually administered norm-referenced cognitive and achievement tests have been used for a wide variety of purposes. In conjunction with other norm-referenced tests and assessment methods, cognitive and achievement tests have typically been used to provide in-depth information on student's (a) intellectual functioning or academic standing in comparison to same-age peers, (b) ability to process certain mental or academic tasks, which can facilitate diagnostic impressions such as learning disabilities, giftedness, or mental retardation, and (c) initial or continuing eligibility for special education services. In most cases, cognitive and

achievement tests provide a wide array of specific tasks that the student is asked to perform either within a given time frame or according to specific scoring guidelines. Each test is concluded when the allotted time is reached (i.e., a timed test) or the student gives a continuous number of failed responses (i.e., a power test). Most tests aggregate the task scores to yield a general or overall score, which is assumed to indicate a student's global level of cognitive or achievement functioning. Nevertheless, as the general score can be influenced by extremely high (or low) performance on one or more specific tasks, composite scores also are computed to assess functioning within a specific domain. For example, cognitive tasks that measure a student's verbal reasoning abilities and general knowledge would be combined to form a verbal composite. Likewise, achievement tasks that assess a student's aptitude for solving math problems or for identifying numbers would be combined to form a math composite.

There are numerous advantages for using individually administered cognitive and achievement tests. First, direct one-to-one attention allows the student and examiner to establish solid rapport, which is essential for obtaining valid results (Sattler, 2001). Also, the examiner has direct control of the testing environment, which includes ensuring that the environment itself is conducive to optimal student performance (e.g., making sure the temperature of the room is not too hot or cold, eliminating non-relevant stimuli that would distract the student). Second, the one-to-one attention allows the examiner to observe student behaviors that may be interfering with task performance but not reflected in the score (e.g., fatigue) or assist in diagnosis (e.g., difficulty remaining in seat). Third, because most task items are orally administered by the examiner, little reading is required by the student, which makes it possible to test very young students or those with limited reading skills (Thorndike, 2005). Finally, scores from individual tests can be interpreted across a variety of levels. For example, in addition to determining the general cognitive or achievement level of the student, composite and even subtest scores can be examined to determine specific processing deficits. Thus, individually administered tests yield detailed information on a student's cognitive or achievement functioning that is not typically obtained from group administered tests.

Nevertheless, there are some disadvantages to using individually administered tests. Perhaps the biggest limitation is the cost of the tests themselves, both monetarily and with respect to time. With the cost of most major tests close to or exceeding \$1,000 (U.S.), purchasing these tests places a financial burden on school districts, especially those with limited economic resources. Further, learning to administer and interpret the results from the tests (particularly the cognitive tests) requires extensive training, and administration time ranges from one to

four hours. Finally, the tests purposely include a wide array of tasks so that an adequate sampling of important cognitive or achievement domains are covered (Anastasi, 1988). Nevertheless, one of the most persistent criticisms (particularly with regard to cognitive tests) is that the underlying conceptual framework of most tests (and thus the tasks included) is largely atheoretical or based on different theories of intelligence (Flanagan & Ortiz, 2006). For example, the commonly used scales in the Wechsler series were originally based on clinical practice rather than a specific theory, while the original Stanford-Binet scales were based on the theory of general intelligence, or *g*, which proposed that all mental abilities can be explained by a single global intellectual functioning (Thorndike, 2005). More contemporary cognitive tests are based on neurophysiological modeling of the brain, while others are based on theories that emphasize broad fluid (i.e., innate) and crystallized (i.e., learned) abilities (Harrison & Flanagan, 2005). Thus, the use of one test may not adequately address domains covered by another test. In the early 2000s, attempts were made to create a cross-battery approach, whereby examiners are not relegated to using one test but instead use portions of multiple tests to ensure that specific domains are covered (e.g., McGrew & Flanagan, 1998). However, more research is needed to verify its clinical utility.

ADVANTAGES AND DISADVANTAGES OF GROUP TESTING

Most students will be administered a group administered cognitive or achievement test during their studies. Indeed, of the millions of cognitive tests that are administered to students annually, only a small fraction of these are individually administered (Cohen & Swerdlik, 2002). Considering their practicality, group tests are used across a variety of environments, including military, industrial/organizational, and educational. Thus, group administered tests have a broader application than individual tests (Aiken, 2006). Like their individually administered counterparts, most group administered tests consist of subtests that assess a variety of cognitive or academic domains and are either timed or power tests. However, the scoring format for most group administered tests is multiple-choice, which is less flexible and yields much less diagnostic information. For this reason, school-based group administered tests are used as screeners to determine whether further evaluation (often using an individually administered test) is warranted.

From their inception, it was clear that group administered tests could address some of the limitations inherent in individually administered tests. For example, by using only printed materials and following a standardized administra-

tion procedure, the financial and personnel resources are much less than the costs associated with individually administered tests. Further, most group administered tests have standardized and computerized scoring systems, which reduces the time necessary to score the protocols and thus minimizes scoring error. Moreover, given the nature of the format, group administered tests can be given to as many students who can comfortably fit into a room, which reduces test administration time and increases testing efficiency. Finally, considering the potentially unlimited number of students who would be administered a group administered test, the norms created are often based on a sample that is much larger than individually administered tests. This advantage allows for a direct comparison of scores across select demographic variables (e.g., race, disability status) that may not be possible when using individually administered tests.

Nevertheless, there are important disadvantages when considering group administered tests. For example, the format does not allow for in-depth observations of individual students as they complete the test. Thus, behaviors such as fatigue, low motivation, anxiety, hunger, and other states that may interfere with performance are not observed. Further, because the examiner may be less trained in the nuances of the test (in comparison to those who administer individual tests), the examiner may break standardization and inadvertently (and inappropriately) answer students' queries or not be able to monitor the testing environment with the same fidelity as can be given to the individual testing environment. Another limitation is the restriction of responses to multiple choice, whereas items on many individually administered tests have different levels of scoring depending on the complexity of the response. In this regard, group administered items may unduly penalize creative or original thinkers. Further, although the sample size of a group administered test may be large, it may also not be representative of children of a particular demographic. For example, many group administered cognitive and achievement tests are normed by students who take the test in the fall and in the spring. However, many students may choose not to take the test (when given a choice) or not be motivated to perform their best on the test (Aiken, 2006). Finally, the results of group administered tests can be used inappropriately. For example, the data obtained from such tests can be used to diagnose and place students into special programs, which should only occur from individually administered tests (Cohen & Swerdlik, 2002).

SEE ALSO *Criterion-Referenced Tests*.

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Richard Gilman

INDIVIDUALIZED EDUCATION PROGRAM (IEP)

Individualized Education Programs, or IEPs as they are commonly called, are an integral part of the U.S. education system. They are the written documents that direct the provision of special education services to students with disabilities who need them. Increasing numbers of students in U.S. public schools have been deemed to need special education services, in a wider variety of categories,

including learning disabilities, speech-language impairments, other health impairments, mental retardation, emotional disturbance, autism, visual impairments, hearing impairments, and others, totaling 13 separate categories in 2004. IEPs are considered a centerpiece of the special education process and, thus, necessary to understand for obtaining a perspective on special education as a whole.

DEFINITION OF THE INDIVIDUALIZED EDUCATION PROGRAM

The Individualized Education Program (IEP) is a written document required for each child who is eligible to receive special education services. It is provided to a student who has been determined first to have a disability and, second, to need special education services because of that disability. The IEP, the team that develops it, and what it must contain are governed by Part B of the Individuals with Disabilities Education Act (IDEA) and amendments to it. The IEP provides information on children's current levels of performance and directs the special services and supports that are provided to students who have IEPs. It includes provisions for defining annual goals, evaluating progress, and formalizing what is to be a free and appropriate public education (FAPE) for the student with the disability.

IEPs have several required components. Among the information that is to be included in IEPs are the following: (1) present levels of academic achievement and functional performance, (2) measurable annual goals, (3) special education, related services, and supplementary aids and services, (4) amount of time students will not participate in general education classes, (5) participation in state or district-wide academic assessments (including accommodations to be provided and reasons for using an alternate assessment if the child will not participate in the regular assessment), (6) initiation date and projected duration of IEP, (7) transition services, and (8) how student progress toward annual goals will be measured and when periodic reports will be provided to parents. Access to and participation in the general curriculum and use of research-based procedures are emphasized in the preparation of IEPs (Yell, Shriver, & Katsiyannis, 2006). States or districts may add to the basic components as they see appropriate, but failure to include all required components has been a source of litigation (Yell, 2006).

LEGISLATIVE HISTORY

The passage of the 1975 Education of the All Handicapped Children's Act (EHA), also commonly known as Public Law 94-142, contained the first requirement for the development of the Individualized Education Program (IEP) for

Individualized Education Program (IEP)

a child with a disability requiring the provision of special education services. Subsequent to the 1975 EHA, reauthorizations of the law refined and adjusted the IEP requirements. Public Law 99 457 (EHA Amendments of 1986) added requirements for early intervention services for infants and toddlers. Public Law 101 476 (EHA Amendments of 1990) renamed the law as the Individuals with Disabilities Education Act (IDEA). Public Law 105 017 (IDEA Amendments of 1997) initiated alignment of IDEA with the Elementary and Secondary Education Act and required participation of students with disabilities in state and district-wide assessments. Public Law 108 446 (IDEA Amendments of 2004) adjusted the name of the law to the Individuals with Disabilities Education Improvement Act and further aligned its requirements to those of the Elementary and Secondary Education Act, particularly its accountability requirements.

With each reauthorization, IEP requirements were adjusted to address the new focus and challenges or needs that were identified during the time since the previous reauthorization. The IDEA amendments in 2004 introduced several adjustments to the IEP, with the intention of addressing the need for increased accountability in line with the requirements of the Elementary and Secondary Education Act, known as No Child Left Behind. The 2004 reauthorization also introduced an easier IEP process, including less paperwork and the need for fewer meetings (President's Commission on Excellence in Special Education, 2002; Yell, 2006).

Among the 2004 provisions were the ability to excuse from required IEP team membership anyone deemed to be unnecessary if agreed to by both school personnel and the child's parents, dropping the requirements to have short-term objectives (except for those students participating in the state alternate assessment) and allowing IEPs to be changed without reconvening the IEP team between annual meetings, as long as the IEP team and the parents agreed. In an attempt to study the idea of having IEP teams meet only every three years rather than the required annual meetings, a pilot program for up to 15 states was initiated in 2004 to test the implementation and consequences of three-year IEPs.

LEGAL REQUIREMENTS

The legal requirements for the Individualized Education Program (including the IEP team and the document itself) encompass not only what must be included in the IEP (see Definition) but also specifics of the process. The IEP team must meet to write the IEP within 30 calendar days of the date that the child was determined to be eligible for special education services. The team must include the child's parents (or guardians), a special education teacher, a general education teacher, a school or local education agency administrator, a person who is able to interpret evaluation

results, and, if appropriate, the child. An individual may fill more than one role. The child's participation is required when the IEP includes a focus on transition services, which must start by age 16. Other individuals may be members of the team, as desired by the parents or school.

Each year, at a minimum, the IEP must be reviewed and revised as needed (unless there is participation in the three-year IEP pilot program; see Legislative History). Attention is paid especially to the IEP goals, progress toward them, and whether they need to be revised, and the placement of the child (where and for how long the child is in specific settings within the school, such as the general education classroom, special education room, or other placements). Every three years, the IEP team must meet to examine reevaluation results, used to determine whether the child continues to meet criteria to be designated as having a disability that requires special education services.

DESIGNING AND IMPLEMENTING IEPs

The actual processes and procedures used in schools and districts to ensure that IEP teams carry out the letter and intent of the law vary and have been the subject of relatively little research. Concerns about the legal requirements have arisen because of perceptions that they have compromised the quality of IEPs (Beattie, Jordan, & Algozzine, 2006). At the same time, the 2004 reauthorization of the law focused on ways to make the process of developing and revising the IEP more efficient and on ways to reduce paperwork in developing IEPs. In practice, states or local education agencies often require or recommend a form to use in developing the IEP so that it meets federal and state requirements. Computer-based IEP development software gained popularity with the perception of increasingly complex IEP requirements. With improvements over time in technology and programming, computer-based IEPs came to be viewed as having the potential to aid in the production of well-thought through IEPs (Wilson, Michaels, & Margolis, 2005).

IEPs are implemented by carrying out the directives of the IEP. Ideally, everyone responsible for implementing the IEP for an individual child has access to a copy of the IEP, and each person knows which responsibilities to implement (Beattie et al., 2006). Along with providing the designated services, supports, and accommodations that are described in the IEP, the IEP defines how the child's progress toward meeting the goals stated in the IEP will be measured. Progress reports designed to indicate the extent to which the child is making sufficient progress to reach goals by the end of the year are given to parents. These progress reports on IEP goals are to be made as often as the parents of children without disabilities are informed of their children's progress.

Despite their importance to the special education process, IEPs often have been inaccessible to those who should use them. Some educators and administrators have treated them as though they define the curriculum for the child with disabilities who requires special education services, rather than as the delineation of the services, supports, and framework for access to the general curriculum provided in the least restrictive environment for each child. In the early 2000s the IEP continued to be the subject of revisions each time IDEA is reauthorized, all the while retaining its central position in the special education process.

SEE ALSO *Special Education*.

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INFORMATION PROCESSING THEORY

Humans process information with amazing efficiency and often perform better than highly sophisticated machines at tasks such as problem solving and critical thinking (Halpern, 2003; Kuhn, 1999). Yet despite the remarkable capabilities of the human mind, it was not until the 20th century that researchers developed systematic models of memory, cognition, and thinking. The best articulated and most heavily researched model is the information processing model (IPM) developed in the early 1950s. The IPM consists of three main components, sensory memory, working memory, and long-term memory (see Figure 1). Sensory and working memory enable people to manage limited amounts of incoming information during initial processing, whereas long-term memory serves as a permanent repository for knowledge. In this entry, the

information processing model will be used as a metaphor for successful learning because it is well supported by research and provides a well-articulated means for describing the main cognitive structures (i.e., memory systems) and processes (i.e., strategies) in the learning cycle.

SENSORY MEMORY

Sensory memory processes incoming sensory information for very brief periods of time, usually on the order of 1/2 to 3 seconds. The amount of information held at any given moment in sensory memory is limited to five to seven discrete elements such as letters of the alphabet or pictures of human faces. Thus, if a person viewed 10 letters simultaneously for 1 second, it is unlikely that more than five to seven of those letters would be remembered.

The main purpose of sensory memory is to screen incoming stimuli and process only those stimuli that are most relevant at the present time. For example, drivers on a busy freeway in heavy traffic are constantly bombarded with visual and auditory stimuli. To maximize efficiency and safety, they process only information that is relevant to safe driving. Thus, they would attend to road conditions but not buildings they pass as they drive. Similarly, they would attend to sounds of other cars, but not to music from the radio or one passenger's casual conversation with another.

Researchers agree that information processing in sensory memory usually occurs too quickly for people to consciously control what they attend to. Rather, attention allocation and sensory processing are fast and unconscious. Information that is relevant to the task at hand, and information that is familiar and therefore subject to automatic processing, are the most likely types of information to be processed in sensory memory and forwarded to the working memory buffer. Information that is highly relevant may receive some degree of controlled, conscious processing if it is crucial to a task (e.g., attending to salient information such as animals along the road while driving at high speed). However, controlled processing in sensory memory would be likely further to reduce the limited amount of information that can be processed at any given moment.

WORKING MEMORY

After stimuli enter sensory memory, they are either forwarded to working memory or deleted from the system. Working memory is a term that is used to refer to a multi-component temporary memory system in which information is assigned meaning, linked to other information, and essential mental operations such as inferences are performed. A number of different models of working memory have been proposed (Shah & Miyake, 1999). However, the three-component model developed by Baddeley (1998, 2001) is the most common, and will be discussed shortly.

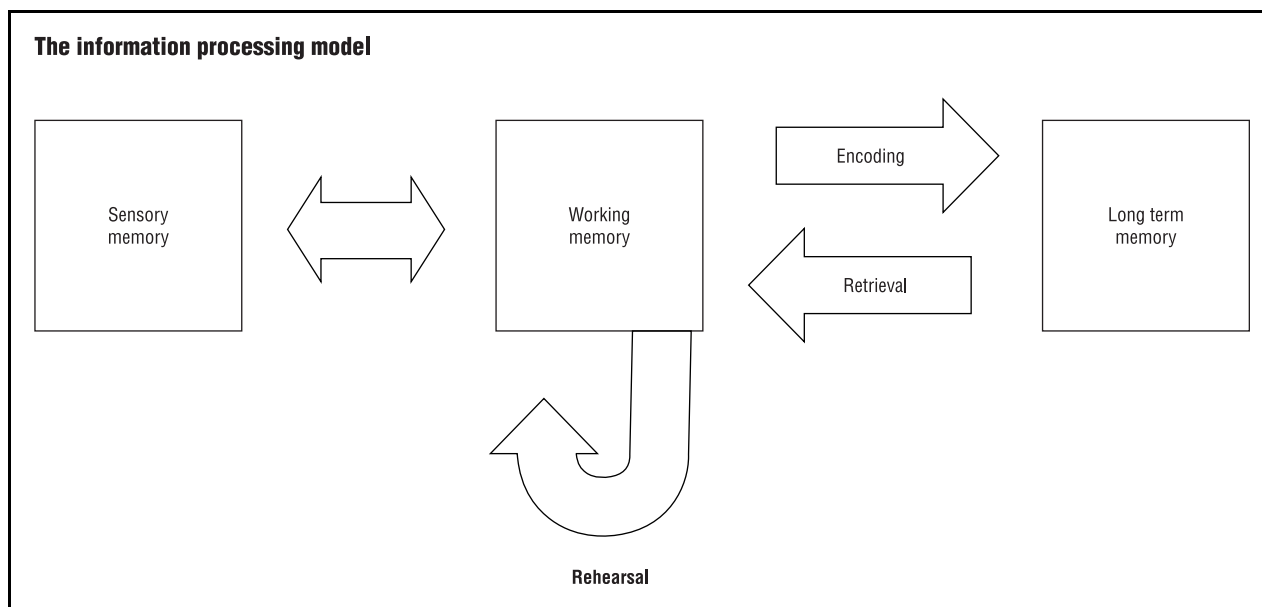


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Several useful terms have been developed to describe efficient cognitive processing in working memory. One term is *limited attentional resources*, which refers to the highly limited nature of information processing (Anderson, 2000; Neath, 1998). All individuals experience severe limitations in how much mental activity they can engage in due to limited cognitive resources (Kane & Engle, 2002). Although humans differ with respect to available cognitive resources, all learners experience severe limitations regardless of their skill and ability level. Often, differences between one learner and another are not due to the amount of resources, but how efficiently those resources are used.

Another key term is *automaticity*, which refers to being able to perform a task very quickly and efficiently due to repeated practice (Stanovich, 2003). Automated activities usually require few cognitive resources; thus, even a complex skill such as driving a car at 75 miles per hour can seem effortless. Effective information processing in sensory memory requires a high degree of automaticity with regard to recognition of familiar stimuli such as spoken or printed words, faces, and sounds.

A third key term is *selective processing*, which refers to the act of intentionally focusing one's limited cognitive resources on stimuli that are most relevant to the task at hand. For example, when driving in snow, one might allocate more of one's limited cognitive resources to watching the center line in the highway than one would allocate on a clear summer day. In contrast, on an extremely windy day, one would pay little attention to the whereabouts of the center line but pay special attention to any flying debris

that could cause an accident. In essence, selective processing enables learners to be optimally efficient by putting all of their cognitive eggs in one basket. It is no coincidence that highly effective learners succeed because they identify what is most important to learn and allocate limited attention to relevant information.

Baddeley's 2001 model of working memory consists of three components, the *executive control system*, *articulatory loop*, and *visual-spatial sketch pad*. The role of the executive control system is to select incoming information, determine how to best process that information, construct meaning through organization and inferences, and subsequently transfer the processed information to long-term memory or choose to delete that information from the memory system altogether (e.g., a telephone number that is no longer needed). Most models of working memory assume that the central executive is the place where humans "make conscious meaning" of the information they process (Shah & Miyake, 1999). The role of the articulatory loop is to maintain and further process verbal information. The role of the visual-spatial sketch pad is analogous to the articulatory loop in that it maintains and further processes non-verbal and visual information. Information is lost quickly from working memory (i.e., 5 to 15 seconds) unless some type of mental rehearsal occurs. Barring rehearsal (e.g., repeating a telephone number), information is either forwarded to long-term memory or is deleted from the system.

Baddeley's model makes several critical assumptions about the processing of information in working memory. One is that each of the three subsystems possesses its own

A comparison of sensory, working, and long term memory			
Type of memory	Purpose	Capacity	Duration of retention
Sensory memory	Provides initial screening and processing of incoming stimuli.	3 to 7 discrete units	0.5 to 3 seconds
Working memory	Assigns meaning to stimuli and links individual pieces of information into larger units. Enables learner to construct meaning and perform visual-spatial mental operations.	7 to 9 units of information	5 to 15 seconds without rehearsal
Long term memory	Provides a permanent repository for different types knowledge	Infinite	Permanent

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

pool of limited cognitive resources. This means that, under normal information processing circumstances, each subsystem performs work without taxing the other subsystems. A second assumption is that the executive control system regulates the articulatory loop and visual-spatial sketch pad.

LONG TERM MEMORY

Unlike sensory and working memory, long-term memory is not constrained by capacity or duration of attention limitations. The role of long-term memory is to provide a seemingly unlimited repository for all the facts and knowledge in memory. Most researchers believe that long-term memory is capable of holding millions of pieces of information for very long periods of time (Anderson, 2000). A great deal of research has gone into identifying two key aspects of long-term memory: (a) what types of information are represented, and (b) how information is organized. These two questions are addressed in the next section of this entry. For present purposes, there is universal agreement that qualitatively different types of information exist in long-term memory and that information must be organized, and therefore quickly accessible, to be of practical use to learners.

Figure 1 shows that working memory and long-term memory are connected by *encoding* and *retrieval* processes. Encoding refers to a large number of strategies that move information from temporary store in working memory into long-term memory. Examples include organization, inference, and elaboration strategies, which will be discussed later. Retrieval refers to processes that enable individuals to search memory and access information for active processing in working memory. Both encoding and retrieval greatly facilitate learning when information in long-term memory is organized for easy access.

A comparison of the three components of the IPM indicates that both sensory and working memory are relatively short term in nature (see Table 1). Their main roles are to screen incoming information, assign meaning, and

relate individual units of information to other units. In contrast, the main role of long-term memory is to serve as a highly organized permanent storage system. Sensory and working memory process few pieces of information within a short time frame. Automaticity of processing and selective allocation of limited cognitive resources greatly increases the efficiency of information processing. Long-term memory is assumed to be more or less permanent and unlimited in terms of capacity. The main processing constraint on long-term memory is the individual's ability to quickly encode and retrieve information using an efficient organizational system.

The information processing model provides a conceptual model which explains the different functions and constraints on human memory. The IPM also has had a major impact on instructional theory and practice. Sweller and Chandler's 1994 work developed *cognitive load theory* to explain how different instructional and learner constraints affect optimal information processing. The crux of their argument is that each task imposes some degree of cognitive load, which must be met either by available cognitive resources or learner-based strategies such as selective attention and automaticity. Reducing cognitive load enables individuals to learn with less overall mental effort. Cognitive load theory has been especially helpful in terms of planning instruction and developing learning materials. Others researchers such as Mayer and Moreno (2003) have developed frameworks to increase learning by systematically reducing cognitive load through better design of learning materials and more strategic use of limited resources by students.

In summary, the information processing model postulates a three-component model of information processing. The IPM is consistent with empirical findings and provides an excellent framework for understanding principles of effective learning, which are considered later in this entry. Sensory and working memory are limited with respect to capacity and duration, whereas long-term memory is more or less unlimited. Information processing efficiency is

increased due to automaticity and selectivity. Encoding and retrieval of information in long-term memory is increased due to efficient organizational strategies.

IMPLICATIONS FOR INSTRUCTION

The information processing model provides four important implications for improving learning and instruction. The first is that memory stores are extremely limited in both sensory and working memory. The two main strategies that effective learners use to cope with limited capacity are selectively focusing their attention on important information and engaging in as much automated processing as possible. From an educational perspective, it is essential for students to become automated at basic skills such as letter and word decoding, number recognition, and simple procedural skills such as handwriting, multiplication, and spelling. Automaticity makes available limited processing resources that can be used to engage in labor intensive self-regulation (Butler & Winne, 1995; Zeidner, Boekaerts, & Pintrich, 2000; Zimmerman, 2000) and comprehension monitoring (Schraw, 2001; Sternberg, 2001).

A second implication is that relevant prior knowledge facilitates encoding and retrieval processes. Highly effective learners possess a great deal of organized knowledge within a particular domain such as reading, mathematics, or science. They also possess general problem-solving and critical-thinking scripts that enable them to perform well across different domains. This knowledge guides information processing in sensory and working memory by providing easy-to-access retrieval structures in memory. It also serves as the basis for the development of expertise (Alexander, 2003; Ericsson, 2003). Thus, helping students use their prior knowledge when learning new information promotes learning.

A third implication is that automated information processing increases cognitive efficiency by reducing information processing demands. As discussed earlier, automaticity is an important aspect of effective learning for two reasons. One is that being automated makes it easier selectively to allocate limited resources to information that is most relevant to the task at hand. Unfortunately, there is no easy road to automaticity other than sustained, regular practice. In addition, automaticity frees limited resources that can be used for other activities such as drawing inferences and connecting new information to existing information in memory.

A fourth implication is that learning strategies improve information processing because learners are more efficient and process information at a deeper level (Pressley & Harris, 2006; Pressley & McDonald-Wharton, 1997). All effective learners draw from a repertoire of learning strategies in a flexible manner. Some of these strategies are used

automatically, while some require controlled processing and metacognitive control that place high demands on limited cognitive resources. Good learners use a wide variety of strategies and use them in a highly automatic fashion. However, there are three general strategies that all effective learners use in most situations. These include *organization*, *inferences*, and *elaboration* (Mayer & Moreno, 2003). Organization refers to how information is sorted and arranged in long-term memory. Information that is related to what one already knows is easier to encode and retrieve than isolated information. In some cases, individuals already possess well organized knowledge with empty slots that can be filled easily with new information. Activating existing knowledge prior to instruction, or providing a visual diagram of how information is organized, is one of the best ways to facilitate learning new information. Constructing inferences involves making connections between separate concepts. Elaboration refers to increasing the meaningfulness of information by connecting new information to ideas already known.

SEE ALSO *Cognitive Development: Information Processing Theories of Development; Cognitive Strategies; Memory; Metacognition.*

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INQUIRY-BASED LEARNING

SEE *Constructivism: Inquiry-Based Learning*.

INTELLIGENCE: AN OVERVIEW

This entry covers intelligence and intelligence testing. Intelligence is a difficult and often misused concept that has had an important impact on education. The entry will first

review the definition and history of the concept of intelligence. Descriptions of the critical issues of measurement and application of the concept are then addressed. Intelligence tests commonly used in the schools are also described. Ways that tests are used in academic settings are covered with a short description of the qualifications for those who use the tests. Finally research trends and the emerging changes in the development of the concept of intelligence are addressed.

THE DEFINITIONS OF INTELLIGENCE

The specific meaning of intelligence in terms of how the concept is applied in education and schooling is difficult to convey. Everyone thinks they know intelligent performance when they see it, but when they try to define it, the elusiveness of the trait becomes apparent (Sternberg, Grigorenko, & Kidd, 2005). As Wagner (2000) has pointed out, definitions of intelligence have been notoriously inconsistent over the last century. Early definitions have tended to focus on specific or general abilities. For example, the work of Charles Spearman (1863–1945) over a century ago emphasized general ability (sometimes referred to as *g*) that involved recognition of relationships (e.g., Spearman, 1904), and intelligent activity involved combining this *g* with specific abilities. Alfred Binet (1857–1911) and Théodore Simon (1872–1961), working at around the same time, defined intelligence as “judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting one’s self to circumstances. To judge well, to comprehend well, to reason well, these are the essential activities of intelligence” (Binet & Simon, 1905, p. 43). Lewis Terman (1877–1956), largely credited for bringing intelligence testing into U.S. schools and developing the first versions of the Stanford-Binet Intelligence Test, emphasized knowledge and abstract thinking in defining intelligence (Aiken, 2003; Hegarty, 2007; Terman, 1918). The definition provided by David Wechsler (1896–1981) was “The aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment” (Wechsler, 1958, p. 7).

Most of these definitions seemed to have an orientation to academic learning and performance. More recent definitions have been moving toward practical definitions with a view toward how the person functions in the real world as well as in traditional academic settings (Wagner, 2000). For example, in their 1998 book, Eleanor Amour-Thomas and Sharon-Ann Gopaul-McNichol have suggested the importance of a relativistic definition that recognized the significance of the interaction between the biological nature of the individual and the cultural and environmental context surrounding the person. Howard Gardner conceived intelligence as “a biopsychological potential to process information in certain ways,

in order to solve problems or fashion products that are valued in a culture or community” (cited in Shearer, 2004, p. 3). Gardner saw intelligent behavior as related to specific kinds of functioning in the real world. Another of the more contemporary theorists, Robert Sternberg, defined intelligence from the perspective of research in cognitive information processing. His approach to intelligence implies successful performance in the real world and depends on an understanding of research in the ways in which the brain might work to produce intelligent behavior such as problem solving, adapting and learning. His theory is organized into three subtheories that address analytical, practical, and creative aspects of intelligent performance (Sternberg, 1994; Sternberg, Castejón, Prieto, Hautamäki, & Grigorenko, 2001). While many more definitions and approaches can be cited, they generally suggest that definitions of intelligence involve ability to learn, problem solve, and adapt. Further, later definitions move away from the notion of a unitary concept such as *g* to one that involves creativity, personal characteristics and traits, attention to the nature of the task or problem being addressed, the research on the brain and function, and environmental adaptation (Sternberg, Grigorenko, & Kidd, 2005; Sattler, 2001; Shearer, 2004).

Although many claim that intelligence is defined by what intelligence tests measure, many other theorists and researchers argue that this definition is too circular and narrow. Scores on intelligence tests are designed to reflect the definitions of intelligence rather than serve as the definition of intelligence (Gardner, Kornhaber, & Wake, 1996), or an exact and unqualified representation of intellectual ability.

BRIEF HISTORY OF INTELLIGENCE TESTING

Interest in intelligence in some form has a long history. The Greek philosopher Aristotle (384–322 BCE) studied memory, logical thought, and what knowing means well before the mid- to late 19th-century investigations of the heritability of intelligence by Francis Galton (1822–1911) took place in England. Galton, considered one of the first scientific investigators of human intelligence, devised an array of simple tests covering an assortment of mental processes involving memory, senses, and motor behavior which he administered to a large sample of people. Performance was analyzed using statistical methods. These efforts are widely considered the beginning of the mental testing movement (Brennan, 2003). Binet, who was working in France at about the same time as Galton was doing his research, was more focused on mental processes such as the ability to adapt, comprehend, and reason. The idea of public education for the masses had just taken hold and schools were compelled to deal with much more widely divergent

abilities and behavior in children than was the case with the more privileged group that had previously attended school. Binet was asked by the French Ministry of Public Instruction to help identify the children who would be successful in school and those who would not (Gardner, Kornhaber, & Wake, 1996). Binet responded with a test for this purpose (Binet & Simon, 1905).

The concept of individual differences was gaining popularity around the world at the same time as Binet’s work, spurred by the movement towards universal compulsory education in many countries. At the time, many psychologists were addressing the problem of how to identify children who would have success in education (Thorndike, 1990). In the United States, a number of psychologists, including Edward L. Thorndike (1874–1949) were addressing the problem. Thorndike, working at Teachers College of Columbia University, was central to the development of American and behavioral psychology and was very influential on American education practice (Brennan, 2003). Thorndike emphasized a neural basis of intelligence and felt that education should take advantage of natural intelligence and promote its development (Thorndike, 1990). Henry Goddard (1866–1957) translated the Binet scales and began experimenting with them. Terman standardized and normed the Binet test on California schoolchildren. He also added a concept developed by another psychologist, William Stern (1871–1938), which became the well-known Intelligence Quotient (IQ score). Originally the Binet tests yielded only a mental age, but Stern proposed dividing the mental age by the child’s chronological age and multiplying by 100. Thus a child with a mental age score of 10 years, 6 months who is 9 years, 6 months old would have an IQ of 111 (i.e., $MA/CA \times 100 = (127 \text{ months}) / (114 \text{ months}) \times 100 = 111$) (Thorndike, 1990). A child with a score of 111 would be said to be performing above other children of the same age. A child whose mental age and chronological ages were the same would have an IQ of 100 and would be considered of average intelligence for the child’s age.

Modern IQ tests use a scaling method based on the normal curve to compute the IQ score. This scaling method, known as *deviation IQ*, permits the test user to interpret a person’s IQ score in terms of the proportion of people in the normative sample that had scores above and below the person’s obtained score. This innovation was developed by Wechsler (1939) principally because the concept of mental age seemed inappropriate to use with adults. That is, intelligence tests of the time were designed with the assumption that a person’s intelligence developed until the around the age of 20, at which time mature adult intelligence had been attained. Therefore the highest mental age that could be attained on a test was 20. However, Wechsler took the view that chronological age should be a predictor of mental age. This would not be the case if chronological age was increasing while mental age was not (Thorndike, 1990).

MODERN THEORIES OF INTELLIGENCE

Early intelligence theory emerged from an emphasis on a unitary concept of general ability, as can be seen in the definitions of Binet and Spearman. Spearman created a statistical technique called factor analysis to explore his approach. From his studies with this technique, he was able to report that about half of the variance in tests of mental ability was due to the general (*g*) factor (Kaplan & Sacuzzo, 2001). The remainder was due to the special ability (e.g., numerical reasoning, vocabulary, mechanical skill) that was required of a person to enable performance of the specific tasks on the test. Later approaches tended to emphasize expanded abilities. For example, Cattell divided *g* into fluid (*gf*) and crystallized (*gc*) intelligence (Horn & Cattell, 1966; Horn & Noll, 1997). *Fluid intelligence* encompasses abilities involved in thinking, reasoning, and in learning, while *crystallized intelligence* represents the knowledge and broader understanding that has developed through learning in the environmental setting.

Other theories further recognized the diversity of intelligent performance. In his 1967 book Joy Paul Guilford (1897–1987), using factor analysis, devised a model of intelligence he termed the *Structure of Intellect* in which he proposed three aspects of intelligence: operations, products, and contents. Each of these is broken down further into specific kinds of intellectual activity which Guilford considered interrelated to produce intelligent functioning of specific tasks.

Gardner (1993) proposed a theory of multiple intelligences based on the differential cognitive processing required for demonstration of intelligent or creative performance in different areas. Gardner's theory references eight intelligences. Linguistic and logico-mathematical intelligences are most often associated with academic performance, although others could be relevant depending on the task (Shearer, 2004). Other intelligences identified by Gardner were musical, kinesthetic, spatial, naturalistic, and personal (intrapersonal and interpersonal).

Robert Sternberg also proposed a theory informed by research from cognitive psychology. Sternberg's model is named the *triarchic theory* of intelligence because it is composed of three kinds of components: memory-analytic, creative-synthetic, and practical-contextual. The first component is related to the academic view of intelligence and is most similar to what most intelligence tests measure. The second component is necessary for creative endeavors, including traditionally academic areas such as science and mathematics. Finally, the practical-contextual is necessary for success in an everyday environment like school or business (Sternberg, 1994). Daniel Golman (1995) has proposed an emotional intelligence

that bears some similarity to the personal intelligences of Gardner and the practical intelligence of Sternberg, but goes further in tying emotion and personality to the capacity for intelligent behavior. For example, fear, excitement, or anger may contribute to how one behaves regardless of one's knowledge or capacity to reason.

In the first half of the 20th century, research in intelligence was heavily influenced by factor analysis (first used by Spearman). Factor analysis is a statistical procedure that enables the systematic study of the relationships within a set of variables in order to find the common aspects. Research and theory emerging in the second half of the 20th into the 21st century has begun to have an impact on the methods of assessment of intelligence (Gardner, et al., 1996). For example, research in cognitive psychology, neuropsychology, cognitive science (Kolak, Hirstein, Mandik, & Waskan 2006), biopsychology and evolutionary processes (Geary, 2005), and cultural psychology (Armour-Thomas and Gopaul-McNicol, 1998) has begun to affect theory and research in intelligence, its measurement and applications.

MEASUREMENT OF INTELLIGENCE IN EDUCATIONAL SETTINGS

Two kinds of intelligence tests will be presented here. The first, group tests, are used to identify the range of IQ scores in a group, usually for research or administrative purposes. Group tests tend to have more specific content and question formats, and are designed for more specific purposes than individually administered tests, which aim for a relatively more comprehensive clinical picture of the individual's cognitive functioning. The individual tests are designed to provide much more information about the individual. They are only used by professionals who are trained and licensed to administer and interpret these assessment instruments as part of a comprehensive clinical assessment that contributes information useful for planning educational or therapeutic interventions. These tests provide a variety of scores and clinical information that licensed professional psychologists may use to plan interventions in schools, family, or other settings. In other words, the usefulness of individual intelligence tests goes well beyond the scores on the test. For this reason, group tests are not suitable substitutes for individual assessments when planning clinical or educational interventions.

Group Tests of Intelligence. Two examples of group intelligence test are discussed here. The Cognitive Abilities Test (Multilevel Edition, Form 6 [CogAT-6]) (Lohman 2001), and the Multidimensional Aptitude Battery, Second Edition (MAB-II) (Jackson, 1998) were chosen because they may be used in school or educational settings.

The Multidimensional Aptitude Battery-II (MAB-II) is a multiple-choice assessment of aptitude and intelligence that can be administered to groups or individuals above the age of 16. The instrument was designed to obtain scores similar to that of the individually administered Wechsler Adult Intelligence Scale-Revised (WAIS-R) in a group, as opposed to individual administration. The MAB-II produces composite scores: Verbal Scale (Information, Comprehension, Arithmetic, Similarities, Vocabulary), Performance Scale (Digit Symbol, Picture Completion, Spatial, Picture Arrangement, and Object Assembly) and Full Scale. The test can be pencil and paper or computer-administered.

The MAB-II is considered to be a useful tool for assessing cognitive abilities when large numbers of students must be screened. It is a well-developed and empirically sound instrument that provides correlations between subtest scores and occupational strengths (Thompson, 2003). The test can be administered by a proctor, rather than by a post-master's-level professional. As a result, the MAB-II should not be used for making clinical diagnoses about intelligence (Widaman, 2003). Additionally, MAB-II should not be administered to students with a learning disability related to reading comprehension or whose reading level is below ninth grade because the test relies on the test-takers' reading ability (Thompson, 2003).

The Cognitive Abilities Test Multilevel Edition, Form 6 (CogAT-6) is one of the more widely used group ability tests for students in kindergarten through 12th grades. The test is intended to guide instruction to match the cognitive abilities and needs of each student, to provide an "alternative" measure of cognitive development, and to identify achievement-ability discrepancies. The test has a multitheoretical foundation as it is based on Vernon's model of hierarchical abilities, Cattell's model of crystallized and fluid abilities, and Carroll's work specifically on general abstract reasoning. The CogAT-6 is composed of two editions: the Primary and Multilevel Editions, both of which are intended to assess reasoning and problem-solving abilities and can be broken down into Verbal, Nonverbal, and Quantitative Batteries. The Primary Edition is designed for students in K-2nd grade and consists of six subtests. The Multilevel Edition is a nine-subtest instrument that is based on the Lorge-Thorndike Intelligence Tests (Lorge & Thorndike, 1954) and is appropriate for students in 3rd to 12th grade. The CogAT-6 has a mean of 100 and standard deviation of 16.

DiPerna's 2005 review of the CogAT-6 suggested that the strengths of the test include a large, representative standardization sample, co-norming with the Iowa Tests, and a theoretical basis. In spite of these positive attributes, significant weaknesses were cited relative to the CogAT's purposes as described earlier. Criticisms included insuffi-

cient empirical evidence to support basing instructional recommendations on test results, a lack of reliability and predictive validity to measure cognitive ability and to predict cognitive ability-achievement discrepancies.

Individual Intelligence Tests. The following individual intelligence tests will be reviewed:

- Wechsler Intelligence Scale for Children-IV (WISC-IV)
- Woodcock-Johnson Tests of Cognitive Abilities-III (WJ COG III)
- Stanford-Binet Intelligence Scales, Fifth Edition (SB5)
- Das-Naglieri Cognitive Assessment System (CAS)
- Kaufman Assessment Battery for Children (K-ABC)

The Wechsler scales continue to be the most widely utilized individually administered tests of intelligence (Flanagan & Kaufman, 2004). As previously discussed, the Wechsler tests are based on the *g* factor or the "overall capacity of the individual to act purposefully, to think rationally, and to deal effectively with the environment" (Sternberg, 2000, p. 481). The Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV) is the current revision of the Wechsler scales for children 6.0 to 16.11 years of age. The WISC-IV comprises 15 subtests (5 of which are supplemental). Scores on these tasks contribute to the four composite indices (Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed) in addition to a Full Scale IQ (FSIQ) score that can range from 40 (very low) to 160 (very high), with a mean of 100 representing the average score, and a standard deviation of 15. A profile of the test taker's learning strengths and weaknesses are derived from the test performance. The FSIQ is derived from a combination of all subtest scores and is considered the most representative estimate of global intellectual functioning. However, when large discrepancies between Index scores exist, the FSIQ can be invalid and misleading. In this case, it is most helpful to describe the strengths and weaknesses in the profile and de-emphasize the FSIQ.

The WISC-IV continues to be a reliable and valid instrument. WISC-IV scores can be interpreted in combination with Wechsler Individual Achievement Test, Second Edition (WIAT-II) scores for comparisons between ability and achievement. Flanagan and Kaufman (2004) provide an extensive description of the strengths and limitations of this assessment tool. They cite the WISC-IV's most significant strengths as being "a robust four-factor structure across the age range of the test, increased developmental appropriateness, de-emphasis on time, improved psychometric properties, and an exemplary standardization sample (p. 171)." Flanagan & Kaufman (2004) indicate that none of the

WISC-IV's limitations are very serious, although they suggest ways in which its validity could be improved.

Other Wechsler scales have been developed to assess IQ for young children and adults. The Wechsler Preschool and Primary Scale of Intelligence, Third Edition (WPPSI-III) (Harcourt Assessment, 2002) can be administered to children 2.6–7.3 years old and the Wechsler and the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III) (Harcourt Assessment, 1997) is given to adults between 16 and 89 years of age.

The Woodcock-Johnson Tests of Cognitive Abilities-III (WJ COG III) is also widely used instrument in school settings. The WJ COG III is often administered as the examiner's second choice, if the age-appropriate Wechsler scale has been administered less than three years from the current assessment date. The WJ COG III is based on Catell, Horn, and Carroll's (CHC) concept of intelligence (Reynolds, Keith, Fine, Fisher & Low 2007). The WJ COG III has been normed on individuals age 2 through 90+. The standard battery includes 10 tests, while the extended battery consists of 20. Based on these scores, the examinee earns three Cluster Scores (Verbal Ability, Thinking Ability, and Cognitive Efficiency) and a General Intellectual Ability (GIA) score. Test scores in the standard and extended batteries are not weighted equally when the GIA score is computed.

The WJ COG III has high technical quality and is based on a well-respected theory of cognitive abilities (Schrank, Flanagan, Woodcock, & Mascolo, 2002). It assesses cognitive abilities for a wide age range and uses sophisticated scoring procedures to calculate scores and discrepancies (Sattler, 2001). Additionally, ability and achievement discrepancy norms are provided as the WJ COG III was co-normed with the Woodcock Johnson Tests of Achievement, Third Edition (WJ ACH III). Greater evidence is necessary to understand the utility of the clinical clusters (Schrank, Flanagan, Woodcock, & Mascolo, 2002). The WJ COG III may also overestimate abilities if interpreted incorrectly. For example, the Written Language test score emphasizes one's ability to write brief sentences rather than to develop and organize paragraphs.

The Stanford-Binet Intelligence Scales, Fifth Edition (SB5), a direct descendent of Terman's adaptation of the Binet test developed more than 100 years ago, is used occasionally in the educational setting. The SB5 is based on the CHC theory of intelligence. It is designed for assessing intelligence and cognitive abilities among individuals between the ages of 2 and 85+. The SB5 consists of ten subtests and these scores are used to calculate four composite scores: factor, domain, abbreviated, and full scale (score range 40–160, mean = 100, SD = 15). The five factors measured include Fluid Reasoning, Knowledge, Quantitative Reasoning, Visual-Spatial Reasoning, and

Working Memory, each with verbal and nonverbal components. The SB5 contains two domain scales: Nonverbal IQ (NVIQ) and Verbal IQ (VIQ). An Abbreviated Battery IQ (ABIQ) can be determined with two routing subtest scores and the Full Scale IQ (FSIQ) is calculated using all 10 subtests.

The SB5 is advantageous as it emphasizes both verbal and nonverbal abilities. The instrument is technically sound, according to Johnson and D'Amato (2005), although Kush's 2005 study cites technical limitations (e.g., lower stability for young children and individuals with low cognitive abilities, problematically high correlations with achievement, uncertain factor structure). In spite of these weaknesses, the SB5 is referred to as an outstanding measurement instrument for the assessment of cognitive abilities of children, adolescents, and adults (Johnson & D'Amato, 2005; Kush, 2005).

The Das-Naglieri Cognitive Abilities System (CAS) is a tool based on Luria's cognitive processing model that is intermittently used to evaluate cognitive abilities in schools. The CAS is useful for assessing Planning, Attention, Simultaneous, and Successive (PASS) abilities among students between the ages of 5.0 and 17.11. The instrument's basic battery comprises 8 subtests and the standard battery consists of 12 subtests.

The CAS is an innovative instrument and its development meets high standards of technical adequacy (Meikamp, 2003). When compared to other individually administered general ability tests, it takes less time to administer (Thompson, 2003). Additional empirical research must be completed to support the PASS construct. Factor analyses of subtests support both a 4-factor PASS model as well as a 3-factor model, which suggests that Planning and Attention may or may not be separate factors. (Thompson, 2003).

The Kaufman Assessment Battery for Children, Second Edition (KABC-II) is occasionally utilized in schools as a culture-fair assessment of cognitive abilities for students between the ages of 3 and 18. The KABC-II is based on a dual theoretical framework, Luria's neuropsychological model (Naglieri, 1998) and the CHC approach. The authors suggest that its multitheoretical base allows the examiner to select which model is most appropriate for interpretation of results depending on the culture and/or verbal skills of the examinee. This assessment instrument contains 20 subtests that contribute to 4 scale scores (Sequential Processing, Simultaneous Processing, Planning, Learning, and Knowledge). The KABC-II has a mean of 100 and standard deviation of 15.

The KABC-II is an acceptable option for measuring cognitive abilities as it provides a reasonable, well-normed, clinically appealing, and technically sound approach to measuring cognitive abilities and generating diagnoses (Braden, 2005). Other strengths of the KABC-II include

smaller score discrepancies between ethnic groups and the ability to compare ability and achievement differences with the Kaufman Test of Educational Achievement, Second Edition, Comprehensive Form. However, it has been criticized for the suggestion that examiners can select the model (Luria or CHC) by which to interpret results. Braden (2005) and Thorndike (2005) suggest that the interchangeability of theoretical models is inappropriate and illogical.

Intelligence testing should not be conducted in a vacuum. In addition to using previously mentioned norm-referenced tests, an assessment should include a variety of other data from a multitude of informants. Sattler (2001) suggests that norm-referenced testing should be accompanied by interviews with a parent, teacher, and student; observations of the student during both the formal testing and natural environment (e.g., classroom, lunchroom, playground); and informal assessment procedures (e.g., district-wide criterion-referenced tests, school records). Such an assessment will provide the most accurate information by which educators can most effectively serve the student.

Group versus Individual Intelligence Tests. Whereas group-administered IQ tests can be very well constructed (Aiken 2003) and can provide valid and reliable information suitable for certain non-clinical applications, they do not provide the same kind of information as individual tests and should not be used for the same purposes. One reason is that group tests primarily emphasize multiple-choice question format, whereas individually administered tests provide a variety of response formats across the test. This allows clinicians to gather considerable clinically useful information about the person being tested, such as the approaches used in problem solving, quality of verbal expression, and other observational data (Domino 2000; Sattler 2001). Group tests were not designed to be used for clinical purposes and therefore should not be utilized in clinical settings or to substitute for individually administered intelligence tests for designing clinical interventions or individual educational programs (IEPs) in school settings.

Individual intelligence tests are designed to be administered by highly trained professionals who interpret data through the lens of learning, cognition, emotion, language, culture, health, and development. The one-on-one setting provides advantages to the test-taker and the examiner. First, it allows the examiner to develop rapport with the test-taker, which can benefit the shy or anxious test-taker. Second, the examiner has the opportunity to observe important test-taking behavior such as impulsiveness, compulsiveness, confidence, anxiety, and wandering attention, which may vary according to the task and contribute to the interpretation of the performance on the test. Third, the examiner can observe specific

problem-solving approaches, which may also vary with the task. The integration of these observations with test scores allows the examiner to take a holistic approach in interpreting scores and developing interventions.

APPLICATIONS IN CLASSROOMS AND SCHOOLS

Individual intelligence tests are used in schools and other educational settings to provide information about children's and adolescents' ability to express themselves, reason and problem solve, and perform on a variety of tasks. This information can be used to design programs for children with special needs or gifts in academic areas. Despite their shortcomings, intelligence tests are considered useful for identifying children for advanced programs for gifted learners (Pyryt, 1996). These tests also play an especially important role in special education. They can be useful for identifying an expected level of academic performance and also in helping school professionals design individual educational programs (IEP) for students with special needs (Sattler, 2001). However, Kim (2005) found in a meta-analysis of 21 studies that IQ tests are not effective for use in identifying students with special talents.

RESEARCH TRENDS

Research in intelligence is active and robust, and this section surveys the spectrum of investigations of intelligence related to school learning and performance. One active area of research is on the tests of intelligence themselves. Specifically, confirmatory factor analysis, a procedure for statistically examining the fit of data from a test to a hypothesized model, is being increasingly utilized to determine whether the theories and models of intelligence underlying tests is verifiable from performance on the test. For example, confirmatory factor analysis was used to verify the structure of the Kaufman Assessment Battery for Children, Second Edition, and the fit of the performance data to the Cattell-Horn-Carroll model of intelligence (Reynolds, Keith, Fine, Fisher, & Low, 2007). The technique was also used successfully to verify the factor structure of Sternberg's Triarchic Abilities Test Level-H (STAT) (Sternberg, Castejón, Prieto, Hautamäki, & Grigorenk, 2001). A related collection of research is directed at investigating the underlying theories and models of intelligence that have been proposed. Most of this research bases hypotheses and research questions on recent research in fields such as cognitive science, neuroscience, emotion, cultural psychology. An example of this kind of research is provided by Visser and her colleagues. Their research compared performance on tests of the components of Gardner's multiple intelligence theory with people's estimates of

their own ability and found only modest significant relationships between estimated and measured abilities, and that people tended to overestimate their abilities (Visser, Ashton, & Vernon, 2008).

Research has shown that IQ scores seem to be trending upward (Flynn, 1984). The research has moved from documentation of the phenomenon across countries and cultures (Flynn, 1987; Daley, Whaley, Sigman, Espinosa, & Neumann, 2003), into investigations of whether people are truly becoming more intelligent or whether other explanations seem more plausible in explaining the phenomenon (Rodgers & Wänström, 2007). Some evidence has been provided that increase in measured IQ seems more related to areas considered more reflective of fluid rather than crystallized intelligence performance, such as mathematics test performance (Dickens & Flynn, 2001; Rodgers & Wänström, 2007).

The importance of cultural context in relation to intelligence cannot be minimized (Benson, 2003; Sternberg, 2004). The early definitions of intelligence were tied directly to school performance but have become more encompassing to include culture, language, social class, and related issues. For example, Sternberg's definition emphasizes success in life (Sternberg, 2004). However, a difficulty emerges in determining the standard criteria to use for this kind of intelligence (Benson, 2003). In primitive society, success might be simply be survival. Traditional IQ tests have long been considered culturally unfair because diverse groups such as those of Hispanic origin, African Americans, and Native Americans have not scored as well on them as White groups (Dickens & Flynn, 2006; Rushton & Jensen, 2006; Sternberg, Grigorenko, & Kidd, 2005). The discrepancy between Black and White Americans' test performance has been used to suggest a genetic determinant of IQ, a view has been attacked as unscientific and simplistic (Cooper, 2005; Cronshaw, Hamilton, Onyura & Wilson, 2006; Sternberg, Grigorenko, & Kidd, 2005). Recent research has shown the gap between Whites and Blacks narrowing (Dickens & Flynn, 2006).

The relationship between intelligence test performance and academic performance is well documented (Brody, 1997; Haywood, 2004; Sattler, 2001). Gagne and St. Pére (2002) found no significant relationship between motivation and IQ scores, and that IQ scores seemed to be even more related to achievement than motivation scores. Other studies have revealed strong relationship between IQ and academic performance. For example, in their 2007 study, Lynn and Mikk found significant relationships between IQ and academic performance in math and science among 10-year-olds in 25 countries and 14-year-olds in 46 countries. Barber (2005) reported significant relationships between literacy and having completed secondary education (among other variables) in 81 countries. Considerable research

suggests that one of the factors underlying the relationship between IQ and performance in academic subjects is mental processing speed (Luo, Thompson & Detterman, 2003). Sheppard's 2008 review of 172 studies of intelligence and the speed of information processing concluded that measures of intelligence and speed of mental processing are highly correlated, and males and females are faster on different types of speeded tasks.

This brief summary of the research relevant to theory and practice in intelligence shows that the field is active and dynamic. Also, it should be evident that intelligence researchers of the 21st century are addressing a broader, more complete concept of intelligence than was evident in the previous century. As related research in biology of the mind, emotion, neuropsychology, family dynamics, and cognitive processing progresses to new findings, these results will be incorporated into increasingly useful models and theories of the workings of intelligence and how to assess them.

Intelligence has been a useful concept for planning education for over a century. It is a difficult concept to define. Aspects of the definition that seem to have wide appeal include learning speed, adaptability, and ability to perform successfully. Group intelligence tests can be useful in research, or for assessing groups of students. They are not useful as a replacement for individual intelligence tests administered by qualified examiners in assessing for individual clinical or educational intervention. The Wechsler tests are among the most widely used instruments for assessing intelligence. Further, IQ score is a necessarily incomplete reflection of intelligence. It is far from perfect as an index of a person's total intellectual ability and is not useful in identifying specific talents. Cognitive and brain research has begun to impact theories of intelligence in important ways. Other areas that have impacted the field of intelligence are language, culture, biology, and the neurosciences. Recent theories of intelligence are emphasizing more than one unitary ability.

SEE ALSO *Intelligence Testing.*

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INTELLIGENCE TESTING

Intelligence and intelligence testing are two of the most controversial and highly polemic of all topics in the field of psychology. It seems that psychologists, educators, and indeed, the lay public alike, all have a love-hate relationship with the concept of intelligence and even more so with intelligence testing. Some form of intelligence test-

ing is one of the most widely used of all forms of psychological tests. While tests for special aptitudes are available, and these are widely used for specialized diagnostic purposes as well as specialized aspects of personnel selection, these tests all measure some aspect of intellectual function. This entry describes more generally intelligence testing, provides a brief history of intelligence tests, presents their fundamental assumptions, applications, and an introduction to their interpretation.

INTELLIGENCE AND ACHIEVEMENT

Achievement tests as those designed to assess students' knowledge or skills in a content domain in which they have received instruction. In contrast, intelligence tests are broader in scope than achievement tests and are designed to measure the cognitive skills, abilities, and knowledge that individuals have accumulated as the result of their overall life experiences coupled with skills in application of these attributes to problem-solving. In other words, while achievement tests are tied to a specific program of instruction, intelligence tests reflect the cumulative impact of life experiences as a whole in concert with an individual's underlying or latent ability to use information. The general intelligence factor, *g*, is the most reliable component present in any multifactorial view of intelligence (Jensen, 1998). In the Cattell-Horn model (Horn & Cattell, 1966; Kamphaus, 2001) of intelligence, *g* is the dominant factor in the hierarchy of multiple abilities, with the next two dominant facets being crystallized and fluid intelligence.

Crystallized intelligence tends to be related more closely to verbal domains as a practical matter and is defined as the application of knowledge to problem solving. Fluid intelligence tends to be related more closely to non-verbal domains as a practical matter and is defined more strictly as reasoning and problem solving in the absence of any requirement for prior knowledge. It turns out that people do not really know how to assess reasoning and problem solving in the total absence of knowledge and so most tests of fluid intelligence attempt to approximate this perfect state to the extent possible by using principally nonverbal tasks that do not require knowledge of language or language concepts (Reynolds & Kamphaus, 2003).

The inclusion of crystallized intelligence measures as a component of most intelligence tests has led many people to believe, erroneously, that intelligence tests are simply measures of what people have learned. While intelligence and knowledge are certainly correlated, intelligence as measured on modern individually administered tests of intelligence and even many group measures is more directed at the assessment of problem solving and reasoning skill as opposed to static knowledge or learned

content. The latter is the domain of achievement testing (Reynolds, Livingston, & Willson, 2006).

This introduction might suggest that there is a clear and universally accepted distinction between achievement and intelligence tests. However, in actual practice such is not the case and the distinction is actually a matter of degree. Many, if not most, testing experts conceptualize both achievement and intelligence tests as tests of developed cognitive abilities that can be ordered along a continuum in terms of how closely linked the assessed abilities are to specific learning experiences. The abilities measured by achievement tests are specifically linked to academic instruction or training. In contrast, the knowledge and abilities measured by intelligence tests are acquired through a broad-range of life experiences, including those at school, home, work, and all other settings.

General intelligence tests historically have been the most popular and widely used aptitude tests in school settings. While many people are familiar with the concept of intelligence and use the term in everyday conversations, it is not easy to develop a definition of intelligence on which everyone agrees. While many people, lay or professional, will have their own separate definition of intelligence, most of these definitions will incorporate abilities such as problem solving, abstract reasoning, and the ability to acquire knowledge. Developing a consensus beyond this point has proved quite difficult.

THE ORIGIN OF INTELLIGENCE TESTS

Intelligence tests had their beginning in the schools, in the early 1900s in France when a compulsory education program was initiated. Alfred Binet (1857–1911) and his colleague Theodore Simon (1873–1961) had been attempting to develop a measure of intelligence for some years and were commissioned by the French government to develop a test that could predict academic performance accurately. The result of their efforts was the first Binet-Simon Scale released in 1905. This test contained problems arranged in the order of their difficulty and assessing a wide range of abilities. The test contained some sensory-perceptual tests, but the emphasis was on verbal items assessing comprehension, reasoning, and judgment. Subsequent revisions of the Binet-Simon Scale were released in 1908 and 1911. These scales gained wide acceptance in France and were soon translated and standardized in the United States by Louis Terman (d. 1959) at Stanford University. Terman's work resulted in the Stanford-Binet Intelligence Test (1916), which has been revised numerous times and continues to be a prominent intelligence test used in the early 2000s.

The introduction of the Stanford Binet intelligence scales in the United States by Terman occurred in close proximity to World War I. Seeing the success of this

approach to measuring mental ability, the U.S. Army set about to devise a means of evaluating recruits. A group of psychologists headed by Robert Yerkes (1876–1956) subsequently developed the Army Alpha and Army Beta examinations, which quickly became the most widely used group intelligence tests in the world. This widespread use also had the effect of familiarizing literally millions of individuals with the concept of intelligence testing and made it an acceptable enterprise. Not long afterward, the College Entrance Examination Board began development and employment of what became the SAT, a conglomerated measure of achievement and intelligence.

The development and success of the Binet-Simon Scale, and subsequently the Stanford-Binet Intelligence Test and the U.S. Army testing programs, ushered in the era of widespread intelligence testing in the United States. Following the model of the Stanford-Binet Intelligence Test, other assessment experts developed and released their own intelligence tests. Some of the tests were designed for individual administration (such as the Stanford-Binet Intelligence Test) while others were designed for group administration. Some of these tests placed more emphasis on verbal and quantitative abilities while others placed more emphasis on visual-spatial and/or abstract problem-solving abilities. As a general rule, research has shown with considerable consistency that contemporary intelligence tests are good predictors of academic success. This correlation is to be expected considering this was the precise purpose for which they were initially developed over 100 years earlier. In addition to being good predictors of school performance, research showed that IQs are fairly stable over time. Nevertheless, these tests became controversial as a result of the often-emotional debate over the meaning of intelligence. To try and avoid this association and possible misinterpretations, many test publishers adopted more neutral names such as “academic potential,” “scholastic ability,” “school ability,” “mental ability,” or simply “ability” to designate essentially the same construct to which the term intelligence referred.

THE USE OF APTITUDE AND INTELLIGENCE TESTS IN SCHOOLS

Clearly, aptitude and intelligence tests have a long history of use in the schools. Their widespread use continues in the early 2000s, with major applications including the following (Reynolds et al., 2006; Reynolds & Kamphaus, 2003):

Providing alternative measures of cognitive abilities that reflect information not captured by standard achievement tests or school grades,

Providing objective evaluations of ability that do not reflect the subjective judgment of observers or others who may be influenced by irrelevant factors,

Helping teachers tailor instruction to meet a student's unique pattern of cognitive strengths and weaknesses,

Assessing how well students are prepared to profit from school experiences,

Identifying students who are underachieving and may need further assessment to rule-out learning disabilities or other cognitive disorders, including mental retardation or intellectual disability,

Identifying students for gifted and talented programs,

Helping guide parents and students with educational and vocational planning.

While this list identifies the most common uses of aptitude/intelligence tests in the schools, the list is not exhaustive. Classroom teachers and school administrators are involved to varying degrees with these applications. For example, teachers are frequently called on to administer and interpret many of the group aptitude tests for their own students. School psychologists or other professionals with specific training in administering and interpreting clinical and diagnostic tests typically administer and interpret the individual intelligence and aptitude tests.

COMMON INDIVIDUALLY ADMINISTERED TESTS OF INTELLIGENCE

As with achievement tests, group and individual intelligence tests are commonly used in schools. Whereas teachers are often asked to help administer and interpret the group aptitude tests, school psychologists and other professionals with special training in administering and interpreting clinical and diagnostic tests usually administer and interpret the individual tests. The most frequently employed individually administered intelligence tests are reviewed briefly below.

Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV). The WISC-IV is as of 2007 the most popular individual test of intellectual ability for children. Empirical surveys of school psychologists and other assessment personnel have consistently shown that the Wechsler scales are the most popular individual intelligence test used in clinical and school settings with children. The WISC-IV, as is true of virtually all individually administered intelligence tests, must be administered by professionals with extensive training in psychological assessment. The WISC-IV is one of the

longest of such intellectual assessments and takes approximately 2 to 3 hours to administer and score. Below are brief descriptions of the subtests (Wechsler, 2003):

Arithmetic the student is presented a set of arithmetic problems that they solve mentally (i.e., no pencil and paper) and answer orally. This subtest involves numerical reasoning ability, mental manipulation, concentration, and auditory memory.

Block Design the student reproduces a series of geometric patterns using red-and-white blocks. This subtest measures the ability to analyze and synthesize abstract visual stimuli, nonverbal concept formation, and perceptual organization.

Cancellation the student scans sequences of visual stimuli and marks target forms. This subtest involves processing speed, visual attention, and vigilance.

Coding the student matches and copies symbols that are associated with either objects (i.e., Coding A) or numbers (Coding B). This subtest is a measure of processing speed, short-term visual memory, mental flexibility, attention, and motivation.

Comprehension the student responds to questions that are presented orally involving everyday problems or social situations. This subtest is a measure of verbal comprehension and reasoning as well as the ability to apply practical information.

Digit Span the student is presented orally sequences of numbers that they repeat verbatim (i.e., Digits Forward) or in reverse order (i.e., Digits Backwards). This subtest involves short-term auditory memory, attention, and on Digits Backwards, mental manipulation.

Information the student responds to questions that are presented orally involving a broad range of knowledge (e.g., science, history, and geography). This subtest measures the student's general fund of knowledge.

Letter-Number Sequencing the student reads a list of letters and numbers and then recalls the letters in alphabetical order and the numbers in numerical order. This subtest involves short-term memory, sequencing, mental manipulation, and attention.

Matrix Reasoning the student examines an incomplete matrix and then selects the item that correctly completes the matrix. This subtest is a measure of fluid intelligence and is considered a

largely language-free and culture-fair measure of intelligence.

Picture Completion the student is presented a set of pictures and must identify what important part is missing. This subtest measures visual scanning and organization as well as attention to essential details.

Picture Concepts the student examines rows of objects and then selects objects that go together based on an underlying concept. This subtest involves nonverbal abstract reasoning and categorization.

Similarities two words are presented orally to the student and the student must identify how they are similar. This subtest measures verbal comprehension, reasoning, and concept formation.

Symbol Search the student scans groups of symbols and indicates if a target symbol is present. This subtest is a measure of processing speed, visual scanning, and concentration.

Vocabulary the student is presented orally a series of words that the student must define. This subtest is primarily a measure of word knowledge and verbal conceptualization.

Word Reasoning the student must identify the underlying or common concept that is implied by a series of clues. This subtest involves verbal comprehension, abstraction, and reasoning.

Information, Word Reasoning, Picture Completion, Arithmetic, and Cancellation are supplemental subtests while the other subtests are core subtests. The administration of supplemental subtests is not mandatory, but they may be used to substitute for a core subtest if the core subtest is seen as being inappropriate for a particular student (e.g., due to physical limitation). A supplemental subtest may also be used if a core subtest is invalidated for some reason (e.g., its administration is interrupted).

The WISC-IV produces four Index Scores. Below are brief descriptions of the Index Scores (Wechsler, 2003):

Verbal Comprehension Index (VCI) is a composite of Similarities, Vocabulary, and Comprehension. Information and Word Reasoning are supplemental VCI subtests. The VCI reflects verbal reasoning, verbal conceptualization, and knowledge of facts.

Perceptual Reasoning Index (PRI) is a composite of Block Design, Picture Concepts, and Matrix Reasoning. Picture Completion is a supplemental PRI subtest. The PRI reflects perceptual and

nonverbal reasoning, spatial processing abilities, and visual-spatial-motor integration.

Working Memory Index (WMI) is a composite of Digit Span and Letter-Number Sequencing. Arithmetic is a supplemental WMI subtest. The WMI reflects the student's working memory capacity that includes attention, concentration, and mental control.

Processing Speed (PSI) is a composite of Coding and Symbol Search. Cancellation is a supplemental PSI subtest. The PSI reflects the student's ability to quickly process nonverbal material as well as attention and visual-motor coordination.

The WISC-IV and its predecessors are designed for use with children between the ages of 6 and 16 years of age. For early childhood assessment the Wechsler Preschool and Primary Scale of Intelligence, Third Edition (WPPSI-III) is available and is appropriate for children between 2 years 6 months to 7 years 3 months. The Wechsler Adult Intelligence Scale, Third Edition (WAIS-III) is appropriate for individuals between the ages of 16 and 89 years of age.

Stanford-Binet Intelligence Scales, Fifth Edition (SB5). The Stanford-Binet Intelligence Test was the first intelligence test to gain widespread acceptance in the United States. While the Wechsler scales have become the most popular and widely used intelligence tests in schools, the Stanford-Binet scales have continued to have a strong following. As of 2007, the most recent edition of these scales is the SB5 that was released in 2003. The SB5 is designed for use with individuals from 2 to 85 years of age. It contains 10 subtests which are combined to produce five factor indices (i.e., Fluid Reasoning, Knowledge, Quantitative Reasoning, Visual-Spatial Processing, and Working memory), two domain scores (i.e., Verbal IQ

Example of a common set of qualitative descriptions of performance levels expressed as IQs

Score level	Qualitative description	Approximate percent of population included
69≤	Significantly below average	2.34
70–79	Moderately Below average	6.87
80–89	Below average	16.12
90–109	Average	49.61
110–119	Above average	16.12
120–129	Moderately above average	6.87
≥130	Significantly above average	2.34

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

and Nonverbal IQ), and a Full Scale IQ reflecting overall intellectual ability. A potentially appealing aspect of the SB5 is the availability of an Extended IQ scale that allows the calculation of FSIQs higher than 160, which can be useful in the assessment of extremely gifted individuals.

Woodcock-Johnson III (WJ III) Tests of Cognitive Ability. The WJ III Tests of Cognitive Ability has gained a loyal following and has some unique qualities that warrant mentioning. The battery is designed for use with individuals 2 to 90 years of age. The WJ III Tests of Cognitive Ability is based on the Cattell-Horn-Carroll (CHC) theory of cognitive abilities, which incorporates Cattell's and Horn's Gf-Gc theory and Carroll's three-stratum theory. The CHC model provides a comprehensive model for assessing a broad range of cognitive abilities, and many clinicians like this battery because it measures such a broad range of abilities.

Reynolds Intellectual Assessment Scales (RIAS). The RIAS is a newcomer to the clinician's collection of intelligence tests. It is designed for use with individuals between 3 and 94 years of age and incorporates a co-normed supplemental memory test. One particularly desirable aspect of the RIAS is the ability to obtain a reliable and valid measure of intellectual ability that incorporates both verbal and nonverbal abilities (crystallized and fluid intelligence) in a relatively brief period (i.e., 20–25 minutes). Most other tests that assess verbal and nonverbal cognitive abilities require considerably more time. The supplemental memory tests require about 10 minutes for administration, so a clinician can assess both memory and intelligence in approximately 30 minutes.

INTELLIGENCE TEST SCORES

In the early decades of intelligence testing, intelligence test scores were expressed as a true quotient, hence the term IQ or intelligence quotient. An IQ was defined as a ratio of the examinee's mental age to the examinee's chronological age which was then multiplied by 100 to eliminate dealing with fractional scores $[(MA/CA) \times 100]$. This form calculation of an IQ has serious psychometric and related measurement problems and has been abandoned for decades although its presentation continues to be common in many introductory psychology and education textbooks. In the early 2000s, IQs are calculated in the form of age corrected deviation scaled scores. These are formal transformations of raw scores (i.e., number of points obtained or items answered correctly) into a standard score format that incorporates the use of the mean and the standard deviation of the raw scores at predetermined age intervals so that the IQ given by the test has the same percentile ranking at each age level, which is not true of the old ratio style IQ. Table 1 presents a common system for ascribing a qualitative descriptor to various score ranges found on most common

intelligence tests, nearly all of which (including all of those reviewed above) report IQs using a metric where the mean IQ is equal to 100 and the standard deviation is 15. When accompanied by significant deficits and adaptive behavior and occurring during the developmental period, scores below 70 are commonly associated with varying degrees of mental retardation or intellectual disability, while scores above 130 are often used to designate individuals as being intellectually talented or cognitively gifted.

The scores from intelligence tests are derived from large samples of individuals drawn using what is known as population proportion of stratified random sampling. Because all individuals in the United States cannot be tested, a sample is drawn to represent the entire population. This sample is typically chosen to be representative of the general population of the United States at large on the basis of gender, ethnicity, social economic status or educational level, region of residence within the United States, and community size, including urban and rural areas.

Scores from intelligence tests are interpreted properly only when the standardized instructions for administering and scoring the test have been followed rigidly. Deviations from standardized administration and scoring cause the scores to move up or down for an individual examinee inappropriately and in ways that are unpredictable, rendering the scores uninterpretable (Lee, Reynolds, & Willson, 2003). Intelligence test scores are viewed by some as reflecting innate potential but clearly that is not the case. While innate ability contributes to intelligence test performance, many other variables contribute to performance on ability measures as well.

Intelligence as measured on such tests as described here is a summative construct at any given point that is a reflection not only of a person's innate potential but the interaction of this potential with the entire life experiences of the individual as well as factors such as early stimulation, nutrition, prenatal care, and numerous other variables too extensive to list and discuss here. Proper interpretation of intelligence tests requires knowledge of the examinee's history, background, educational exposure, and generally the context of the examinee's life, especially when clinical diagnoses are being considered. Intelligence tests in the schools are very good predictors of academic achievement, but even this prediction is predicated upon averages among the various examinees. This qualification means that intelligence tests' predictions of future attainment are based on various assumptions about individuals taking such tests. Such assumptions, for example, would include the assumption that a particular examinee is no more motivated to achieve than the average person taking the test, that such an examinee would spend no more and no less time studying in any particular academic area, and would have no more or

Interest

no less opportunity to acquire information in a particular academic domain. To the extent such assumptions are violated, the predictive schema of the intelligence test score interpretation would not hold.

SEE ALSO *Intelligence: An Overview*.

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INTEREST

Researchers have identified two types of interest. Situational interest is spontaneous, transitory, and environmentally activated, whereas personal interest, also referred to as individual interest, is less spontaneous, of enduring personal value, and activated internally. Situational interest often precedes and facilitates the development of personal interest. Situational interest appears to be especially important in catching students' attention, whereas personal interest may be more important in holding it (Durik & Harackiewicz, 2007; Mitchell, 1993). Personal interest appears to be especially important for sustaining engagement and long-term learning (Hidi & Renninger, 2006).

Situational interest increases learning when the task or to-be-learned information is novel or when information is relevant to a task or learning goal. Text variables such as coherence, identification with characters, suspense, and the concreteness and image-ability of salient text segments also increase situational interest. Collectively, these variables can explain over 50 percent of sample variance in students' learning from text (Schraw, 1997).

Personal interest increases learning due to increased engagement, the acquisition of expert knowledge, and making mundane tasks more challenging. Personal interest

is also important because it appears to mediate the relationship between short-term situational interest and long-term mastery and learning within a domain (Hidi & Renninger, 2006). In addition, several studies suggest that personal interest increases the amount and quality of information processing. For example, Schiefele (1999) found that readers with personal interest in a topic were more likely to engage in deeper text processing, characterized by the construction of situational models (i.e., a mental representation of the people, setting, and events implied by the text).

CATCHING AND HOLDING INTEREST

Mitchell (1993) suggested that personal interest develops over time because some topic or event catches an individual's interest in a situational manner that is supported by learning events that help the person to hold that interest. Sustained interest increases engagement and motivation to learn, as well as facilitates strategy use and deeper processing. Thus, the development of sustained personal interest is an important component of learning.

Several researchers have investigated the development of interest in more detail. Ainley, Hidi, and Berndorff (2002) reported that situational factors lead to the development of sustained personal interest and that personal interest was related to positive affect, persistence, and learning. Durik and Harackiewicz (2007) described similar findings with one important exception. Experimental manipulations designed to catch learners' attention were effective if the learner has initial interest but undermined learning if the learner had little initial interest. Chen and Darst (2002) reported that background level of expertise had a mediating effect on situational and personal interest. These results suggested that both situational and personal interest are important but that manipulations designed to increase situational interest may not lead to sustained personal interest or learning. These findings also mirrored research on seductive details (i.e., text segments that are interesting but unimportant to a text's main themes), which found that seductive information may reduce learning (Harp & Mayer, 1998; Lehman, Schraw, McCrudden, & Hartley, 2007).

DEVELOPING SUSTAINED INTEREST

Mitchell (1993) originally proposed a simple three-stage model in which situational interest leads to personal interest, which leads to higher learning. Hidi and Renninger (2006) proposed a more sophisticated model in which interest develops through four continuous stages, including triggered situational interest, maintained situational interest, emerging personal interest, and well-developed individual interest. Triggered situational interest refers to

a change in interest that is related directly to a temporary change in the stimuli, environment, or to-be-learned information. These changes may be evoked by a wide variety of factors, including highly relevant information, surprising or unexpected information, information that is incongruous with the task, a change in environment, or the enthusiasm of a teacher or mentor. Maintained situational interest refers to a state of focused attention and greater personal investment with the to-be-learned information. These changes usually are supported externally by a stimulating text, task, or teacher. In addition, maintained interest is sustained through meaningful tasks and personal involvement. Emerging individual interest refers to a state in which interest does not need to be sustained externally and one in which the interest becomes an enduring disposition. These changes are supported by increased curiosity, greater domain knowledge, and a perceived sense of pleasure and usefulness in the activity. Well-developed individual interest refers to an enduring change in disposition for the information or activity. These changes are characterized by positive affect, greater intrinsic motivation, extensive knowledge about the domain, a high level of procedural expertise, and an ability to monitor and self-regulate one's future development in the domain.

The four-phase model of interest development provides a concise explanation of how interest develops, is sustained, and how it impacts engagement and learning. A number of studies provide empirical support for the model (Ainley et al., 2002; Durik & Harackiewicz, 2007). Nevertheless, a number of important issues remain as of 2008 for future research. One is whether the model is equally applicable across the lifespan. It may be the case that interest develops in a somewhat different way, or on a different developmental trajectory, for children compared to older students or adults. A second issue is whether interest is a necessary precursor of expertise or independent of expertise. For example, someone may develop considerable knowledge of investment strategies out of financial necessity rather than personal interest. A third is whether interest development is subject to reversals and, if so, how interest erodes and is replaced by new interests. A fourth issue pertains to how environmental factors affect the transition of early interest to sustained personal affect. As some research indicates, well meaning attempts to increase interest may actually have a negative effect on affect and learning (Lehman et al., 2007; Schraw & Lehman, 2001).

EFFECTS ON STUDENT LEARNING

Definitive evidence indicates that situational and personal interests are related to learning in three important ways. One way is that interest increases motivation, engagement, and persistence. Situational interest has a

positive effect on extrinsic motivation, whereas personal interest has a positive long-term effect on intrinsic motivation. Presumably, external factors such as teachers and interesting textbooks provide external motivation to learn more about a domain. Once situational interest develops into well-developed individual interest, external factors likely play a smaller role in motivation, whereas intrinsic motivation and enjoyment play larger roles.

Extrinsic and intrinsic motivation are essential precursors to engagement. Students who are interested in a topic or activity are more likely to engage and persist, which in turn leads to the acquisition of new skills and knowledge. Motivation helps individuals to develop the confidence to undertake a new learning activity or to venture into an unfamiliar intellectual domain such as mathematics and science. For example, Renninger (2000) reported a compensatory effect in which high interest compensated for lower achievement and lower ability. Engagement enables learners to develop conceptual knowledge and essential procedural skills within a domain. In turn, motivation and engagement facilitate persistence within a domain that is necessary to develop true expertise. Persistence produces greater competence, which increases confidence and self-efficacy, and makes it easier and more enjoyable to learn.

A second way that interest is related to learning is through strategy use (Alexander & Jetton, 1996; Schraw & Lehman, 2001). Students who are interested in a topic report using more strategies are more likely to monitor their performance and shift strategies when necessary and are better able to self-regulate their learning. Increased strategy use, metacognitive monitoring, and self-regulation improve the efficiency of skill and knowledge acquisition as well as the amount of information learned.

A third way that interest affects learning is through deeper information processing. Schiefele (1999) found that high-interest learners were more likely to construct deeper mental representations of a text. This correlation may be due in part to the fact that high-interest learners are more likely to possess topic-specific knowledge and learning strategies. Yet regardless of knowledge and strategies, students with high levels of interest are more likely to engage in an activity, persist, report positive affect, and focus more of their effort on constructing a deeper understanding of the skill or domain that they are studying.

SUGGESTIONS FOR INCREASING INTEREST

Research suggests that interest is an important precursor to learning and is changeable. A number of suggestions are included below that are based on previous articles (Schraw, Flowerday & Lehman, 2001; Hidi & Renninger, 2006). Each of these strategies may have a unique facilitative effect;

thus, it is reasonable to use as many strategies as are feasible in the classroom.

1. **Model interest and engagement in the classroom.**
Some teachers are enthusiastic about what they teach and demonstrate that enthusiasm on a day-to-day basis. Teacher enthusiasm develops initial interest due to events, topics, and observation. One way to promote and sustain interest is for teachers, tutors, or peers to model it.
2. **Offer meaningful choices to students.** Choice is hypothesized to promote a greater sense of self-determination because it satisfies students' need for autonomy. Empirical studies of choice support this view. Teachers also suggest that choice increases students' interest in a text.

Teachers interviewed by Flowerday and Schraw (2000) recommended offering a wide variety of choices to all students on a regular basis. In terms of when to use choice, teachers suggested offering meaningful choices to students of all ages, especially those who demonstrate low interest otherwise. Regarding where to offer choice, teachers do so in a variety of settings, including tasks such as homework and student assessment, as well as academic and social activities. Regarding how to use choice, teachers offered the following suggestions: offer simple choices at first, help students practice making good choices, provide feedback about the choices students make, use team choices for younger or less-experienced students, and provide information that clarifies the choice. For example, one teacher stated that she lets her students choose from a menu of five or six stories that she knows are interesting and suitable to her students.

Use engaging real-life problems. Students are engaged by interesting topics, but also by challenging and interesting activities. Several studies suggest that real-life problems are of interest to students and that even boring activities can be made more interesting if students challenge themselves. Hidi and Renninger (2006) recommended activities that require multiple students, including cooperative learning groups, team projects, one-on-one tutors, and interactive problem solving with or without teachers.

Use well organized texts and learning materials. Well organized texts are those that are coherent and informationally complete. These two variables are strongly related to interest and learning in text (Schraw, 1997). As texts become less user friendly or as students become less knowledgeable about text content, it is recommended that teachers make a greater effort to provide useful background knowledge about the text, given that knowledge and coherence appear to make separate contributions.

Select texts and learning materials that are vivid. Texts are vivid because they contain rich imagery, suspense, provocative information that surprises the reader, and engaging themes. Research suggests that text vividness has a positive impact on interest and learning provided the vivid information is germane to the learning task. Texts that include irrelevant or highly seductive information may actually interfere with learning by diverting readers' attention from important text segments (Harp & Mayer, 1998; Lehman et al., 2007).

Use texts that students know about. Prior knowledge is related positively to interest and deeper learning. Teachers should follow one of two strategies to promote interest. One is to use texts whose content is familiar, though not highly familiar, to the majority of students. Familiarity with text helps students generate thematic inferences within the text as well as between the text and prior knowledge. A second strategy is to provide pre-reading background information to help students better comprehend what they are asked to learn. This can be done directly by the teacher or via small group discussions among students.

Encourage students to be active learners. Students who actively make meaning learn more information at a deeper level. A number of researchers have suggested that interest increases active learning as well as the reverse (Mitchell, 1993; Hidi & Renninger, 2006). One way that students become more active is by using specific learning strategies such as predicting and summarizing. Another way is by using general study strategies in which students identify what they already know, want to know, and have learned.

Provide relevance cues for students. Relevance refers to whether information is salient to a task (McCrudden & Schraw, 2007). Almost any kind of information can become relevant to a learning situation. Understanding what is relevant to the learning task beforehand increases interest and learning. Teachers should highlight relevant themes and information for students before they begin to read or study. This is especially important for low-interest students. Several strategies may be used for highlighting the relevance of information: (a) encouraging students to set personal reading goals before reading, (b) helping students understand what is most important or salient to the reading task, (c) asking students to focus on cause and effect relationships, and (d) asking students to explain the text to other students.

Highlighting the relevance of information or goals for learning may increase the perceived value of information. Previous research suggests that individuals are more motivated to process information they value. Although valuing may be due in part to personal interest, it also appears to be

affected by the culture of the school as well as teacher values. Teachers who highlight the relevance and value of information and skills for students may also increase interest.

Do not use seductive information gratuitously. Research suggests that information that is irrelevant, out of place, or increases the relative cognitive load of information processing may actually interfere with learning. For example, Harp and Mayer (1998) found that highly interesting segments that were added to a text passage, but were not important or relevant, decreased learning of main idea, even though memory for the seductive information was quite high. One recommended rule is to incorporate a limited amount of highly interesting information, but make sure it is relevant to the learning task and does not seem incongruous with other to-be-learned information (Lehman et al., 2007).

SEE ALSO *Expectancy Value Motivational Theory; Intrinsic and Extrinsic Motivation.*

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INTRINSIC AND EXTRINSIC MOTIVATION

Teachers can often readily identify students who demonstrate high or low motivation in a certain task. Motivated students engage in the task with intensity and feeling, whereas unmotivated students procrastinate and indicate in other ways that they would rather do something else. These differences exemplify the *quantitative* dimension of motivation, ranging from high to low. Teachers can often also identify highly motivated students who engage in tasks in different ways. Some may attempt to finish the task quickly, while others may seek more information. Some may persist, while others may begin enthusiastically but give-up when they encounter difficulty. These differences reflect the *qualitative* dimension of motivation. The distinction between intrinsic and extrinsic motivation has been one of the important theoretical conceptualizations of qualitative differences in engagement.

Intrinsic motivation refers to engagement in an activity with no reason other than the enjoyment and satisfaction of engagement itself. By comparison, extrinsic motivation refers to engagement that provides means to ends that go beyond the engagement itself. The goals of extrinsically motivated engagement might be the attainment of tangible rewards such as money, prizes, or other benefits; intangible rewards such as social approval, a sense of worthiness, or even a sense of conscientiousness; or the avoidance of tangible and intangible punishments such as time-out, scolding, rejection or sense of low self-worth.

THE ORGANISMIC SOURCES OF EXTRINSIC AND INTRINSIC MOTIVATION

Motivational theorists of the early 20th century searched for general principles of behavior. Theories of the period focused primarily on the motivations triggered by organismic physiological drives or needs such as food, sleep, procreation, and security (e.g., Hull, 1943). Organisms

were perceived to be motivated to behave in ways that replenish biological deficits and secure survival. Because behavior that aims to satisfy a physiological deficit is done in order to achieve a goal and not for its own sake, it represents a type of extrinsic motivation.

Taking a different approach to motivation, behaviorist psychologists (e.g., Skinner, 1953) argued that behavior can be explained by the organisms' motivation to approach pleasant and desirable outcomes and to avoid unpleasant and undesirable outcomes. Pleasant outcomes constitute a reward, and enhance the chance that a behavior will recur, whereas unpleasant outcomes constitute a punishment and reduce the chance that a behavior will recur. Behaviorist psychologists argued that human (and animal) behavior can be explained by the various rewards and punishments in the environment. Thus, from a behaviorist perspective, all motivation is extrinsic.

However, during the middle of the 20th century, several theorists challenged the mechanistic models of the drive and behaviorist perspectives. These theorists relied on observations indicating that sometimes people (and animals) engage in behavior without an apparent reward. This engagement was seen to manifest universally early in life in children's exploration and play (Berlyne, 1960; White, 1959). But it also appears among older people who engage in games and hobbies. These observations seemed to suggest that such engagement is inherently enjoyable and satisfying. This type of motivation was contrasted with behavior propelled by "extrinsic" forces, and was labeled "intrinsic" motivation (Hunt, 1965).

Researchers of the period proposed a variety of theoretical explanations for intrinsic motivation, including characteristics of activities such as novelty and fantasy and biological mechanisms such as play instincts, curiosity, and need for stimulation. In a seminal paper, White (1959) reviewed several of these theoretical explanations and argued for their integration in a motive that developed along evolution, which he termed "effectance" motivation, or need for competence. White argued that this motive propels children to explore their surroundings, manipulate objects, and interact with others in ways that promote mastery of the environment. Unlike physiological needs, which operate on a homeostatic principle—that is, they are aroused when the organism is deficient in a resource, and operate to guide action towards reducing the deficiency—effectance motivation is aroused particularly when no deficiency exists. Engagement out of effectance motivation does not have a clear end-goal; rather, it is the engagement in the activity itself that elicits positive feelings of efficacy, which constitute an "intrinsic" reward.

Taking a different ideological approach, humanistic psychologists of the mid 20th century such as Maslow (1954) and Rogers (1963) challenged the drive and

behaviorist perspectives by suggesting the existence of human needs that give rise to intrinsic motivation. Maslow, for example, argued that the physiological and safety needs, which he labeled "deficiency needs," are distinct from self-actualization needs, such as the need to develop talents, achieve comprehension, and fulfill potential, which he labeled "growth" needs. While the former provide the basis for extrinsic types of motivation, the latter provide the basis for intrinsic types of motivation.

At the beginning of the 21st century, many theorists still hold that intrinsic and extrinsic motivations are based in organismic needs. One such comprehensive theoretical framework—self-determination theory (SDT) (Deci & Ryan, 1985; Ryan & Deci, 2000)—explicitly asserts that humans are motivated by three basic psychological needs: for competence, relatedness, and autonomy. The need for competence in SDT is what White (1959) called effectance motivation. The need for relatedness refers to people's need to belong and to feel accepted by others. The need for autonomy refers to people's need to feel self-determined to be the source of their own action (deCharms, 1968). Like physiological needs, these psychological needs are thought to represent necessary nourishment for psychological development and growth. When an individual's three needs are fully satisfied, engagement in action is intrinsically motivated and promotes adaptive development and well-being. When one of the needs is unsatisfied, engagement is likely to be extrinsically motivated and development may be hindered.

MODELS OF INTRINSIC AND EXTRINSIC MOTIVATION

Whereas organismic needs energize intrinsic and extrinsic motivations, the concept of need in itself is too general to explain engagement in specific behaviors and too vague to be a guide for empirical research (Harter, 1981; Pintrich & Schunk, 2002). Therefore, during the second half of the 20th century, researchers developed models that described how motivation triggered by needs manifests in intrinsic and extrinsic motivation in specific domains and activities. These models also explained how factors in the environment may shape and affect the type of motivation that people manifest in different domains.

In one important model of intrinsic motivation, Csikszentmihalyi (1990) focused on a phenomenological state of full absorption in an activity, which he labeled "flow." In this pure form of intrinsic motivation, "Concentration is so intense that there is no attention left over to think about anything irrelevant, or to worry about problems. Self-consciousness disappears, and the sense of time becomes distorted" (p. 71). Csikszentmihalyi interviewed professional artists, athletes, rock climbers, and chess players about their flow experiences and concluded

that flow is most likely to be experienced when there are clear goals to be achieved and there is an optimal balance between the challenge posed by the activity and the person's level of skill. In addition, flow is experienced when there is immediate feedback on one's action and when the person feels a sense of control over the environment. According to Csikszentmihalyi, flow experiences promote further intrinsic motivation as well as skills in a domain. Since experiences of flow are rewarding, people are motivated to replicate the experience. Through engagement in challenging activities, skills develop and the person is motivated to seek more difficult challenges in the domain. Thus, growth of competencies and intrinsic motivation in the domain facilitate each other.

In a different program of research, Harter (1981, 1992) developed a model detailing how intrinsic motivation in different domains is shaped by experiences of success and failure as well as reinforcement from significant others. According to Harter, effectance motivation leads children to seek challenges, learn out of curiosity and for the experience of pleasure, and rely on themselves for a sense of success. When curiosity, independence, and exploration result with experiences of mastery and meet the approval and encouragement of parents or teachers, children experience pleasure, feel competent and in control of their environment, and have stronger intrinsic motivation for the domain or activity. However, when such engagement results with experiences of failure and meet disapproval by others, children feel anxious, perceive themselves to have low competence and control, and have lower intrinsic motivation. According to Harter, when parents and teachers demand compliance and employ extrinsic rewards and punishments, children develop extrinsic motivation for activities and domains.

In yet another elaborate model, self-determination theorists (Deci & Ryan, 1985; Ryan & Deci, 2000) suggested that intrinsic and extrinsic motivation can be arranged on an internal-external continuum according to the individual's perception of relative autonomy. Motivations that involve a higher perception of autonomy are more internal and represent a higher quality of engagement. Intrinsic motivation is positioned on the internal end of the continuum, and represents a perception of full autonomy in engagement. "External regulation" lies on the external end of the continuum and describes the sense of coercion and external control that individuals experience when they engage in an undesirable task in order to avoid punishment or achieve rewards. Between these poles are three other types of extrinsic motivation that vary in level of perceived relative autonomy. Whereas most activities may not be intrinsically motivating, SDT proposes that people have an organismic tendency to internalize motivation for uninteresting and enjoyable activities. However, internalization is likely to occur only if the

three psychological needs for competence, relatedness, and autonomy are satisfied.

ASSESSING INTRINSIC AND EXTRINSIC MOTIVATION

Researchers have used multiple methods to assess intrinsic and extrinsic motivation, either as a motivational "state" the motivation a person has in a particular task or as a motivational "trait" the type of motivation a person has a tendency to display across domains and activities (Harter & Jackson, 1992). One common indicator of "state" intrinsic motivation is "free choice" the amount of time spent on a task when alternative activities are available and no reward is offered (e.g., Deci, 1971; Lepper, Greene, & Nisbett, 1973). While an important measure in the literature, "free choice" is also somewhat problematic because there may be reasons other than intrinsic motivation for choosing a certain activity over others (e.g., wanting to prove worthiness) (Ryan, Koestner & Deci, 1991).

Perhaps the most frequently used method of assessing intrinsic and extrinsic motivation has been through participants' self-report. Early in her research, Harter (Harter & Zigler, 1974) assessed "trait" intrinsic motivation with an instrument comprised of four tasks, each targeting a different component of effectance motivation: seeking variation, preference for novelty, engagement for mastery, and preference for challenge. In each task, the child had a choice between two options indicating high or low level of effectance motivation. A few years later, Harter (1981) developed a different self-report instrument that was comprised of five scales of items, each assessing a different motivational component. Each item in the instrument *contrasted* intrinsic and extrinsic motivation (e.g., preference for challenging versus easy work). But several researchers, including Harter (1992) herself, recognized the possibility of adopting intrinsic and extrinsic motivation simultaneously a possibility masked by instruments asking participants to choose *either* intrinsic *or* extrinsic motivation. Therefore, researchers divided Harter's instrument into separate intrinsic and extrinsic scales (Harter & Jackson, 1992; Lepper et al., 2005). Similar self-report scales have also been constructed by other motivational researchers (e.g., Pintrich et al., 1993; Ryan & Connell, 1989).

INTRINSIC MOTIVATION, EXTRINSIC REWARDS, AND OUTCOMES

The research literature is quite unanimous with regard to the benefits of intrinsic motivation to learning and development (Stipek, 1996). Engagement out of intrinsic motivation requires no external incentives and enhances motivation to engage again in the future. Studies also suggest that engagement out of intrinsic motivation is associated with enhanced

comprehension, creativity, cognitive flexibility, achievement, and long-term well-being. By comparison, engagement out of extrinsic motivation may cease once the external motivator is removed. Moreover, extrinsic motivation is often associated with negative indicators of achievement and well-being. It is clear, however, that extrinsic motivation is preferable to having no motivation at all. Some perspectives also emphasize the possible motivational benefits of having both intrinsic and extrinsic motivation for an activity (Lepper & Henderlong, 2000). Unfortunately, research findings point quite consistently to a gradual decline in students' academic intrinsic motivation, and sometimes also extrinsic motivation, over years of schooling (Harter, 1981; Sansone & Morgan, 1992; Lepper et al., 2005). These trends have been attributed to the prevalence of extrinsic forces in schools such as tests and token economies, to the irrelevance of school tasks to students' lives and, more generally, to the growing mismatch between characteristics of school environments and the needs of adolescence for autonomy, self-expression, and meaningful social interaction (Eccles et al., 1993; Lepper & Henderlong, 2000).

The use of extrinsic rewards as a motivational strategy has spurred a persistent and heated debate in the literature (Sansone & Harackiewicz, 2000). Generally, humanistic motivation researchers argue that offering extrinsic rewards has detrimental effects on existing intrinsic motivation and is morally problematic (Kohn, 1993). Behaviorist researchers argue that offering extrinsic rewards has either negligible effects on intrinsic motivation or that it actually contributes to intrinsic motivation (Eisenberger & Cameron, 1996). What emerges from the research is that extrinsic rewards have no universal effect. Rather, the effect depends on the meaning of the reward to the child. Research also points to varying effects of different types of rewards and of different standards for their administration. For example, rewards that are expected, contingent on engagement or on task completion, and tangible are more likely to be detrimental to intrinsic motivation than rewards that are unexpected, not contingent, and intangible (e.g., verbal, social approval) (Lepper & Henderlong, 2000). More specifically, when positive rewards are perceived to provide valid information on student's competence—for example, performance-contingent rewards or feedback—they are likely to enhance intrinsic motivation. In contrast, when rewards are perceived as controlling and as suppressing the student's autonomy, they are likely to interfere with intrinsic motivation.

IMPLICATIONS FOR EDUCATORS

While some important variation exists (e.g., Nisan, 1992), there seems to be a wide-spread consensus among researchers and educators that enhancing intrinsic motivation among students is beneficial. Students' intrinsic motivation

is enhanced when practices promote their sense of personal autonomy, when schoolwork is challenging and relevant to students, when social relationships are supportive, and when environments are physically and psychologically safe. Practices that promote these environmental characteristics include providing students with choices among activities and between ways of completing tasks, encouraging students to explore and pursue their interests, building on their backgrounds and prior experiences in constructing tasks, encouraging them to collaborate, incorporating fantasy in activities, providing feedback that is informative and frequent, and reducing rewards that are controlling (Lepper & Henderlong, 2000; Pintrich & Schunk, 2002).

Nevertheless, sometimes students are required to engage in tasks that they are not motivated to do. Thus, extrinsic motivation cannot be, and should not be, abandoned (Hidi & Harackiewicz, 2000). However, educators should pursue the internalization of students' extrinsic motivation for these tasks. Such internalization can be promoted by employing as many of the recommendations specified above as possible and, in addition, educators should make the value of the activity explicit and clear. This can be done most effectively through modeling and through providing a clear and age-appropriate rationale for the requirement (Assor et al., 2002).

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Avi Kaplan

IQ

SEE *Misdiagnoses of Disabilities*.

ITEM ANALYSIS

Item analysis is a general term that refers to the specific methods used in education to evaluate test items, typically for the purpose of test construction and revision. Regarded as one of the most important aspects of test construction and increasingly receiving attention, it is an approach incorporated into item response theory (IRT), which serves as an alternative to classical measurement theory (CMT) or classical test theory (CTT). Classical measurement theory considers a score to be the direct result of a person's true score plus error. It is this error that is of interest as previous measurement theories have been unable to specify its source. However, item response theory uses item analysis to differentiate between types of error in order to gain a clearer understanding of any existing deficiencies. Particular attention is given to individual test items, item characteristics, probability of answering items correctly, overall ability of the test taker, and degrees or levels of knowledge being assessed.

THE PURPOSE OF ITEM ANALYSIS

There must be a match between what is taught and what is assessed. However, there must also be an effort to test for more complex levels of understanding, with care taken to avoid over-sampling items that assess only basic levels of knowledge. Tests that are too difficult (and have an insufficient floor) tend to lead to frustration and lead to deflated scores, whereas tests that are too easy (and have an insufficient ceiling) facilitate a decline in motivation and lead to inflated scores. Tests can be improved by maintaining and developing a pool of valid items from

which future tests can be drawn and that cover a reasonable span of difficulty levels.

Item analysis helps improve test items and identify unfair or biased items. Results should be used to refine test item wording. In addition, closer examination of items will also reveal which questions were most difficult, perhaps indicating a concept that needs to be taught more thoroughly. If a particular distracter (that is, an incorrect answer choice) is the most often chosen answer, and especially if that distracter positively correlates with a high total score, the item must be examined more closely for correctness. This situation also provides an opportunity to identify and examine common misconceptions among students about a particular concept.

In general, once test items have been created, the value of these items can be systematically assessed using several methods representative of item analysis: a) a test item's level of difficulty, b) an item's capacity to discriminate, and c) the item characteristic curve. Difficulty is assessed by examining the number of persons correctly endorsing the answer. Discrimination can be examined by comparing the number of persons getting a particular item correct with the total test score. Finally, the item characteristic curve can be used to plot the likelihood of answering correctly with the level of success on the test.

ITEM DIFFICULTY

In test construction, item difficulty is determined by the number of people who answer a particular test item correctly. For example, if the first question on a test was answered correctly by 76% of the class, then the difficulty level (*p* or percentage passing) for that question is *p* = .76. If the second question on a test was answered correctly by only 48% of the class, then the difficulty level for that question is *p* = .48. The higher the percentage of people who answer correctly, the easier the item, so that a difficulty level of .48 indicates that question two was more difficult than question one, which had a difficulty level of .76.

Many educators find themselves wondering how difficult a good test item should be. Several things must be taken into consideration in order to determine appropriate

difficulty level. The first task of any test maker should be to determine the probability of answering an item correctly by chance alone, also referred to as guessing or luck. For example, a true-false item, because it has only two choices, could be answered correctly by chance half of the time. Therefore, a true-false item with a demonstrated difficulty level of only *p* = .50 would not be a good test item because that level of success could be achieved through guessing alone and would not be an actual indication of knowledge or ability level. Similarly, a multiple-choice item with five alternatives could be answered correctly by chance 20% of the time. Therefore, an item difficulty greater than .20 would be necessary in order to discriminate between respondents' ability to guess correctly and respondents' level of knowledge. Desirable difficulty levels usually can be estimated as halfway between 100 percent and the percentage of success expected by guessing. So, the desirable difficulty level for a true-false item, for example, should be around *p* = .75, which is halfway between 100% and 50% correct.

In most instances, it is desirable for a test to contain items of various difficulty levels in order to distinguish between students who are not prepared at all, students who are fairly prepared, and students who are well prepared. In other words, educators do not want the same level of success for those students who did not study as for those who studied a fair amount, or for those who studied a fair amount and those who studied exceptionally hard. Therefore, it is necessary for a test to be composed of items of varying levels of difficulty. As a general rule for norm-referenced tests, items in the difficulty range of .30 to .70 yield important differences between individuals' level of knowledge, ability, and preparedness. There are a few exceptions to this, however, with regard to the purpose of the test and the characteristics of the test takers. For instance, if the test is to help determine entrance into graduate school, the items should be more difficult to be able to make finer distinctions between test takers. For a criterion-referenced test, most of the item difficulties should be clustered around the criterion cut-off score or higher. For example, if a passing score is 70%, the vast majority of items should have percentage passing values of

Extreme group method			
Item number	Correct response proportion in the top percentile	Correct response proportion in the bottom percentile	Discriminability index
1	.92	.40	.52
2	.97	.93	.04
3	.61	.74	-.13

Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

$p = .60$ or higher, with a number of items in the $p > .90$ range to enhance motivation and test for mastery of certain essential concepts.

DISCRIMINATION INDEX

According to Wilson (2005), item difficulty is the most essential component of item analysis. However, it is not the only way to evaluate test items. Discrimination goes beyond determining the proportion of people who answer correctly and looks more specifically at who answers correctly. In other words, item discrimination determines whether those who did well on the entire test did well on a particular item. An item should in fact be able to discriminate between upper and lower scoring groups. Membership in these groups is usually determined based on their total test score, and it is expected that those scoring higher on the overall test will also be more likely to endorse the correct response on a particular item. Sometimes an item will discriminate negatively, that is, a larger proportion of the lower group select the correct response, as compared to those in the higher scoring group. Such an item should be revised or discarded.

One way to determine an item's power to discriminate is to compare those who have done very well with those who have done very poorly, known as the extreme group method. First, identify the students who scored in the top one-third as well as those in the bottom one-third of the class. Next, calculate the proportion of each group that answered a particular test item correctly (i.e., percentage passing for the high and low groups on each item). Finally, subtract the p of the bottom performing group from the p for the top performing group to yield an item discrimination index (D). Item discriminations of $D = .50$ or higher are considered excellent. $D = 0$ means the item has no discrimination ability, while $D = 1.00$ means the item has perfect discrimination ability.

In Figure 1, it can be seen that Item 1 discriminates well with those in the top performing group obtaining the correct response far more often ($p = .92$) than those in the

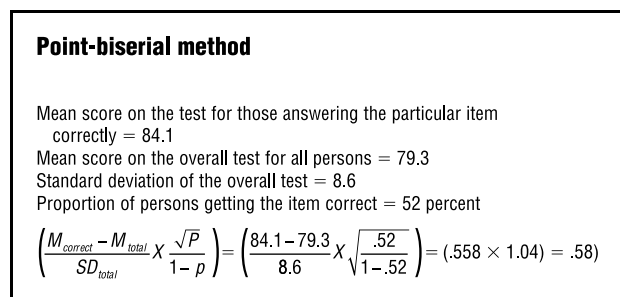


Figure 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

low performing group ($p = .40$), thus resulting in an index of $.52$ (i.e., $.92 - .40 = .52$). Next, Item 2 is not difficult enough with a discriminability index of only $.04$, meaning this particular item was not useful in discriminating between the high and low scoring individuals. Finally, Item 3 is in need of revision or discarding as it discriminates negatively, meaning low performing group members actually obtained the correct keyed answer more often than high performing group members.

Another way to determine the discriminability of an item is to determine the correlation coefficient between performance on an item and performance on a test, or the tendency of students selecting the correct answer to have high overall scores. This coefficient is reported as the item discrimination coefficient, or the point-biserial correlation between item score (usually scored right or wrong) and total test score. This coefficient should be positive, indicating that students answering correctly tend to have higher overall scores or that students answering incorrectly tend to have lower overall scores. Also, the higher the magnitude, the better the item discriminates. The point-biserial correlation can be computed with procedures outlined in Figure 2.

In Figure 2, the point-biserial correlation between item score and total score is evaluated similarly to the extreme group discrimination index. If the resulting value is negative or low, the item should be revised or discarded. The closer the value is to 1.0, the stronger the item's discrimination power; the closer the value is to 0,

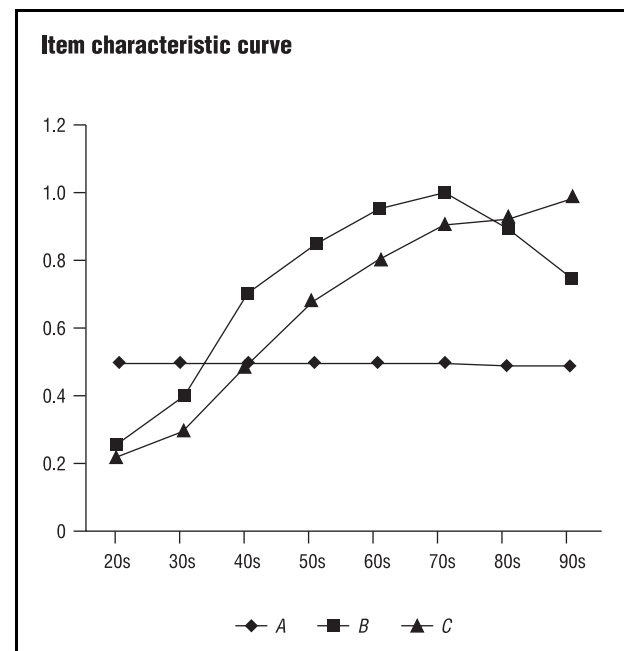


Figure 3 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

the weaker the power. Items that are very easy and answered correctly by the majority of respondents will have poor point-biserial correlations.

CHARACTERISTIC CURVE

A third parameter used to conduct item analysis is known as the item characteristic curve (ICC). This is a graphical or pictorial depiction of the characteristics of a particular item, or taken collectively, can be representative of the entire test. In the item characteristic curve the total test score is represented on the horizontal axis and the proportion of test takers passing the item within that range of test scores is scaled along the vertical axis.

For Figure 3, three separate item characteristic curves are shown. Line A is considered a flat curve and indicates that test takers at all score levels were equally likely to get the item correct. This item was therefore not a useful discriminating item. Line B demonstrates a troublesome item as it gradually rises and then drops for those scoring highest on the overall test. Though this is unusual, it can sometimes result from those who studied most having ruled out the answer that was keyed as correct. Finally, Line C shows the item characteristic curve for a good test item. The gradual and consistent positive slope shows that the proportion of people passing the item gradually increases as test scores increase. Though it is not depicted here, if an ICC was seen in the shape of a backward S, negative item discrimination would be evident, meaning that those who scored lowest were most likely to endorse a correct response on the item.

SEE ALSO *Item Response Theory*.

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ITEM RESPONSE THEORY

Item response theory (IRT) is an approach to modern educational and psychological measurement that posits a particular notion about cognition and sets forth sophisticated statistics to appraise cognitive processes. Its objective is to reliably calibrate individuals and test stimuli (i.e., items and exercises) on a common scale that is interpreted to show the individuals' ability or proficiency and specified characteristics of the test stimuli.

IRT is attractive for a number of reasons but principally because it is presumed that IRT-based estimates of examinees' ability are more precise than can be garnered through traditional means, such as summing the number of correct responses to a set of test items or exercises. Also, IRT is applicable to many practical testing problems, such as generalizability of test results, various item analyses, examining test bias and differential item functioning, equating test forms, estimating construct parameters, domain scoring, and adaptive testing.

In the IRT theory, cognitive processes are hypothesized as abilities or proficiencies. Some examples are reading, computing, and reasoning problems through to credible solutions, as well as beliefs, attitudes, opinions, and likely desires and aspirations, too. In short, almost anything that is a cognitive process. Some skills or talents, like playing a musical instrument, giving a theatrical performance and some physical acts such as running or successfully hitting a baseball, can be accommodated in the theory as well. Each ability or proficiency is conceived as lying along a continuum that ranges from none at all to complete mastery. In statistical terms, the range is infinite ($\pm\infty$). Figure 1 depicts this notion graphically.

Graphical depiction of ability or proficiency continuum



Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

As cognitive processes, abilities and proficiencies are deeply seated in the brain and cannot be directly observed. For this reason, they are described as latent, and often as latent traits. Some persons working with IRT believe that describing aspects of cognition as traits is too limiting; It does not capture the fact of their malleability or the notion that they may be influenced by environmental and social factors; hence, more generic terms such as abilities and proficiencies are sometimes used. In this essay, the term ability is used.

The notion of mental abilities ranging along a continuum contrasts with classical testing theory (CTT) in which knowledge is conceived as being circumscribed within a domain

(e.g., a reading domain), and a true score for any particular examinee can be estimated for that knowledge domain. In CTT, the more precisely the true score is estimated, the less error in measurement, and hence the greater reliability

A principal objective of IRT is to determine the point along the ability continuum that best calibrates a particular individual to the scale. This point—the test score expressed in IRT terms—is interpreted to reflect the individual's ability on whatever is the object of measurement (e.g., reading). Figure 2 illustrates this foundational IRT notion. For mathematical reason, ability is expressed as theta (θ) and when referring to individuals, the continuum is called the θ scale.

Graphical depiction of individuals along ability or proficiency continuum

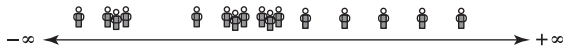


Figure 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

As seen in Figure 2, a given person may be low in the ability (shown as toward the left side of the θ scale), whereas another may be in the middle, while a third person may be high (shown as toward the right side of the θ scale). There is no assumption about the spread of individuals as in a bell-shaped (normal) distribution: all persons in a population could be high in the ability or all could be in the middle or have any other dispersion.

Of course, determining where a given individual's θ is situated along the scale (i.e., his or her ability) requires that some questions (test stimuli: items or exercises) be administered to the individual so that the θ estimate may be calculated. For the calculation, it is necessary to know characteristics of these test stimuli, a feature of IRT called *item characteristics*. Three commonly-used item characteristics are 1) its level of difficulty along the continuum, 2) its discrimination in detecting differences in ability between examinees (an item that everyone responds to correctly yields no discrimination), and 3) the likelihood of low ability examinees guessing a correct answer. Figure 3 depicts the notion of test characteristics being placed along the continuum.

Graphical depiction of many individuals dispersed along ability continuum

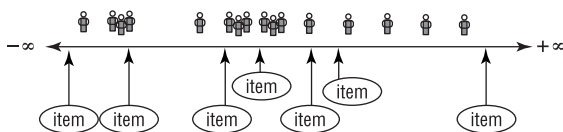


Figure 3 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Just as examinees may be located at any particular point along the continuum, so too may characteristics of items be situated at any point for their characteristic. In other words, any given items may be low in difficulty or have low discriminating power or be relatively simple to guess whereas another item may be middle or high in characteristics. Many items are typically situated all along the scale, reflecting wide dispersion.

To repeat, the three ingredients of IRT are: the scale, the examinees, and the items. As earlier stated, the scale's range is infinite, ($\pm\infty$). What remains is to determine the θ value for each examinee in the tested sample and the characteristics of the employed test items. Characteristics for the items can be discussed next.

In IRT (as well as in some other statistical contexts), item characteristics are plotted on a curve, called an ICC (item characteristics curve). While any number of characteristics may be plotted, it is common to display three of them: the discrimination, the difficulty, and the guessing. By convention, these are labeled as a , b , and c . In a statistical sense, the known characteristics of any given item are representative of a population of like items and hence are labeled *parameters*. The a , b , and c characteristics are thus labeled as a parameter or b parameter or c parameter. When all three characteristics are estimated, the IRT model is called the three-parameter model (3PL).

In IRT, there are many variations of ICCs. For instance, a common circumstance in IRT work is to estimate only a single item parameter, its difficulty (b parameter). This is the 1PL, and usually falls into an IRT category of estimation called the Rasch model, an eponym for the Danish mathematician Georg Rasch. The 3PL accounts for the most common IRT applications. Item characteristics for the 3PL are plotted in Figure 4.

ICC of one item, displaying three characteristics

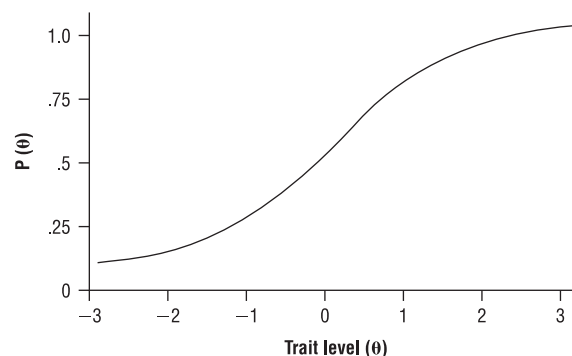


Figure 4 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

In Figure 4, there are two scales, represented on the vertical X (abscissa) and horizontal Y (ordinate) axis. The X axis is the probability of θ , labeled $P(\theta)$ meaning the probability of a given θ value. It ranges from 0 to 1.0 and is considered the likelihood of getting the item correct (for dichotomous items). The Y axis is the IRT θ scale which (theoretically at least) ranges ($\pm\infty$). For interpretability, however, the X scale is expressed in standardized units with a mean of 0 and standard deviation 1; since nearly all of the population is contained within the ± 3 standard deviations, this is all of the range of the scale that is typically shown.

Regarding the ICC itself, the reader can see that the curve is shaped like a lazy S for an item with meritorious characteristics (but obviously it can assume almost any shape). Technically, the curve is an ogive, but many authors simply refer to it as the ICC. It begins at the lower left, which indicates the c parameter (guessing by low ability examinees: here almost -3 standard deviations from the mean 0). In the figure, this starting point is about .10, meaning that persons of very low ability still have about a ten percent probability of getting the item correct, even by mere guessing. As the curve progresses to the right, reflecting more and more ability, the curve slopes upward, indicating that as ability increases so does the probability of a correct response. The slope of the ICC represents the a parameter, the item's discriminating power. Next, the reader can observe that the overall location of the curve along the θ scale and imagine a vertical line drawn from its mid-point down to the Y axis. In this example, that line would intersect the Y axis at about .5, meaning that this item is best suited to examinees who are slightly more able than average examinees (about a half standard deviation above the mean ability). It is important to realize from this example that an ICC can be situated anywhere along the θ scale, and its mid-point reflects its difficulty, the b parameter. In Figure 4, then, all three item characteristics can be seen: (a) the discrimination, (b) the difficulty, and (c) the guessing parameters.

When a person is learning IRT it is important to appreciate the fact that persons and items are calibrated on the same scale. This allows observers to learn features of each ingredient in IRT (persons and items) from the other. In other words, when test makers know the characteristics of items, they can observe (through the test) which ones a particular examinee gets right and wrong and thereby determine his or her ability. Conversely, when test makers know the θ values for a relatively large number of examinees, they can calibrate items to the scale. This reciprocal finding is something akin to saying that if a teacher knows a student's grade point average the teacher can ipso facto identify something about the stu-

dent's study habits and vice versa (not a perfect indicator but in the main a reliable one).

To persons new to IRT or not experienced in statistics, it may seem perplexing to state that items are calibrated to the scale from what test makers know about examinees' abilities and examinees are fitted to the scale from what test makers know about items. It seems a bit like the question: "Which came first, the chicken or the egg?" This is a relevant observation in IRT. Mathematically, this issue is addressed through the maximum likelihood function, a specialized statistical approach that determines the likelihood of observing a set of data in a hypothesized model. To explain how this works in IRT, one can suppose an item is well crafted and appropriate in its characteristics to a given examinee. The test maker presumes the examinee has a .5 chance of giving a correct response. This is expressed as syntactically as in Equation 1.

$$X = .5 \quad (1)$$

Next, the test maker can generalize this notion to a response (either correct or incorrect) to any item. Since the probability rests on ability, the generalization is written as follows.

$$P(U_i | \theta) \quad (2)$$

Equation 2 is read as the probability (P) of a response (U) on any given appropriate item (i) is a function of ability (θ). Thus, for the hypothetical examinee in the description of Equation 1 taking the item presumed that $P(U_i | \theta) = .5$. Examinees of another ability level would have a different probability.

Tests are composed of more than one item, of course, so the probability function is extended to include a test of any length (n items). Now, the probability of a correct response is conditioned upon several items and is accordingly a joint probability, meaning the probability of a response on all the items. A joint probability is calculated as the probability of a response on the first item times the probability of a response on the second item, and so forth to n items. This is written in Equation 3.

$$P(U_1, U_2, \dots, U_n | \theta) = P(U_1 | \theta) P(U_2 | \theta) \dots P(U_n | \theta) \quad (3)$$

To see Equation 3 in action, the reader may imagine that a particular examinee has 3 items presented to him on a test: a perfectly suited item (one in which the probability is .5 for his ability), another that is very easy for his ability (with, say, probability of .8), and a third item that is difficult relative to his ability, say, probability is .4). The joint probability of responding correctly to all the items on this short test is .16 (.5 x .8 x .4), or about 16 percent. Determining item characteristics is similarly

done with a likelihood function, but this time using the examinee's presumed ability to inform an item's characteristics.

The mathematics of solving likelihood equations involves calculus and is not easily done when there are many items on a test. However, if the metric is in log units, the calculations are much simpler. Adding a small constant to the log-produced results yields answers that are nearly identical to what would be acquired in normal metric. Hence, most IRT calculations are done in log metric, and the θ scale is expressed in log units, called *logits*.

The mathematical expression for the 3PL, in logistic units, is as follows.

$$P_i(\theta) = c_i + (1 - c_i) \frac{e^{D_{a_i}(\theta - b_i)}}{1 + e^{D_{a_i}(\theta - b_i)}} \quad i = 1, 2, \dots, n \quad (4)$$

While Equation 4 appears formidable, it is straightforward. In the equation, most terms are already known, including the probability (P), as well as the a, b, and c parameters. The e merely denotes that the expression is in log units of base e, and the D is a scaling constant to allow the results of log units to closely approximate a normal metric.

From this point on, IRT is mostly a search process wherein examinee responses to items give search to item characteristics and estimated item characteristics search for the best fitting examinee ability. When the process is

complete, the test maker knows both IRT ingredients: examinee ability and item characteristics.

IRT is a powerful route to estimating an examinee's ability on the tested construct as well as learning about characteristics of test items. For these reasons, it is commonly used in many national testing programs such as the NAEP (National Assessment of Educational Progress), the SAT (Scholastic Achievement Test), GRE (Graduate Records Examination), LSAT (Law School Admission Test), MCAT (Medical College Admission Test), and many other assessment programs.

SEE ALSO *Classical Test Theory*.

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Steven J. Osterlind

J

JAMES, WILLIAM 1842–1910

William James, often referred to as the Father of American Psychology, was born in New York City on January 11, 1842. As a youth, he was educated in private schools and had a succession of tutors in Europe and the United States. In 1864 he entered the Harvard Medical School, where five years later he received his medical degree, the only degree James ever received.

In 1873 James was offered a post at Harvard teaching physiology. His acceptance signaled the start of a prestigious career, for James was to become a gifted teacher, skilled orator, and prodigious thinker and writer. In 1875 he established the first laboratory of experimental psychology in the United States, and a year later he became the country's first professor of psychology. "The first lecture in psychology that I ever heard," he later wrote, "was the first I ever gave." In 1878 he married Alice Howe Gibbens. They had five children. His brother Henry became a famous novelist.

The Principles of Psychology, a two-volume work that had taken James 12 years to complete, was published in 1890. At the urging of his publisher to create a book with greater classroom appeal, James later condensed the two volumes into one, *Psychology: The Briefer Course* (1892). The complete work came to be known as *The James*, and the abridged tome as *The Jimmy*. For years, the two served as the standard psychology texts for generations of American university students.

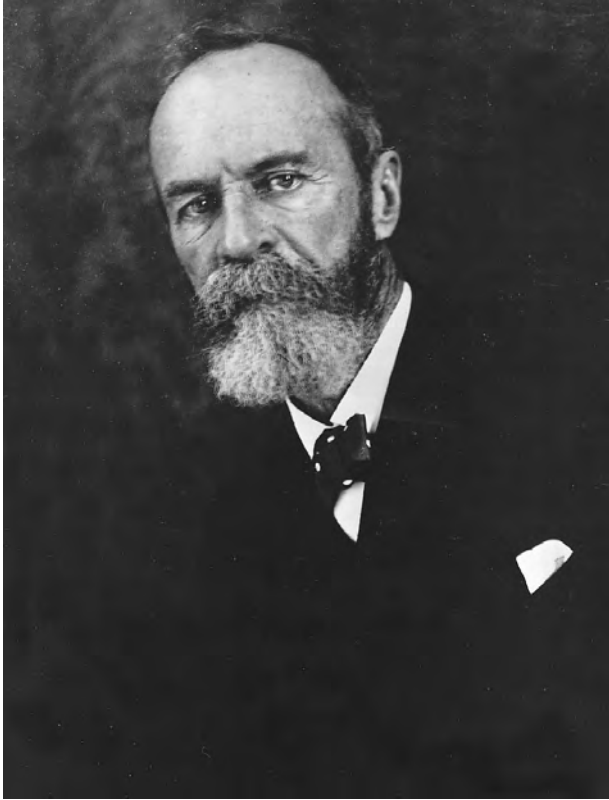
The dawn of the 20th century found James at the height of his eminence both in philosophy and psychol-

ogy. *The Will to Believe* (1897) and *Varieties of Religious Experience* (1902) reflected his growing spiritual and philosophical concerns. In 1907 he published *Pragmatism*, a concept that identified one of the prevailing philosophical movements of the 20th century. A method for resolving philosophical disputes, pragmatism aimed to discover the truth of an idea and to consider its value in terms of its practical, ethical/moral, and intellectual consequences.

James was the first American psychologist to directly address educational concerns. In July of 1892, he delivered the first of 12 lectures on psychology to teachers in Cambridge under the title of "Talks on Psychology of Interest to Teachers." Published in 1899 as *Talks to Teachers on Psychology*, the book became popular with educators, who subsequently used it prominently in teacher training programs throughout the world.

In *Talks*, James urged educators to familiarize themselves with the needs and interests of their students so that teaching practices could be geared to helping students develop the habits and make the associations and connections necessary to ensure effective learning. Progressive for its day, James's approach offered a view of teaching and learning in which freedom and compulsion each play an appropriate role. His educational psychology abounds with references to rigor, effort, ambition, competition, pugnacity, and pride.

The impact of James's ideas on modern educational psychology has been profound. In 1903 John Dewey referred to James as the "spiritual progenitor" of the progressive education movement launched at the University of Chicago. His emphasis on the importance of habit



William James THE LIBRARY OF CONGRESS.

and associations on human functioning influenced the behaviorist movement in psychology, but when humanistic psychologists searched for an antidote to behaviorism, they too stumbled on to James and his plea for a psychology centered on the individual and receptive to the importance of self-processes and introspection. Albert Bandura's social cognitive view of reciprocal determinism is also indebted to the Jamesian view of human functioning in which individuals and environments influence each other reciprocally.

Emphasis in the early 2000s on the importance of self-processes such as self-concept and self-efficacy in education is rooted in the critical aspects of self-awareness and personal cognition that James believed vital to the study of psychology. Moreover, 21st-century interest in conceptual change can be traced to James's vivid description of this process. Interest and research on habit (subsequently referred to as automaticity) also continues to

thrive. Additionally, motivation researchers are active in their study of Jamesian concepts such as interest, attention, memory processes, modeling and imitation, and transfer. Modern theories of constructivism can also be traced to James's theory of knowledge.

After his retirement from Harvard in 1907, James was in constant demand for lectures. In 1909 he published *A Pluralistic Universe* and *The Meaning of Truth*. Soon, however, his health began to deteriorate. On August 26, 1910, cradled in the arms of his wife Alice, William James died of an enlarged heart. He was 68. Two years after his death, a number of his articles were published as *Essays in Radical Empiricism*.

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K

KNOWLEDGE

One of the main goals of cognitive psychology is to understand the relationship between knowledge and learning. To do so, researchers developed the *information processing model* (IPM) in the early 1950s, which has been used as the modal model of cognition since that time. The IPM consists of three main components, including sensory memory, working memory, and long-term memory (Neath & Surprenant, 2003). Sensory memory processes incoming sensory information for very brief periods of time, usually one-half to three seconds. The amount of information held at any given moment in sensory memory is limited to five to seven discrete elements such as letters of the alphabet or pictures of human faces. Working memory refers to real-time information processing in which meaning is assigned to incoming information from a text, pictures, or math problem. Long-term memory refers to a permanent repository of knowledge in memory. To use a computer analogy, sensory memory corresponds to inputting information via the keyboard, working memory corresponds to information current on the computer screen, and long-term memory corresponds to the computer's hard drive.

CATEGORIES OF KNOWLEDGE

Information processing theory assumes that ongoing mental activity in working memory is aided by different types of information in long-term memory that supports thinking and problem solving. At least three categories of knowledge are stored in long-term memory, including declarative, procedural, and self-regulatory knowledge (Anderson, 1976; Tulving, 1972). Declarative knowledge refers to the

facts and concepts. Procedural knowledge refers to how to do things. Self-regulatory knowledge refers to knowledge individuals have about themselves as learners, what they know, and how to control their learning. All three types of knowledge are important. However, even large amount of declarative and procedural knowledge, without self-regulatory knowledge to support it, does little to help people survive and adapt successfully.

Declarative knowledge is a broad category that includes facts, concepts, and the relationships between concepts that lead to an integrated conceptual understanding of a domain of knowledge. Declarative knowledge includes thousands of facts such as the names of colors, numbers, coins, and trees. Concepts consist of two or more units of factual information that are used to understand a broader phenomenon such as human rights or social justice. Often concepts are phenomena that can be described abstractly, such as freedom or happiness, even though these phenomena do not exist in the physical world. Declarative knowledge also includes integrated conceptual knowledge that is sometimes referred to as *structural knowledge* or *mental models* (Halpern, 2003).

One of the most important organizational units in memory is the *schema*, which refers to an organized body of information about some distinct domain of knowledge. For example, every adult has a "car schema" in which information about different types of cars is organized. A car schema could be organized in several ways using either the cost or size of the car to generate subcategories. Anyone asked to name a luxury car could quickly name cars such as Rolls Royce or Bentley as examples. Most other people who share the same cultural group would have this information organized in a similar way as well.

Procedural knowledge is knowledge about how to do things, ranging from simple action sequences such as brushing one's teeth, to complex actions such as driving a car. Most adults possess an enormous amount of procedural knowledge, which enables them to perform complex activities such as grocery shopping easily because those procedures are automated through practice. Although there are many different types of action sequences, there are three sequences of special importance, including complex scripted actions, algorithms, and heuristics that are stored as single entities in memory.

Scripts refer to extended action sequences and plans that are stored in memory as single units of knowledge. Each person possesses thousands of scripts, for activities such as getting dressed, driving a car, dining at restaurants, and social interactions that save enormous amounts of time because scripts can be activated intact from memory. Scripts are analogous to schemata. Whereas schemata help individuals organize declarative knowledge about a topic or domain, scripts help people organize and remember steps in a complicated action sequence. Algorithms and heuristics can be thought of as "mini-scripts." An algorithm is a rule for solving a specific problem that always works, whereas a heuristic is a rule of thumb for solving a problem that often works, but not always. For example, an algorithm could be used to compute the average of 1,000 scores by adding all the scoring and dividing the total by the number of scores. A simple heuristic could also be used to estimate the average by sampling seven scores at random, rank ordering the scores, and using the middle score as an estimate.

Self-regulatory knowledge is knowledge about how to regulate one's memory, thought, and learning (Schunk & Zimmerman, 2006). Declarative and procedural knowledge alone are not sufficient to be an adaptive learner. In addition, individuals must possess knowledge about themselves as learners and about the skills they need to learn effectively. Self-regulatory knowledge can be divided into two types, including domain specific knowledge and domain general knowledge (Alexander, 2003). The former is knowledge individuals possess about themselves with regard to a domain such as mathematics or a sub-domain such as geometry. In contrast, the latter includes general knowledge such as learning strategies that enable people to adapt and self-regulate across all domains.

Domain specific knowledge refers to knowledge that is encapsulated within a particular domain of learning such as mathematics, history, and literature. Sometimes domain specific knowledge is referred to as *topic knowledge*, although this term suggests knowledge about a specific topic such as geometry within a broader domain such as mathematics. Domain specific knowledge is extremely important in the development of expertise and skilled

problem solving (Ericsson, 2003). Cognitive psychologists once believed that it was possible to capture the knowledge of experts through interviews and observation, and in turn, help novices become experts quickly. However, researchers discovered that experts become experts slowly through years of hard work, deliberate practice, and guidance from other experts. Most experts have deep knowledge in one domain, yet shallow knowledge in other domains, due in large part to the amount of time they invest in developing expertise in their chosen domain. Expertise in one domain usually does not transfer spontaneously to other domains, although it can be facilitated through direct instruction and analogical cues, which help the learner understand the relationship between two different problems.

Domain general knowledge refers to knowledge that is equally useful to learners across domains and topics. Domain general knowledge often is referred to as *metacognitive knowledge*, which includes knowledge of cognition and regulation of cognition (Schraw, 2006). The former includes strategy knowledge and conditional knowledge, while the latter includes knowledge of regulatory skills such as planning, monitoring, and evaluation of learning. Metacognitive knowledge enables learners to identify problems and self-correct by changing strategies.

TEACHER KNOWLEDGE

Like other experts, skilled teachers possess different types of knowledge that facilitates classroom practice. Shulman (1987) suggested that skilled teachers possess knowledge about domain content, pedagogy, learners and student development, as well as educational contexts, and educational ends, purposes and values. Many educators view content and pedagogical knowledge as essential to effective teaching. Content knowledge refers to knowledge in a particular domain, such as mathematics, science, social studies, reading, and language arts. Pedagogical content knowledge has been defined as "a collection of teacher professional constructions, as a form of knowledge that preserves that planning and wisdom of practice that the teacher acquires when repeatedly teaching a certain topic" (Hashweh, 2005, p. 273).

Content knowledge is domain-specific in nature, whereas many teachers have endorsed domain-general pedagogy that emphasizes constructivist teaching. The fundamental idea of constructivism is allowing students to connect to the learning environment through problem-based learning, inquiry activities, and dialogues with others. By allowing students to construct knowledge as learners, the educational goal is to help them think critically about concepts. There are many strategies that a teacher might employ when teaching a particular content areas: (a) scaffolding, which allows

the learner to make sense of complex tasks; (b) modeling, which requires the teacher to think aloud about problem solving; while (c) coaching, guiding, and advising requires the teacher to probe the students' thinking. Experiences should be genuine and relevant to the learners and inquiry is used as an approach for students to engage in discovery learning.

IMPLICATIONS FOR LEARNING AND TEACHING

Knowledge facilitates information processing and long-term learning by providing an integrated conceptual network of information in long-term memory. Knowledge in isolation (i.e., inert knowledge) is of little value, whereas organized knowledge is powerful because it enables people to sort and store information in memory, predict and judge, and evaluate their learning accurately. Knowledge also enables individuals to process information more efficiently (Neath & Surprenant, 2003).

Recent research emphasizes the importance of constructed knowledge, distributed cognition, and distributed knowledge. *Constructivism* refers to the assumption that knowledge is constructed actively by learners, rather than transmitted passively through lecture, discussion, or observation. Constructivism assumes that active learning is better because knowledge is understood in a deeper, more relevant way. An extension of constructivism is the assumption that knowledge and learning are more sophisticated when mutually shared across multiple learners in an active dialogue. This is referred to often as *distributed cognition*. In contrast, *distributed knowledge* refers to knowledge that is distributed across two or more individuals, but may be distributed across hundreds of individuals, such as knowledge about complex technological products. Knowledge can also be distributed between humans and human artifacts such as books and tools such as calculators.

Distributed cognition and knowledge are topics of considerable debate for both practical and theoretical reasons. Many educators assume that mutually constructed meaning is more dynamic than individually constructed meaning, and some believe that knowledge exists only as a distributed set of beliefs and assumptions across multiple individuals (Zhang & Patel, 2006). In addition, many have argued that complex ideas and knowledge require multiple contributors to exist at all. From a theoretical standpoint, researchers are interested in how to best foster distributed cognition across multiple people and/or machines, and how to represent knowledge in human and machine databases in a distributed manner.

Like students, teachers possess different types of knowledge that are essential to effective teaching (Shulman,

1987). Teachers develop this knowledge slowly over time, often taking 5 to 10 years of teaching practice to develop deep expertise. Both students and teachers construct most higher-order conceptual knowledge through personal experiences, reflection on experiences, and dialogue with other students and teachers (Ericsson, 2003). Individuals also construct metacognitive knowledge that enables them to self-regulate within their domain of expertise. Constructed *executive knowledge* is assumed to be stored in long-term memory in sophisticated schemata and scripts that enable the individual to perform a variety of complex skills with a high degree of efficiency.

SEE ALSO *Information Processing Theory; Knowledge Representation.*

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KNOWLEDGE REPRESENTATION

Knowledge representation refers to how knowledge is stored in long-term memory. Researchers have been keenly interested in this topic for over 50 years and a number of models of knowledge representation have been developed (Miyaki & Shah, 1999). There are four main families of models that are of interest to researchers. These include network, production, dual coding, and connectionist models. Each model is summarized below, compared to other models, and briefly discussed regarding its contributions to understanding learning in the classroom.

NETWORK MODELS

Network models of knowledge representation became popular in the 1960s. Early models focused on the hierarchical representation of declarative knowledge in memory and the relationship between different knowledge units (Quillian, 1968; Collins & Quillian, 1969). Network models possess three major components, including nodes in which a specific unit of information is stored, properties of information within nodes, and relational links among nodes. This can be explained by reference to the domain of animals. Subsumed within this domain are different types of animals such as birds, fish, and mammals. Network models envisioned each of these categories as nodes, while each node possessed a number of essential properties. The “animal” node included properties such as “breathes, eats, has skin.” The “bird” node included properties such as “has wings, has feathers, and flies” whereas the “fish” node included different properties such as “has fins, has gills, and swims.” Network models emphasized parsimony in mental representation; thus, properties included in a superordinate node were not replicated at a subordinate node. Because birds and fish are both animals, it was not necessary to include the property “has skin” because this property was included already in the “animal” node.

Quillian (1968) proposed five different kinds of relational links between nodes, including superordinate and subordinate, modifier, disjunctive, conjunctive, and residual links. These links specified whether properties of one node were shared with another node. For example, the fact that all animals have skin is a superordinate link that is true of all other links subsumed beneath it unless otherwise noted as a disjunctive link. Network models based on the notion of nodes, properties, and links helped explain how people remember information in an efficient manner and why it is relatively easy to search memory and make simple judgments, such as whether a canary eats and has skin.

The search process of memory was explained by the concept of spreading activation of attention among nodes.

Some concepts activated particular nodes and activation would spread to adjacent nodes. For example, the word “camel” would activate the “mammal” node and all properties of mammals would be activated, whereas properties of distance nodes such as fish would not be activated. Thus, activation spread through memory both vertically and horizontally. Activation spread vertically in an upward (i.e., camel to mammal) or downward (i.e., camel to dromedary). Activation also spread horizontally (i.e., camel to horse, camel to mule). Activation typically spreads further in a horizontal versus vertical direction, although activation is constrained in part by the situational demands of learning.

The idea that memory is organized into nodes of specific information that are interrelated to other nodes has been a lasting idea. Almost all other models of knowledge representation incorporate the idea of node, although what a node includes varies from model to model. The assumption that nodes have properties and are linked in a manner that indicates the type of relationship between nodes has not fared as well. Early network models provided a useful description of how declarative knowledge was represented in long-term memory, but they failed to explain the construction and representation of procedural and self-regulatory knowledge. Network models also paved the way for the development of schema theory in the 1970s, which spawned hundreds of practical experiments about the effect of schemata on learning and memory.

In recent years, a new class of network models has appeared that focuses on higher order processes such as complex problem solving, creativity, and metacognition (Griffiths, Steyvers & Tenenbaum, 2007). These models frequently describe excitatory and inhibitory processes similar to those described in connectionist models. This new breed of semantic network models often provides a better account of complex mental processes, such as understanding the overall gist of text or conversation.

PRODUCTION SYSTEM MODELS

Production models of knowledge representation and learning were first developed in the 1970s. One goal of these models was to explain a broader array of memory phenomena such as procedural learning, in addition to the representation of declarative knowledge. The most comprehensive production model is the ACT-R model (Adaptive Character of Thought, Revised) by John Anderson (1996, 2000). Anderson’s model developed from the human associative learning (HAM) model proposed by Anderson and Bower (1973).

ACT-R proposes three interactive memory systems that support adaptive thinking, including declarative knowledge, procedural knowledge, and working memory. The declarative knowledge component consists of schemata

and chunks within schemata that encode specific declarative knowledge units. The procedural knowledge component consists of production rules that break down complex action sequences into a number of “if-then” steps, which enable the learner to perform complex actions using a series of simple steps. Declarative and procedural components are connected to each other, as well as a working memory system in which activated declarative and procedural units are used to solve problems, make decisions, and adapt to environmental conditions.

ACT-R differs from earlier network models in that it proposes production rules, which are combined into production systems, which enable the brain to represent complex actions. A production rule specifies the action to be taken to achieve a specific goal and the conditions under which each action is taken. For example, imagine that a person has a ring of five keys and needs to open an office door. This scenario can be represented as a simple production as follows: IF a person must open a door, THEN he or she must insert key one and open the door; IF key one fails to open the door THEN the person must insert key two, and so on.

This production rule could be subdivided further into finer grained production rules that specify how to use each key until the correct key is identified, or none of the keys open the door. In addition, conditions could be added to each substep in the production sequence to assist the learner. For instance, one might add a condition statement, instructing the person not to attempt to use long, narrow keys with square heads because these keys often open car doors rather than office doors.

Anderson states that complex cognitive activity can be understood and explained in terms of small productions, based on simple units of declarative and procedural knowledge. This suggests that learning is a systematic process of acquiring declarative and procedural knowledge through experience and using this knowledge under specific conditions to execute complex actions, which themselves are comprised of many small productions. The theory of ACT-R also discusses how individuals construct and infer new knowledge based on past experiences. Thus, the theory is not entirely experience driven. Nevertheless, ACT-R views learning as a systematic process of acquiring the right knowledge and using that knowledge under the right conditions. Using knowledge repeatedly (i.e., practicing) increases the speed and accuracy of productions. Tuning productions to varying conditions also increases the efficiency of learning and performance.

Like network models, ACT-R postulates a process of spreading activation among declarative and procedural knowledge units during the execution of production sequences. Anderson (1996) provides sophisticated weighting systems, which serve as algorithms for which production

rules to apply under particular conditions. Activation spreads among production rules as a function of conditions and weights, which highlight some rules and downplay others. Activation is not necessarily hierarchical from superordinate to subordinate nodes, as is often the case in network models. Thus, production systems tend to be less hierarchical than networks.

Production system models have two clear advantages over earlier network models. First, they incorporate procedural knowledge into the model and explain how procedural and declarative knowledge are interrelated through working memory. Second, they do an excellent job of explaining incremental skill acquisition and the development of expertise. Production systems have been used to create and model intelligent tutoring systems that might take the place of human tutors. One potential criticism is that production systems are highly mechanistic; that is, they postulate that learning and performance is the sum and nothing more than the sum of a sequence of discrete productions. Related to this criticism is the fact that production systems highlight the role of experience and direct leaning and downplay rational reflection and the role of discovery and creativity.

DUAL CODING MODELS

Dual coding theory (DCT) was first postulated by Alan Pavio in the early 1970s and continues to be an important model of processing and knowledge representation in long-term memory (Pavio, 2007). DCT postulates two separate modular stores in long-term memory that include visual-spatial and verbal representation systems. Both systems are assumed to be functionally separate, yet interconnected. This means that visual-spatial and verbal long-term memories can perform tasks independent of one another, yet are able to pool resources when necessary. A number of researchers have speculated that dual-coding systems may be reflected in neurological differences between the brain’s right and left hemispheres (Pavio, 2007). DCT also postulates that some learners may have a visual-spatial or verbal preference for information processing.

DCT hypothesizes different representational systems for each of the two codes. The visual-spatial system uses mental images as the primary representational code, while the verbal system uses speech as the primary code. DCT assumes that every object and concept has a verbal label in verbal memory, whereas not every object or concept has an imaginal label in visual-spatial memory. Specifically, some concepts such as “automobiles” have concrete referents, while some concepts such as “affection” do not. DCT refers to this distinction as concrete versus abstract concepts.

The most important assertion of DCT is that concrete concepts may be easier to process and learn because mental activity can be distributed across the two stores

Four models of knowledge representation in long term memory				
	Network	Production system	Dual coding	Connectionist
Type of architecture	Hierarchical	Non-hierarchical production rules	Modular; two separate modules	Non-hierarchical distributed neural networks
Important components	Nodes, properties, relational links	Production rules and systems of rules	Verbal and visual-spatial stores networks	Units (explicit and hidden); weighted connections; neural networks
Important processes	Spreading activation	Spreading activation	Separate storage systems with separate resources	Activation; forward and back propagation
Strengths	Simple; does good job of modeling hierarchical relationship of declarative knowledge	Models procedural knowledge. Explains development of expertise	Explains differences in visual vs. verbal processing and recall	Modeled after brain physiology. Can be tested using computer simulations. Generalizes to other life forms.
Weaknesses	Does not explain procedural, conceptual or self-regulatory knowledge	Mechanistic. Places strong role on experience and practice rather than reflection.	Does not explain integrated visual-verbal representations.	Very data-driven Removes "mind" from learning.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

(Reed, 2006; Sadoski, 2005). Thus, a word such as “cat” can be represented separately in each storage system, whereas a word such as “truth” presumably is represented only in the verbal system. Two implications follow from this assumption. One is that information that is concrete in nature or that can be visualized will be better learned (Sadoski, Goetz, & Rodriguez, 2000). This has led to a great deal of research on the use of mnemonic techniques. A second implication is that visual information such as pictures in a book, summary tables, graphs, charts, and other visual aids should facilitate learning (Schnotz, 2002).

Research findings generally support the two-store model proposed by dual coding theory. DCT seems to be especially useful as an explanation of beginning reading processes such as vocabulary learning. It also explains why words are easier to learn in context as well as in the presence of visual aids such as pictures. In contrast, the theory does not explain well how congenitally blind individuals learn or how students create integrated visual-verbal representations in memory.

CONNECTIONIST MODELS

Connectionist models of knowledge representation and learning became popular in the 1980s and sometimes are referred to as neural networks or parallel distributed processing (PDP) models (Neath & Suprenant, 2003). Connectionist models represent an important paradigm shift from network and production system models because they de-emphasize the intentional role of the learner, while emphasizing the role of experience in building neural pathways and connections, as well as assumptions about cognitive architecture (Bechtel & Abrahamsen, 2002).

Although a great deal of attention has been devoted to connectionist models the past 20 years, especially the seminal work of Rumelhart and McClelland (1986), their origin can be traced to earlier researchers such as Selfridge (1959).

Connectionist models differ from network and production models in two ways. The first difference is that previous cognitive models used a computer metaphor to describe human information processing. In this view, information passes through an initial sensory system, is acted upon in working memory, and represented in permanent store in long-term memory. Connectionist models replaced the computer metaphor with a neural pathway metaphor modeled on the human brain. In this view, information is represented as patterns of activation across a variety of units, which correspond to neurons in the human brain.

A second difference is that network and production models focus on the representation of discrete units of information within a node in memory (e.g., a fact or a simple production rule), whereas connectionist models view knowledge representation as continuous across a number of interconnected units in memory. Thus, information such as facts, concepts, and production rules are not represented within single nodes, but distributed across nodes.

Connectionist models propose a rather simple architecture based on units, which maintain elementary information, typically simpler than corresponding nodes in network and production models. Multiple units are connected to create information that one might label as facts or concepts. The connectivity pattern among these units is of utmost importance. Any given unit may be connected to

many other units, using a number of different connectivity patterns. Thus, one unit may be part of different knowledge representations much like a single light in a theatre marquee may be used to spell different words. Connectionist theories have proposed different types of units. The most important of these are input units, output units, and hidden units, which are mediating connections between inputs and outputs.

Each unit has an activation value assigned to it under different processing conditions. Activation spreads throughout the system, but depends in part on the connectivity pattern among units, as well as connection weights, which determine whether one unit contributes more activation than another unit. There are a variety of activation algorithms; however, the two most important are forward (i.e., input to output units) and backward propagation (i.e., output to input units). Training (i.e., learning) in a connectionist network occurs as units are activated and deactivated, and connection weights change due to environmental conditions and feedback to the connectionist network through back propagation.

Connectionist models have several strengths and weaknesses. Strengths include their close physiological analogy to the human brain, the fact that their major claims can be tested using computer simulations, and that they provide a general theory of learning that is not unique to humans, but explains how learning may occur in other mammalian and non-mammalian life forms. Possible weaknesses, depending upon one's theoretical point of view, is that connectionist models are too bottom-up (i.e., learning occurs exclusively through experience and data-based feedback), and the mind is removed from models of learning (i.e., the role of rational reflection and inference construction is downplayed).

COMPARING THE FOUR MODELS

Each of the models described above has unique strengths. Table 1 provides a summary of these, as well as the main assumptions of each model. Several points should be considered regarding Table 1. First, each of the models is speculative and incomplete in nature. A large number of studies have supported some, but not all, of the assumptions of each of the models. Currently, there are few cross-model comparisons that definitely support one of the four hypothesized representational architectures. Second, all of the models emphasize the bottom-up nature of learning from experience. Network models are most likely to emphasize the role of higher-order knowledge, whereas connectionist models are least likely to make assumptions about higher-order knowledge or conscious self-regulatory skills. Third, all have useful implications for understanding learning.

IMPLICATIONS FOR LEARNING

Theories and models of knowledge representation all agree on two important implications for learning. One is that knowledge is represented in complex, multi-dimensional ways in memory. The models in Table 1 assume that learners possess higher-order knowledge that develops from simpler knowledge representations. In addition, all the models assume that knowledge is modular in nature (i.e., partitioned in memory into functional units), albeit each model postulates different modules such as concepts embedded in schemata (i.e., networks), separate declarative and procedural representations (i.e., production systems), or imaginal and verbal processing systems (i.e., dual coding).

A second implication is that knowledge is acquired very slowly. Concepts, schemata, and procedural skills are built up slowly over time, automated over hundreds of hours of practice, and often honed under the watchful eye of mentors and master teachers. From an educational perspective, it seems naïve to expect students to become highly knowledgeable within a domain without years of exposure and practice within that domain. Observing and modeling the performance of an expert helps novices develop the knowledge and skills necessary to perform at a high level of expertise.

One important difference among the four perspectives described above is how they address very complex representations such as mental models (Radvansky, 2006). A mental model is a cognitive representation of a complex process (e.g., flying a jet), spatial map (e.g., mental navigational map of New York City), or explanatory model of some phenomenon (e.g., Big Bang Theory). Many experts would agree that constructing mental models and using them to reason and solve problems is the height of cognition. Nevertheless, it is unclear presently how individuals construct mental models, represent them in memory, or use them to make complex decisions (Dougherty, Franco-Watkins, & Thomas, 2008). Network and production system models seem better suited to explain them, whereas connectionist models often deny the necessity of complex representations like mental models. Understanding the representation of complex mental phenomenon such as a mental model remains an important goal of cognitive psychology.

SEE ALSO *Information Processing Theory; Knowledge.*

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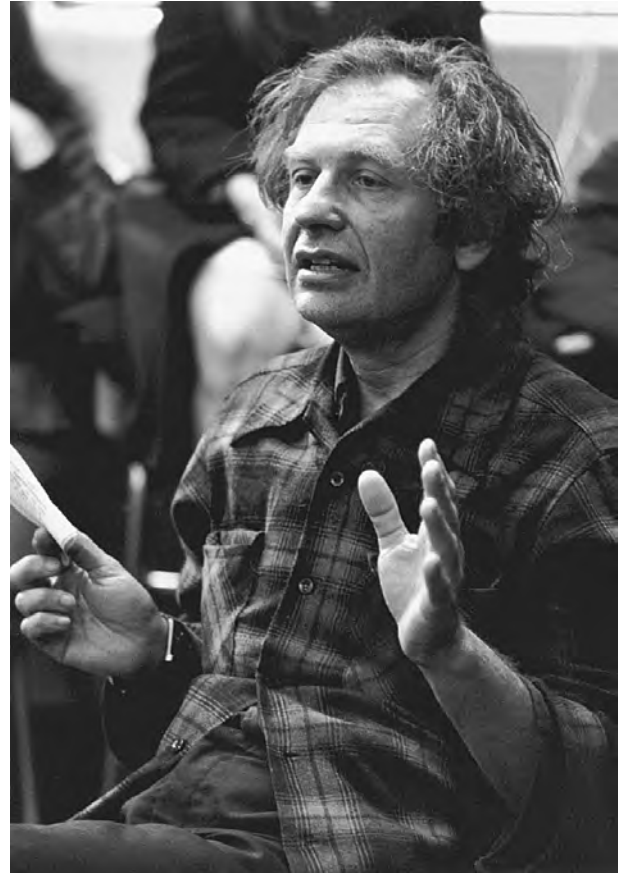
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Gregory Schraw

KOHLBERG, LAWRENCE **1927–1987**

Lawrence Kohlberg (1927–1987) was a psychologist who drew on education, anthropology, and philosophy, to inform his work on the development of moral judgment and on moral behavior. Kohlberg was raised in Bronxville, New York, and attended Phillips Academy, an elite board-



Lawrence Kohlberg. BARRY DONAHUE. COURTESY OF HARVARD OFFICE OF NEWS AND PUBLIC AFFAIRS.

ing school. After World War II he assisted in smuggling European Jewish refugees to Palestine. This work, a turning point in Kohlberg's interest in morality, was documented in his first article, "Beds for Bananas" (1948). At the age of 21, Kohlberg enrolled as an undergraduate at the University of Chicago and earned his bachelor's degree within a year. Kohlberg continued studying at the University of Chicago in pursuit of a degree in clinical psychology; he was inspired by Jean Piaget's work to interview children and adolescents about morality, which was the focus of his dissertation. Kohlberg completed his doctoral degree in 1958. He held a faculty position at the University of Chicago department of psychology for six years before joining the Graduate School of Education at Harvard in 1968. Kohlberg was devoted to developing his research and mentoring students at Harvard until his death in 1987.

Kohlberg's work was particularly influenced by the philosophies of Socrates, John Locke, Thomas Jefferson, and John Stuart Mill, as well as the works of Jean Piaget and John Dewey. Just as Socrates thrived on dialogue and

conflict, Kohlberg viewed such interactions as essential for his development. Thus, many of his critics could also be considered his collaborators. Most notably, this group includes feminist psychologist Carol Gilligan, who began teaching at Harvard with Erik Erickson in 1967. After meeting her in 1968, Kohlberg invited Gilligan to collaborate on a study and, in 1970, to become his teaching and research assistant. Colleagues and friends, the pair coauthored a book and several papers. In 1982, Gilligan authored *In a Different Voice*, in which she challenged Kohlberg's work by calling for the inclusion of female populations and women's perspectives in morality research. Though at odds with each other in their publications Kohlberg and Gilligan continued to teach together, actually teaching about their disagreements.

Kohlberg's initial contribution to educational psychology set the stage for the remainder of his work. Previous theories on morality assumed that society or adults imposed morality on children or that moral judgments were based on avoiding negative feelings. In contrast, Kohlberg asserted that children are moral philosophers whose ability to formulate their own moral decisions develops with experience. For his doctoral dissertation, Kohlberg interviewed 72 White Chicago boys about the Heinz dilemma: Heinz, a man without the means to buy the drug necessary to save his wife's life, steals the drug from the pharmacist. Based on the boys' responses and influenced by Piaget's theory of developmental stages, Kohlberg identified six stages of moral judgment development contained within three levels. The preconventional level includes stage 1, punishment and obedience orientation, and stage 2, instrumental relativist orientation. The conventional level includes stage 3, interpersonal concordance orientation, and stage 4, society maintaining orientation. The postconventional or principled level includes stage 5, social contract orientation, and stage 6, universal ethics principles. Seeking to validate his theory, Kohlberg developed an interview protocol and scoring guidelines (moral judgment interview) and gathered longitudinal and cross-cultural data. These studies included a 22-year study with data collected every three years and over forty studies conducted in Western and non-Western countries. Generally, these studies found support for Kohlberg's theory.

Although widely known for his theoretical and empirical work, Kohlberg focused increasingly on practical applications of his work. He consulted on and created moral education programs for schools, universities, prisons, and community organizations. The most radical of these programs was his "just community approach" in which organizations are fully democratic. Kohlberg helped several schools adopt this approach in which every student and

staff member has an equal voice, and an equal vote, in every school decision. One decision at the Cluster School in Cambridge, Massachusetts, allowed students to leave school early if there was no elective course they wanted to attend. Elsa Wasserman, a Cluster School counselor, reported that the students felt a rare sense of commitment to the school and to fellow students due to the just community approach.

The impact of Kohlberg's work is not that he provided a definitive answer to a particular psychological question, but that he breathed new life into the formulation of questions and the pursuit of answers. Kohlberg brought a new perspective and new methodology to moral development inquiry and encouraged students and colleagues to challenge his and others' work by bringing their own perspectives to bear on issues. Thus, whereas Kohlberg's theory of moral development is so highly regarded that it is included in nearly every psychology textbook, Kohlberg's work as a whole energized the field, actually diversifying the perspectives and approaches represented in the moral development research conducted by other researchers.

SEE ALSO *Moral Development*.

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LANGUAGE IMPAIRMENTS

SEE *Speech and Language Impairments*.

LAVE, JEAN 1939–

Jean Lave is a social anthropologist, whose work on learning as an integral aspect of social practice has been a major influence on thinking in several fields, including cultural studies, sociolinguistics, organizational studies, human geography, and of course education. That so many disciplines have been influenced by her work speaks to the power of her insights.

Born in 1939, Jean Lave received her BA in anthropology from Stanford University and her PhD in social anthropology from Harvard University. She has taught at the University of California at Irvine and at Berkeley. She has done fieldwork research on the nexus of social practice, learning, and identity in a variety of settings, including Indian communities in Brazil, tailor apprentices in Africa, and shoppers in the United States. Subsequently, in the context of an ethno-historical study of the port trade undertaken with Paul Duguid, Lave investigated the complex identities of British families in Portugal (see the book *History in Person*). She has received several awards, including in 1994 the Sylvia Scribner Research Award from the American Educational Research Association in recognition of the influence of her work on thinking and research in education.

Those who have had the privilege to work with her know Lave as an exceptional teacher and collaborator, who practices her theorizing and invests in it her deep concern about the social production of marginalization. For her, in both her theory and her life, the production of knowledge is a fundamentally social enterprise. The book *Understanding Practice*, which she edited with Seth Chaiklin, reflects this ability to open spaces for learning together: It was the result of a highly collaborative two-part conference, during which a group of scholars met initially without position papers, but collaborated until a major contribution had been published.

Lave is best known for her seminal writing on situated learning, which she describes as “changing participation in changing practices.” In their book *Situated Learning*, she and Etienne Wenger introduced the now widely adopted concepts of “legitimate peripheral participation” and “communities of practice.”

But it is important to place these contributions in the context of Lave’s intellectual trajectory. On the one hand, these developments were the result of two decades of careful studies of learning as situated in activity. Early in her career, Lave did an ethnographic study of apprenticeship among Vai and Gola tailors in Liberia, a study summarized in *Situated Learning* and analyzed in more details in a subsequent book *Apprenticeship in Critical Ethnography*. This ethnography convinced Lave that knowing and learning had to be understood as situated in the activities and trajectories of the apprentices whose new skills were part of their becoming tailors. Back in the United States, she applied the insights of the tailor study to understand the use of mathematics by shoppers in grocery stores. This study examined the complex relations

among persons in action, social contexts, and knowledgeability, and yielded an insightful critique of purely cognitive perspectives on learning laid out in her groundbreaking book *Cognition in Practice*.

On the other hand, communities of practice and legitimate peripheral participation are not isolated concepts. They are part and parcel of a broader framework, a learning theory anchored in a “historical, dialectical, social practice theory.” (Lave, 1996, p. 150) This theory places learning in the context of the lived experience of persons in the socially constituted world with its histories, cultures, institutions, identities, generations, claims to knowledge, and their contested production and reproduction in communities of practice. A person always participates in multiple communities of practice, and learning entails the development of an identity across practices.

Turning this theoretically and ethnographically informed gaze on the classroom, Lave questions some fundamental assumptions about schooling. She uses insights from apprenticeship to challenge the privileged status of teaching and to argue that learning, not teaching, is the primary phenomenon for both students and teachers learning as the fashioning of a trajectory of identity. Listening to students, she hears them talk about the work of entering their social reality rather than school subjects. She suggests that to advance teaching, “teachers need to know about the powerful identity-changing communities of practice of their students, which define the conditions of their work” (Lave, 1996, p. 159).

Her focus on social practice provides both a theoretical framework and a body of field research to analyze the classroom as a unique place of practice, with its own logic, politics, and history. This yields three fundamental questions about classroom teaching:

What is the practice of the classroom as a historically specific setting for learning?

How is the practice of the classroom related to “mature practices” in the world?

How is the practice of the classroom related to the everyday lives of students more broadly?

That these three questions seem natural to educators in the early 2000s is a tribute to the influence of Jean Lave.

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LEARNED HELPLESSNESS

Learned helplessness results from experiencing uncontrollable events that cause individuals to expect future lack of control. It is characterized by decreased motivation, failure to learn, and negative emotions such as sadness, anxiety, and frustration. The learned helplessness response pattern was discovered accidentally during the mid-1960s in the study of animal learning: Psychologist Martin Seligman observed that after exposure to inescapable electric shock some dogs passively accepted the shock even when they could take action to turn it off. The so-called helpless dog puzzle initiated decades of research and theory on learned helplessness that covered various topics, including passivity in laboratory rats, clinical depression, children’s classroom behavior, success in selling insurance policies, and mortality in nursing homes.

Learned helplessness is formally defined as a disruption in motivation, affect, and learning following exposure to noncontingent (uncontrollable) outcomes. There are three crucial elements to its definition: contingency, cognition, and behavior. Contingency refers to the objective relationship between actions and outcomes; for helplessness to occur there must be no relationship between a person’s actions and the outcome he or she experiences. Cognition refers to how individuals perceive the contingency, explain it, and extrapolate from this understanding. The perception of uncontrollability (noncontingency) may be accurate or inaccurate, but once it occurs individuals attempt to explain it. From this explanation they make extrapolations about the future and, when learned helplessness occurs, they expect that their behavior will not influence future outcomes. Behavior refers to the observable effects of being exposed to uncontrollable outcomes. Most often it involves a sense of giving up weaker attempts to control the situation or even failure to try to do so at all—a behavior incompatible with new learning. The response is also accompanied by negative emotions such as anxiety and sadness.

LEARNED HELPLESSNESS IN CHILDREN

It was not long before the idea of learned helplessness was extended to child behavior. In the early 1970s, Carol Dweck demonstrated that some children adopted the view that once failure occurred the situation was out of their control and that there was nothing they could do. Specifically, she used children's explanations for failure on a questionnaire to study two groups, those who viewed failure as due to insufficient effort and those who did not. She was able to document two response patterns to failure by having fifth and sixth grade students talk out loud while attempting problems too difficult for their age level immediately after successfully solving age-appropriate problems. She labeled the patterns learned helpless and mastery oriented.

The learned helpless pattern, shown by children whose questionnaire responses did not invoke insufficient effort for failure, involved denigrating their abilities upon encountering failure, overestimating the number of problems they did not solve, and expressing considerable self-doubt. Their performance deteriorated as they were less likely to solve problems after experiencing failure even when the problems were identical to those solved before the failure. Integral to this response pattern is the experience of negative feelings, including anxiety, sadness, and expressed boredom. Thus, the helpless pattern comprises a reaction to failure that undermines the self and impairs performance.

The mastery oriented pattern, in contrast, leads to increased motivation in the face of failure. Children who demonstrate this response pattern typically show some form of self-instruction or self-monitoring when they encounter failure. Their mood remains positive and they maintain the belief in their ability to perform well. Their optimistic view is matched by their behavior as most (over 80%) maintain or improve their problem-solving strategies and they solve just as many, or more, problems as they did prior to experiencing failure. In sum, these children view failure as a challenge and as a learning opportunity, not as an indictment of their ability.

These response patterns show that the differences are not due to ability. Children who display learned helpless versus mastery oriented patterns perform equally well prior to encountering failure, but those who are mastery oriented show superior performance following a failure experience. About 80% to 85% of all students clearly demonstrate one of the response patterns with students of all abilities falling into each group. It is therefore not uncommon to find very intelligent, bright students who are learned helpless, a group that is all too easily overlooked in the classroom.

LEARNED HELPLESSNESS IN THE CLASSROOM

Because the patterns described were identified in rigorous experimental studies, it is important to note that they have also been shown to occur on typical classroom tasks. Specifically, children who encountered confusing instructions in a questionnaire booklet in the classroom performed differently on subsequent questions depending on whether they fell into learned helpless or mastery oriented groups. Under these circumstances, the number of children answering all questions correctly was lower for those showing the learned helpless response pattern (34.6%) as compared to the mastery oriented pattern (71.9%). When, however, the instructions were clear, there was no appreciable difference in the performance of helpless (76.6%) and mastery (68.4%) groups.

Learned helplessness in the classroom can result from teacher behavior. This discovery emerged from the observation that girls in grade school receive higher grades and less negative feedback in the classroom than boys. Although the feedback girls receive confirms their

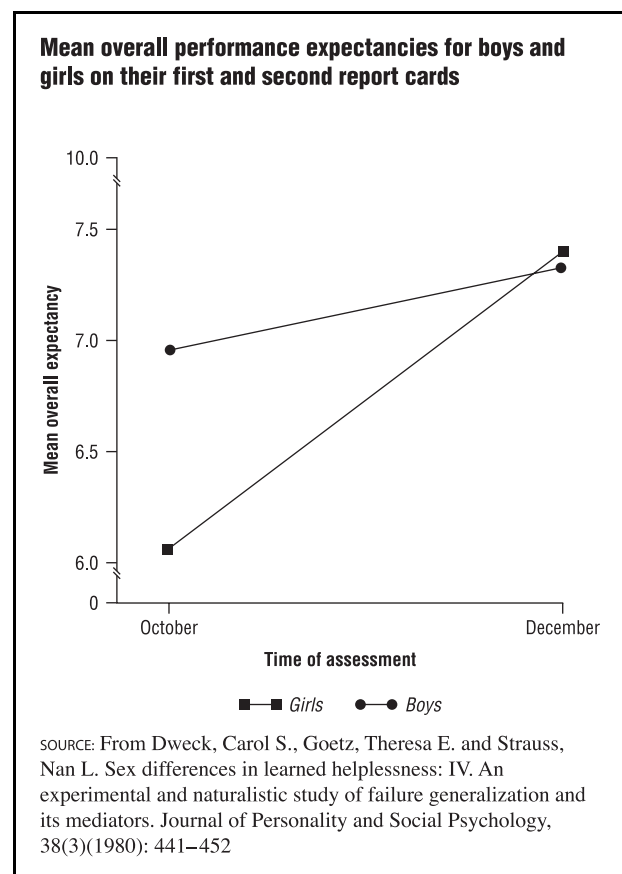


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

competence they tend to question their ability in the face of failure, putting them at greater risk of displaying learned helplessness. In an attempt to address this conundrum, Dweck and colleagues observed the pattern of evaluative feedback given to boys and girls in grade school classrooms (Dweck et al., 1978). They found that the contingencies of feedback differed in that 45% of boys' work-related feedback referred to its nonintellectual aspects (e.g., neatness) whereas for girls the feedback referred almost exclusively to its intellectual quality. Teachers also more frequently ascribed boys' failures to lack of motivation. They then conducted an experiment to show that both boys and girls who received the teacher-girl contingency were more likely to view subsequent failure feedback from that evaluator as indicative of their ability.

The teacher-boy feedback pattern allows boys to avoid ascribing failure to their ability and to even blame the teacher for negative feedback, allowing them to enter a new grade with high expectations of success. This option is less likely for those experiencing the teacher-girl contingency as the areas of academic performance remain similar; hence, failure attributed to lack of ability will remain relevant. If correct, boys should be able to enter a new grade level with higher expectancies for success as compared to girls, but these differences should decrease as children experience evaluation from the new teacher. This is precisely what Dweck, Goetz, and Strauss (1980) found when expected success was assessed at the beginning of a school year (October) and later in the year (December).

There is some evidence that the learned helpless and mastery oriented patterns are socialized by parents. For example, parents who attribute their children's failures to their children's ability tend to have children who display helpless behaviors (Fincham & Cain, 1986). Observation of third grade children and their mothers performing a series of solvable and insolvable problem-solving tasks showed that mastery oriented children had mothers who increased task-focused teaching behaviors and maintained high-positive affect during the insolvable puzzles, whereas mothers of children showing learned helplessness reciprocated their child's negative affect. Similarly, when children mentioned performance goals, mothers of the learned helpless group responded by focusing on performance, whereas mothers in the mastery oriented group redirected attention by focusing on a learning goal (e.g., "Let's see if we can figure out a pattern here").

IMPLICATIONS OF LEARNED HELPLESS FOR EDUCATORS

Attempts to remediate learned helplessness have largely focused on changing the ability attributions associated

with learned helplessness to effort attributions (e.g., "Work harder and you'll do better"). These attempts efforts have met with limited success possibly because little attention has been given to the perceived credibility of the feedback. When credible, such feedback likely increases motivation, but it may be demoralizing if not credible. Effort attribution feedback is likely most successful in the early stages of learning and for difficult tasks, when greater effort can produce better results and its credibility is high. However, Dale Schunk has found that ability feedback (e.g., "You're good at this") given when children succeeded early in the course of learning enhanced achievement better than effort feedback.

Although feedback that focuses on controllable attributions (e.g., effort, strategy use) is widely recommended, research suggests that focusing students' attention on the goal of learning rather than on showing how well they can perform has beneficial effects in combating helplessness. Success obtained in attempts to remediate learned helplessness responding has occurred largely in short term interventions, and it remains to be determine how best to produce lasting changes. In view of evidence that a relationship develops over time between learned helplessness patterns and children's achievement level (Fincham, Hokoda, & Sanders, 1989), there is an urgent need to address this gap in researchers' knowledge.

SEE ALSO *Attribution Theory; Attributional Retraining.*

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Frank D. Fincham

LEARNING AND TEACHING FOREIGN LANGUAGES

Although a large proportion of the world's population speaks two (or more) languages, the psychological study of second/foreign language learning is not commonplace. Typically, courses in second language learning are not offered in departments of psychology; thus, few students ever have the opportunity to avail themselves of such knowledge. This is unfortunate because psychology has much to offer to the field of foreign language instruction. Almost everyone has studied a second language at some time in their schooling, but only a few psychologists have developed a specialized interest in learning and teaching a second language (e.g., Bialystok, 2001; Hakuta, 1986; Hamers & Blanc, 2000; Rivers, 1964; Krashen, 1981).

The relevance of second language learning and teaching for psychology is as critical as any topic having to do with the intricacies involved in any aspect of human learning. The goal here is to discuss a few of the psychological questions involved in second language learning and to provide a theoretical and empirical understanding for why the learning and teaching of foreign languages is a legitimate area of work for psychologists (see McLaughlin, 1987; Padilla, 2006). This discussion will be framed around key questions in the field of language education.

METHODS FOR TEACHING A NEW LANGUAGE TO STUDENTS

Over the years many methods for teaching a new language have evolved. The most longstanding method and the one that has been most heavily influenced by the work of psychologists is the Audio-Lingual Method (Rivers, 1964). The goal in this method is to overlearn the target language through communicative drills directed by the teacher. The idea is to use the target language to the point that it becomes automatic and in the process new habits in the language are formed that overcome the tendency to rely on first language habits. In this method new vocabulary and grammatical structures are presented through teacher-directed dialogue drills, as well as heavy reliance on language lab drills organized around imitation and repetition drills. Students' correct responses are positively reinforced. Listening and speaking in the second language are the objectives in this method. Students' native language habits are considered as interfering, thus the use of the native language is restricted in the classroom. This method emphasizes proper pronunciation, simple everyday dialogues, and correct grammar.

In recent years there has been a gradual shift in language education to an approach that favors communicative competence in the second language. This is

called the Communicative Approach. The goal of this approach is to teach students the new language through classroom activities that engage students in the process of negotiating meaning in everyday conversations, rather than in teacher-directed repetitions of contrived dialogues. Students are taught to be communicators, not learners merely of vocabulary and grammar as in the audio-lingual method. In this approach to teaching a new language, the emphasis is on developing motivation to learn through establishing meaningful, purposeful things to do with the new language (see Padilla, 2006). Individuality in using the new language is encouraged, as well as cooperation with peers, which promotes a sense of personal competence in the use of the target language.

DEFINING FOREIGN LANGUAGE AND SECOND LANGUAGE EDUCATION

The social context in which a new language is learned is the deciding factor in determining whether the new language is identified as a foreign or second language. For example, a program that teaches students English in school in the United States is referred to as English as a second language (ESL) instruction. However, in the same school and down the hall from the ESL classroom, a teacher may be instructing students in Spanish, French, or Japanese. Because these languages are not the primary medium of communication in the United States, students in these classes are learning a foreign language (FL). The distinction is subtle but important. English language learners (ELLs) are immersed in English and get much more authentic English input from native speakers than students learning a foreign language (e.g., French) since this is not the medium of everyday communication in the United States. Thus, English learners have many sources (e.g., peers and mass media) and opportunities for receiving English language input. In contrast, students learning a foreign language in an American school typically have only their teacher to rely on for authentic language input. The distinctions in language learning contexts are important because they reveal how language instruction is planned and implemented.

An important contrast between foreign language education and English language instruction is that in an FL class students are not expected to develop proficiency in one or two years of instruction. Even students who reach the advanced placement level in an FL are seldom capable of showing a high level of oral proficiency in the FL. However, in ESL instruction students are expected to be mainstreamed into English-only classrooms within one or two years. For many learners this is an unreasonable expectation that often creates other related school achievement difficulties. Thus, expectations differ depending on whether the discussion is about learning a second or a foreign language.

ELEMENTS INVOLVED IN LEARNING A SECOND LANGUAGE

Language learning is complex, whether the language is acquired in infancy as a first language or later in life as a second or third language. The learning process consists of acquiring a language system, rather than learning a series of disconnected components. A language system consists of not only grammatical rules and vocabulary, but also the proper way to use language, such as requesting information, inviting a friend to a social event, thanking a person for a kind act, or greeting a stranger. In addition, a language system includes discourse, whereby speakers learn what to say to whom and when.

In their research on bilingualism, Hamers and Blanc (2000) studied how bilinguals carry out a large variety of cognitive tasks in the two languages. Bilingualism involves having a command of the linguistic system—the phonology, morphology, syntax, semantics, and pragmatics that constitute the essence of each language, but it also means being able to keep the languages separate cognitively when necessary, and strategies to search the memory store in one language in order to use the information in the other language.

The specific elements of the language system learned in a second language classroom vary by language. For example, the student learning Chinese or Farsi must learn an entirely new orthography, whereas students learning Spanish will only have minor differences in alphabets to contend with (Akamatsu, 2002). Some languages will have very different sentence structures compared to English; others will appear to be more familiar. However, familiarity with the language system alone is not enough to enable students to engage in successful communicative activities. Learners also acquire the strategies that assist them in bridging communication gaps that result from differences of language and culture. Examples of these strategies include circumlocution (saying things in different ways), using context clues, understanding, interpreting, producing gestures effectively, asking for and providing clarification, and negotiating meaning with others.

In language learning and teaching an important concept is comprehensible input. Students can only learn what they understand and in language teaching this means that the teacher must make content comprehensible. There is a theoretical debate about what exactly comprehensible input is and how it advances a learner's knowledge of a new language (Sanz, 2005). However, at a practical level teachers understand that with early to intermediate language learners, teaching for comprehension includes providing many nonverbal clues such as pictures, objects, demonstrations, gestures, and intonation cues. As competency in the language develops, other strategies include using hands-on activities and coopera-

tive or peer tutoring techniques. As learners' vocabulary and knowledge of the language expands, they are able to comprehend more information. Ultimately, mastery demands that learners understand what the teacher is saying in class or what a native speaker is saying in a real-life context as well as the appropriate conversational interactive exchanges in and out of the classroom. Sound strategies for teaching languages to students who differ by their level of proficiency have been incorporated into a compendium, "Standards for Foreign Language Learning in the 21st Century" (National Standards in Foreign Language Education Project, 1999). All of the professional language associations have endorsed the Standards and they are a critical element in teacher education programs today. In fact, education students must demonstrate mastery of these Standards in order to receive their teaching credential to teach a foreign language.

THE ROLE OF MOTIVATION

Gardner (1985) studied a variety of psychological and social variables in examining the role of motivation in second language learning. According to Gardner, anyone who seeks to learn a second language recognizes the potential value of speaking a new language and must be motivated to learn the language for one of two reasons: instrumental purposes (e.g., to get a job or to meet a school graduation requirement) or for integrative purposes (e.g., to understand better how native speakers of the language think and behave). Motivation underlies the learning of language because it addresses the goals and expectations of the learner as well as the teacher. If a person is only interested in enough survival skills in a new language to be able to secure employment then the level of attainment will be different from learners who want to read and discuss the important literature of another culture. In an extension of Gardner's research, Sung and Padilla (1998) found an "ethnic heritage-related motivation" for learning Chinese, Korean, or Japanese. Students who wanted to learn the language of their ancestors were more motivated to learn these more difficult languages, especially if their parents also wanted them to learn the language. Thus, knowing students' reasons for learning a second language enables teachers to plan an appropriate curriculum.

TIME INVOLVED IN LEARNING A SECOND LANGUAGE

How long it takes to learn a second language is an important pedagogical as well as psychological question because the answer depends in part on the learner's age, aptitude, personality, and motivation. If a person wants just enough language to be able to interact on a social level with native speakers, he or she will spend considerably less time learning the new language than a person

who wants to be able to succeed academically in a classroom in the new language and compete with native speakers.

The learning of basic survival communication skills in a new language takes a few months to a year or two depending on the amount of language input the learner receives from native speakers of the target language, the accuracy of second language output demanded by the context, the motivation of the learner, and the amount of practice in listening and speaking the new language. This depends too on the age of the learner. The knowledge of the new language that a child would need to interact with native speakers on the playground is different from what would be required of a university student who intends to study in Spain or China and take academic coursework in Spanish or Mandarin with native students. The time needed to master a second language for interpersonal communication is considerably less than the time required to master second language oral and literacy (reading and writing) skills in order to do academic level courses with native speakers of the second language.

In sum, there is no one answer to the question of how much time is necessary to learn a second language. The answer depends on expectations of what language skills (oral, listening, reading, or writing) and level of proficiency are desirable in the student. If the goal is basic survival skills, the amount of time needed will be far less than if the aim is to develop a high level of communicative competency.

ATTAINING PROFICIENCY IN A SECOND LANGUAGE

A learner who is proficient in a second language is able to exhibit a high level of accuracy in the second language. This includes being able to use the new language with grammatical accuracy in ways that are contextually and culturally authentic. Accuracy pertains to the precision of the message in terms of fluency, grammar, vocabulary, pronunciation, and cultural appropriateness. When language practice reflects real-world use, it forms the foundation for developing proficiency. This is true regardless of age, grade level, and type of language instruction offered the student.

The demands of accuracy in a second language, as can be seen, are high. There are four modes of expression—listening, speaking, reading, and writing—that constitute the paths by which information and concepts are transmitted from one person to another. Listening and reading are receptive skills; speaking and writing are productive skills. Students cannot create the language they are learning without first receiving input from teachers, peers, and the media. Thus, developing proficiency in each of these modes reinforces proficiency in the other modes. For

example, learning to read in a new language facilitates vocabulary acquisition, which augments speaking and writing in the second language. Thus, all four modes of expression are important elements in language learning, and their use is required in all formal classroom contexts.

Bialystok (2001) has shown that language input provided to language learners and the language output expected of them must be developmentally appropriate in two senses: (1) appropriate to the developing level of second language learning that the person has attained, and (2) appropriate to the cognitive and linguistic level of the student in his or her first language. In first language acquisition research shows that parents simplify their language input to their young children by speaking slower, frequent repetition, and simplified vocabulary and grammar. Hakuta (1985) argues that good language teachers use these same strategies in the early stages of ESL or FL instruction.

As the learner advances in the acquisition of the second language, three categories of discourse describe language use on the basis of receptive and productive skills. The categories are: interactive comprehension and production, receptive comprehension, and comprehensible production. Examples of interactive comprehension and production include telephone conversations and correspondence with friends through e-mail or instant messaging. These activities provide for an exchange of ideas. If one person does not understand the interchange, it is relatively simple to achieve understanding by seeking clarification. The interactive comprehension and production category of discourse is common in the social use of language.

Receptive comprehension refers to activities such as reading a book in a science class or viewing a video in a history class, activities that preclude seeking clarification from the author or narrator. In these situations, readers or listeners rely solely on their reservoir of concepts and language decoding skills for comprehension. Receptive comprehension becomes increasingly important with each grade level because students are required to do more reading and to integrate the information acquired with new knowledge presented by the teacher. Teachers are very important in this stage since they can provide valuable strategies to help students advance to more complex language structures.

Comprehensible production is critical because it shows what a learner is capable of doing in their new language (e.g., completing a job application, making an oral class presentation). During such activities the second language user makes a presentation or writes a letter that precludes any seeking of clarification of meaning by the reader or listener. This places a responsibility on the second language user to communicate with clarity and

accuracy. The comprehensible production category of discourse is common in the academic use of language. Further, many high-stakes tests (e.g., AP tests in a foreign language) include a writing component that requires students to produce an essay that is scored not only for grammaticality, but for the persuasiveness of an argument.

METHODS FOR TEACHING A SECOND LANGUAGE

Many strategies have evolved over the years to teach a second or foreign language to students. It is beyond the scope of this entry to cover all the methods that can be found in schools. However, two such methods used at the elementary school level will be described.

Foreign Language in the Elementary School. In this model a second language is presented as a distinct subject much like science or social studies—that is typically taught at least three to five times per week, with classes lasting anywhere from 20 to 50 minutes. Most FLES programs focus on teaching the four communication skills, as well as the culture of the speakers of the language being learned. Some programs called content-based or content-enriched programs incorporate themes and objectives from the regular academic curriculum as a vehicle for developing foreign language skills. Depending on the frequency and time devoted to language instruction and the opportunities provided for practicing the language, children can attain substantial second language proficiency.

Immersion Programs. Immersion programs have grown in popularity in Canada and the United States since the late 1970s (Padilla, 2006). In an immersion program English-speaking children spend part or all of the school day learning a second language (e.g., French, Spanish, Japanese). In a full (total) immersion program, students learn all subjects (e.g., math, social studies, science) in the second language. Partial immersion programs operate on the same principle, but only a portion of the curriculum is presented in the second language. Partial immersion programs are generally more common than full immersion programs. In this type of program students may learn social studies and math in the second language for part of the day, and science and language arts in English for the remainder of the day. In both full and partial immersion, the second language is the medium for the content instruction rather than the subject of instruction. Students enrolled in immersion programs work toward full proficiency in the second language and usually reach a higher level of language competence than students participating in FLES or other types of language programs. The research findings supporting this conclusion are well established.

In conclusion, there are many ways in which psychologists can contribute to the study of foreign language teaching and learning. Psychologists have much to give to educators and parents who want to know more about the latest research in cognition and language and how this applies to learning a second language.

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LEARNING AND TEACHING MATHEMATICS

Major theoretical approaches to learning and teaching mathematics have been developed from three psychological perspectives of human learning. The *social constructivist approach* to mathematical learning emphasizes classroom learning as a process of both individual and



Doing a problem on the board helps students share solutions and strategies with the whole class. © TERRY VINE/CORBIS.

social construction. Critical to this framework is the need for mathematics teachers to construct a form of practice that fits with their students' ways of learning mathematics (Wood, Cobb, & Yackel, 1995). "The most basic responsibility of constructivist teachers is to learn the mathematical knowledge of their students and how to harmonize their teaching methods with the nature of that mathematical knowledge" (Steffe & Wiegel, 1992, p. 17). This is the planning whereby teachers plant powerful mathematical ideas in a personally meaningful context for students to investigate. Cobb, Wood, and Yackel (1993) further elaborate on teachers' responsibility in the mathematics classroom as playing the dual role of fostering the development of conceptual knowledge among students and facilitating the constitution of what is often referred to as taken-as-shared knowledge in the classroom community. This is the teaching in which, without direct access to one another's understanding, members of the classroom community achieve through social interaction a sense of some aspects of knowledge being shared, promoted by classroom social norms understood by members as constitut-

ing effective participation in the mathematics classroom community.

The underlying metaphor of social constructivism is *persons in conversation*, which highlights the critical role of language (see Ernest, 1996). For example, when teaching the theorem that the sum of the three inner angles of a triangle is 180 degrees, a teacher practicing social constructivism would present the idea of moving the three angles together to calculate the sum and would then have students talk about or share their ideas about moving angles. Manipulatives would be provided to students so that they could take a triangle apart and experiment with different ways of making three angles come together. Students would find that many of their ideas about moving angles would produce three angles forming a straight line indicating 180 degrees. This physical construction would then be followed by another "talk point" for students promoted by the teacher about how to move angles mathematically for geometric proof. Students, now with papers and pencils, would engage in continuing conversation about moving angles mathematically with

the main idea being creating equal angles in different places in order to pull three angles together (the mathematical construction would refer frequently to the physical construction). The language elements are always critical during the whole process from moving angles physically to moving angles mathematically.

The cognitive science approach to mathematical learning emphasizes the nature of knowledge representation (this separates cognitive psychologists from constructivist theorists). Representation in mathematical learning can take on different forms: cognitive (the internal representation of a learner's knowledge), mathematical (the mathematical representation of a mathematical structure), symbolic (the external representation of a mathematical notation), explanatory (the model and theory developed to account for cognitive structures and processes), and computational (the hypothetical mental representation in computer programs based on observed human behaviors) (see English & Halford, 1995). These representations provide a way to construct cognitive models of mental structures of mathematical knowledge and cognitive processes of mathematical learning. Cognitive processes operate on cognitive representations (mental structures) that are viewed as a network of interrelated mathematical ideas.

The quality of mathematical learning is measured through the number of connections that learners can make among mental representations and the strength of each connection (Hiebert & Carpenter, 1992). The notion of connected representation "provides an effective link between theoretical cognitive issues and practical classroom issues" (English & Halford, 1995, p. 13). Cognitive science has proven to be the most effective way to investigate problem-solving behaviors in mathematics. In addition to solid mathematical knowledge, successful problem solving in mathematics is found to require "a repertoire of general problem-solving heuristics" that remind mathematics educators of the classic work of Polya (1957) (English & Halford, 1995, p. 14).

For example, English and Halford (1995) argued that "a mental model of the relations between numbers themselves" is needed to truly understand numbers (p. 60). The mental model starts with a correspondence between a number and a set of objects (e.g., 5 corresponds to five apples). Relations between numbers can then correspond to relations between sets. Because the set of five apples has more objects (members) than the set of three apples, 5 is larger than 3. Students establish the mental model of number by experimenting with sets of objects to reinforce the correspondence between number relations and set relations. Without this mental model, most students would have to rely on the succession relation to understand numbers, with rote learning emphasizing the counting order of the numbers. Obviously, the notion that 5 is larger than 3 because 5 comes after 3 is at best vague and fuzzy to most students.

The sociocultural approach to mathematical learning emphasizes the effort to situate mathematical ideas within culturally organized activities. Because education is a process of enculturation (or socialization), it is important for learners to engage in social interaction with more knowledgeable experts in what Lev Vygotsky called the *zone of proximal development* and for teachers to use culturally developed sign systems and culturally appropriate artifacts as psychological tools for instruction (Vygotsky, 1978). "The qualities of thinking [and learning] are actually generated by the organizational features of the social interaction" (van Oers, 1996, p. 93). Internalization is another central notion in Vygotsky's cultural-historical theory of human development which "appears first between people as an intermental category and then within the child as an intramental category" (Vygotsky, 1960, p. 197-198). Particularly relevant to mathematics education is the notion that "learning is the initiation into a social tradition [of mathematical inquiry, mathematical discovery, mathematical argument, and so on]" (Solomon, 1989, p. 150).

With enculturation as the emphasis, a teacher who employs the sociocultural approach to teach mathematics would design a learning task through which students can interact with experts. Simply put, it is a process of guided participation and interaction of learning by solving problems just beyond a student's current capability with the help of a more expert other via scaffolding. Experts do not necessarily imply mathematicians. Teachers are most often the experts in real classrooms, and continuing professional development strengthens their expertise in mathematics. In addition, teaching assistants, advanced peers, and even parents can all be trained to become mathematics experts in real classrooms.

For the theorem that the sum of the three inner angles of a triangle is 180 degrees, experts would ask well-thought questions around the main idea of creating equal angles in different places so that the three angles can be pulled together to examine the sum. These questions prepare students for the demonstration of experts who would show students how to move one angle (both physically and mathematically), would have students comment on the move, and would ask students to move the other angles following a similar strategy. Observing students closely, experts would alert students of wrong moves, would point out reasons for wrong moves, and would demonstrate correct moves repeatedly. This modeling and coaching process between experts and students, often considered apprenticeship in nature, is the very foundation of the sociocultural approach that requires social participation and interaction of the whole classroom community. Finally, experts would evaluate with students on different strategies of moving angles and would reason with them on the best way to move angles.

The whole interaction between experts and students would end up with the establishment (or enculturation) of an important mathematical tradition (or practice) on the use of auxiliary lines for geometric proof. As a result, experts would have trained students on geometric proof in a way very similar to how masters would have trained apprentices in, say, furniture building.

LEARNING GOALS FOR MATHEMATICS EDUCATION

“Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge” (National Council of Teachers of Mathematics [NCTM], 2000, p. 11). The mathematics education research community has been fairly united in identifying understanding as the major learning goal for mathematics education teaching mathematics for understanding. Simon (2006) stated:

Recent discourse in mathematics education has coalesced around the importance of focusing on and fostering students’ mathematical understanding. This agreement among mathematics educators has led to a commitment to generate new learning goals for students that are less skewed in favor of skill and facts learning and more focused on student thinking. (p. 359)

Although mathematics education has a long history, teaching mathematics for understanding is a fairly new notion.

Believing that two effectively different subjects are taught under the same name called mathematics, Richard Skemp published his classic paper on mathematical understanding in 1976. He distinguished between *instrumental understanding* (knowing how) and *relational understanding* (knowing both how and why). According to Skemp (1976), there are three advantages in instrumental understanding of mathematics: (a) easier to understand, (b) more immediate and more apparent rewards, and (c) quicker in getting correct answers. But the metaphor for instrumental understanding is *getting an instruction to go to a certain place* (i.e., still not knowing how to go to any new place). There are four advantages in relational understanding of mathematics: (a) more adaptable to new tasks, (b) easier to remember, (c) effective as a goal in itself, and (d) organic in quality. The metaphor for relational understanding is *getting a map to go to a certain place* (i.e., knowing how to go to any new place).

It is common among teachers to use rhymes to help students understand mathematical properties. Such an effort in many cases results in instrumental understand-

ing. For example, many teachers use the following rhyme to help students understand (or memorize) the order of number operation: *Please* (parenthesis) *Excuse* (exponential) *My* (multiplication) *Dear* (division) *Aunt* (addition) *Sally* (subtraction). Many students who have gained instrumental understanding through this teaching practice would mistakenly believe that, for example, they should do addition before subtraction because of the order shown in the rhyme. This rhyme does not illustrate the fact that there are equivalent levels of operation. The order of operation does not matter between multiplication and division. Neither does it between addition and subtraction.

In contrast to instrumental understanding, relational understanding aims to make students know the very reason behind every mathematical action (or manipulation). For example, when solving the equation $2X - 4 = 8$, for X , a teacher adopting instrumental understanding would procedurally have students move the 4 from the left side of the equation to the right side. Their instrumental understanding also reminds them to change the sign of the number (in this case from negative to positive): $2X = 8 + 4$ or $2X = 12$. However, many students have no understanding of why this rule governs this mathematical action. Instead of having students learn this procedural rule, a teacher adopting relational understanding would emphasize properties of equation operation, such as the one that adding the same number to both sides of an equation keeps equality. Therefore, students with relational understanding would perform: $2X - 4 + 4 = 8 + 4$ resulting in $2X = 12$.

Instrumental understanding produces procedural knowledge, whereas relational understanding produces conceptual knowledge. Hiebert and Lefevre (1986) defined conceptual knowledge as “knowledge that is rich in relationships . . . a network in which the linking relationships are as prominent as the discrete pieces of information” (pp. 3–4, cited in Simon, 2006). This is the reason why effective classroom teaching for mathematical understanding often emphasizes one key aspect of understanding: connection.

Researchers have increasingly recognized the importance of affect-related factors in mathematical learning and teaching. Stuart (2000) stated that “mathematics is like a sport: [performance is] 90 percent mental one’s mathematics confidence and 10 percent physical one’s mathematics competence in performing mathematical skills” (p. 330–331). After a review of studies, Eynde, de Corte, and Verschaffel (2002) noted that both affective and cognitive factors play a key role as the constituting elements of the learning process:

Motivation and volition (i.e., the conative factors) are no longer seen as just the fuel or the engine of the

REFORM AND CONTROVERSY IN MATHEMATICS INSTRUCTION

Between 1955 and 1975 mathematics education in the United States underwent major and expensive curricular reforms called “modern mathematics” or “new math.” The movement took various and sometimes contradictory forms with uneven implementation and outcomes. In 1989 the National Research Council (NRC) published *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*. It identified some of the successes and failures of the reform movement:

- Some important aspects, such as a renewed emphasis on geometry, probability, and statistics, were widely adopted.
- Applications of mathematics to other fields, such as biology and business, became accepted components of mathematics curricula.
- Some attempts at deepening mathematical understanding, such as sets and commutative law, were poorly applied and became the butt of public ridicule.
- By moving the curricula into unfamiliar territory, teachers and schools lost the confidence of parents and the community.

Everybody Counts outlined some of the lessons learned from these attempts at curricular reform:

- The wholesale adoption by school districts of an intact outside curriculum is destined for failure.
- Superficial district wide curricular overhauls can be disastrous.
- Improvement in mathematics curricula and instruction requires a major public information campaign, strong leadership from teachers, parents, professionals, and politicians, and strong public support.

The NRC report identified ongoing transitions in mathematics education:

- from minimal mathematics for the majority of students and advanced mathematics for the gifted few to a common core of mathematics instruction for all students
- from an authoritarian “transmission of knowledge” to student centered “stimulation of learning”

- from public indifference or hostility toward mathematics to a recognition of its importance in contemporary society
- from a focus on routine skills to developing broad based mathematical abilities, including discerning relationships, logical reasoning, and using a wide variety of methods for solving new problems
- from preparation for subsequent math courses to topics with relevance for the present and future needs of students
- from an emphasis on paper and pencil calculations to the use of calculators and computers
- from a public perception of mathematics as a static set of rules to an appreciation of mathematics as an active science of patterns.

The National Council of Teachers of Mathematics (NCTM) published their landmark *Curriculum and Evaluation Standards for School Mathematics* in the same year as the NRC report. Among the NCTM’s recommendations:

- Voluntary acceptance of national standards based on the work of the NCTM to establish a common philosophy and framework for mathematics education
- Local implementation of reform involving the entire community
- The study of mathematics during every school year, including a broad range of mathematical subjects, the use mathematics in other classes, and the active engagement of students in learning
- The involvement of parents in demanding that schools meet the NCTM standards, encouraging their children to continue studying math, expecting homework to involve more than routine computations, and supporting teachers in curricular improvements
- An upgrading of the teaching profession, with teachers working together, familiarizing themselves with issues of mathematical education, examining current practice, and debating new proposals, and team teaching at the elementary level

- Designing appropriate assessments for future needs
- Strengthening college mathematics.

In 2000 the NCTM published *Principles and Standards for School Mathematics (PSSM)*, a refinement of the 1989 standards, outlining a common foundation for mathematics education for all students from preschool through grade 12. Its numerous recommendations for reform were generated from a set of principles:

- The Equity Principle: high expectations and strong support for all students, including an end to tracking that permanently excludes groups of students from a challenging comprehensive mathematics program to be replaced by structures that accommodate differences
- The Curriculum Principle: a consistent curriculum through the grade levels that draws on research for implementing standards and is chosen with input from families and the community
- The Teaching Principle: teacher understanding of what students know and need to learn and challenging and supporting them; teachers adapting to changing curricula and technologies and incorporating new knowledge about how students learn mathematics; improved pre service education, professional development, and collaboration
- The Learning Principle: students have time and opportunity to learn mathematics with understanding and to build on prior knowledge

and experience; elementary students study mathematics for at least one hour per day with well prepared teachers who enjoy math, including team teaching and the use of specialists; middle and high school students take the equivalent of one year of mathematics at each grade level, spending a substantial amount of time each day on work that keeps them engaged in mathematical learning

- The Assessment Principle: multiple forms of assessment that are aligned with instructional goals and provide teachers and students with useful information
- The Technology Principle: equitable allocation and utilization of technology that is embedded in the curriculum and enhances teaching and learning.

The *PSSM* stressed the urgent need for mathematics specialists to work with teachers, administrators, families, and community members.

In 2006 the NCTM published *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics*, which was at least in part a response to criticism that the *PSSM* had led to curricula lacking basic instruction in arithmetic. However controversy over new standards and teaching methods remained at least as heated as that over the new math in the 1960s and 1970s.

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learning process, but are perceived as fundamentally determining the quality of the learning. In a similar way, self confidence and positive emotions (affective factors) are no longer considered as just positive side effects of learning, but become important constituent elements of learning and problem solving. (p. 14)

NCTM has been highlighting five new goals for mathematical learning and teaching since 1989 when it published the first-ever curriculum standards. Two of the five new goals are affective in nature: (a) students learn to value mathematics, and (b) students become confident in their ability to do mathematics.

CHALLENGES FOR EFFECTIVE MATHEMATICS INSTRUCTION

As early as 1985, Slavin and Karweit stated that “one of the most troublesome and enduring problems of mathematics instruction is accommodating heterogeneity in student

preparation and learning rate” (p. 351). The problem of classroom heterogeneity is much more pronounced in mathematics than in any other school subject because mathematics is structured in the most highly sequential fashion among all school subjects access to and performance in mathematics courses are determined by prior success in particular courses often referred to as prerequisites that systematically regulate student performance and progress in mathematics (see Oakes, 1990). This means that mathematical problems and difficulties accumulate, and the degree of classroom heterogeneity enlarges over time.

Traditionally, there are two ways to deal with the problem of classroom heterogeneity. One is ability grouping at various levels: (a) grouping students within a class (e.g., regular mathematics groups and advanced mathematics groups), (b) grouping classes within a school (e.g., curriculum tracking and curriculum placement), and (c) grouping schools within a district (e.g., special education programs and magnet programs for gifted students). The other

prevalent way to accommodate classroom heterogeneity is individualized instruction in which students work on learning materials at their own level and rate with frequent assistance from teachers.

NCTM (1989) introduced another means to accommodate diverse learning needs: *content differentiation*. This concept emphasizes that the depth to which a topic is explored should depend on the level of abstraction at which students are capable or operating. To apply this concept, classroom teachers make concrete examples and applications of a topic open to all students to learn but make higher levels of abstraction and generalization available to, but not required of, all students. Classroom heterogeneity remains a major challenge in mathematics instruction today because the effectiveness of ability group and individualized instruction has been challenged, and the concept of content differentiation is difficult to implement even for experienced teachers.

A related, but largely isolated, challenge in mathematics instruction is the presence, in some cases substantial, of English as a second language (ESL) students. ESL students face enormous difficulties in mathematical learning because both mathematics and the language that carries it are foreign to them. NCTM (1994) clarifies that all students, regardless of their language or cultural background, must study a core curriculum in mathematics based on its curriculum standards. In 1991 NCTM recommended five major changes in mathematics classroom to help ESL students succeed in mathematics: (a) selecting mathematics tasks that engage students' interests and intellect, (b) orchestrating classroom discourse in ways that promote the investigation and growth of mathematical ideas, (c) using, and helping students use, technology and other tools to pursue mathematical investigations; (d) seeking, and helping students seek, connections to previous and developing knowledge; and (e) guiding individual, small-group, and whole-class work (students benefit from a variety of instructional settings in the classroom).

EFFECTIVE INSTRUCTIONAL TECHNOLOGY FOR MATHEMATICS EDUCATION

Various types of instructional technology (IT) have been developed to enhance mathematical learning and teaching. Lou, Abrami, and d'Apollonia (2001) classified IT into five major categories according to its educational functions: (a) tutorial, (b) communication media, (c) exploratory environment, (d) tools, and (e) programming language (with limited application so far). Tutorial refers to programs that can directly teach mathematics by creating a stimulating environment in which information, demonstration, and practice are shared with students.

Computer-assisted instruction (CAI) and various mathematics games (e.g. Math Blaster) are typical examples. Research points to CAI as a potentially effective mechanism for teaching students (including those with special needs), with increased mathematics performance as positive outcomes (e.g., Xin, 1999).

Communication media refers to communication tools such as email, computer-supported-collaborative learning (CSCL) systems, videoconferencing, and the Internet. These tools promote effective communication and information sharing. Multimedia program and videoconferencing have begun to emerge as potentially effective tools for mathematical learning and teaching (e.g., Irish, 2002; SBC Knowledge Ventures, 2005). For example, videoconferencing is found to help meet state and national curriculum standards, reach new heights in staff professional development, and help students take classes not offered at their school. In particular, students involved in the operation of the videoconferencing equipment benefit the most by having learned both subject contents and technical skills.

Exploratory environment seek to encourage active learning through discovery and exploration. Logo, simulations, and hypermedia-based learning are typical examples. One of the hypermedia-based learning programs in mathematics is the Adventures of Jasper Woodbury, a mathematics program developed at the Vanderbilt University and widely used around the world. Based on the theory of anchored instruction, the program uses video and multimedia computing technology to provide problem-scenarios to help students develop skills and knowledge for problem solving and critical thinking. Implementation of this program has yielded positive findings (e.g., Mushi, 2000; Shyu, 1999).

Tools serve the technological purpose of making learning and teaching attractive, effective, and efficient. Word processors, PowerPoint, spreadsheet, Geometer's Sketchpad, data-analysis software, and various virtual manipulatives are typical examples. In mathematics classrooms, particularly at the elementary level, manipulatives are used extensively to help students build a foundation for understanding abstract mathematical concepts. Accessed via the Internet, virtual manipulatives are replicas of real manipulatives and capable of connecting dynamic visual images with abstract symbols (a limitation of regular manipulatives). A variety of studies have examined the use of virtual manipulative tools in mathematics classrooms and have found positive effects on student mathematics achievement and attitude toward mathematics (e.g., Moyer & Bolyard, 2002; Reimer & Moyer, 2005; Suh, Moyer, & Heo, 2005).

ASSESSING MATHEMATICAL LEARNING AND TEACHING

As an emerging concept, classroom assessment is different from student assessment in that the goal of classroom assessment is to understand learners' learning in order to improve teachers' teaching. Based on results of a comprehensive review of empirical research on whether classroom assessment can benefit learning (in mathematics, science, and English) by Black and Wiliam (1998), Harlen and Winter (2004) offered this summary:

[There is] convincing evidence that classroom assessment raises students' attainment when it has these key characteristics: that information is gathered about the processes and products of learning and is used to adapt teaching and learning; that learners receive feedback that enables them to know how to improve their work and take forward their learning; that teachers and learners share an understanding of the goals of particular pieces of work; that learners are involved in assessing their work (both self and peer assessment); that pupils are actively involved in learning rather than being passive recipients of information. (p. 390)

Some developments have also occurred in student assessment. There have been calls for traditional large-scale assessments not only to measure (or assess) but also improve (or support) student mathematical learning. Chudowsky and Pellegrino (2003) argued that large-scale assessments can and should do a much better job of "gauging student learning, holding education systems accountable, signaling worthy goals for students and teachers to work toward, and providing useful feedback for instructional decision making" (p. 75). As one of the efforts, large-scale tests are moving toward a closer alignment with mathematics curriculum and instruction.

Portfolios are emerging as a popular alternative student assessment. A portfolio is a purposeful collection of a students' work as indicators of their effort, progress, and achievement over time to gauge their cognitive and affective development. For mathematical learning, the purpose of a portfolio is to understand "student thinking, student's growth over time, mathematical connections, student views of themselves as mathematicians, and the problem solving process" (Stenmark, 1991, p.37). However, there ought to be a note of caution on alternative student assessments. Herman and Winters (1994) discussed the lack of empirical evidence on claims of advantages of portfolios over traditional student assessments. Carney (2001) noted that the research literature on portfolios did not change much from 1994 to 2001. An inspection of the leading *Journal for Research in Mathematics Education* shows again the lack of empirical research on all forms of alternative assessments since 2001.

RESEARCH GROUNDED CURRICULUM AND INSTRUCTION PROJECTS IN MATHEMATICS

After an evaluation of current mathematics curriculum projects based on his Curriculum Research Framework, Clements (2004) ranked the Realistic Mathematics Education (RME), the Investigations in Number, Data, and Space (Investigations), Everyday Mathematics, and the Connected Mathematics Project (CMP) as (large-scale) research-based curriculum projects in mathematics education. The RME actually is a learning and teaching theory about mathematics education, developed by the Freudenthal Institute in the Netherlands. Freudenthal (1991) views mathematics as connected to reality and as a human activity. "Realistic" refers not only to the connection of mathematics with the real world and everyday life but also to problems real in mind of students. The RME organizes mathematics education into a process of guided reinvention to allow students to experience the similarity between the process by which mathematics is learned and the process by which mathematics is invented. "Invention" emphasizes the need to develop steps in the learning process, and "guided" emphasizes the need to create an instructional environment for the learning process. The RME can be characterized as making good use of (a) contexts (phenomenological exploration), (b) models (instrument bridging), (c) productions and constructions from students (student contribution), (d) educational interactions (interactivity), and (e) intertwining (of various learning strands).

The Investigations is a complete K-5 reform-based mathematics curriculum developed under the leadership of Dr. Susan Russell at TERC in Cambridge, Massachusetts. It designs activity-based investigations to encourage students to think creatively, develop their own problem-solving strategies, and work cooperatively. In addition to talking, writing, and drawing about mathematics, students use manipulatives, calculators, and computers to explore mathematical concepts and procedures. Classroom assessment is embedded within each investigation for improvement in teaching. Studies are in favor of Investigations students in (a) straight calculation problems (basic facts and whole number operations), (b) understanding of number concepts and number relationships, (c) word problems and complex calculation problems, and (d) performance in a high-stakes standardized test (administered in Massachusetts). Studies also indicate that Investigations works well with students across all mathematics achievement levels.

Research and development of Dr. Max Bill and his colleagues during the 1980s and 1990s resulted in the University of Chicago School Mathematics Project. The major component, Everyday Mathematics, is a

research-based K-6 curriculum, with the goal to significantly improve both curriculum and instruction for all students to learn mathematics. The project began with a research phase in which a thorough review was conducted of existing research on mathematics curriculum and instruction with an emphasis on mathematical thinking. This review study was accompanied by interviews of hundreds of K-3 children and surveys of curricular and instructional practices in other countries. The research phase eventually established several basic principles to guide the curriculum development, including that (a) students learn mathematics from their own experiences obtained in an environment in which mathematics is rooted in real life, learners are actively involved in learning, and teachers provide learners with rich and meaningful mathematical contexts; (b) K-6 mathematics curriculum should build on an intuitive and concrete foundation, gradually shifting children to an abstract and symbolic foundation; and (c) teachers are the key factor in the success of any curriculum project, requiring adequate attention to their working lives.

Based on these principles, curriculum at each grade level went through a 3-year development cycle (1 year of writing, 1 year of extensive field testing, and 1 year of revising) with collaboration between mathematicians, education specialists, and classroom teachers. This unique development process has resulted in a comprehensive K-6 curriculum with a sequence of instruction carefully building upon and extending knowledge and skills obtained in the previous learning experience.

Led by Dr. Glenda Lappan at Michigan State University, the Connected Mathematics Project (CMP) is a research-based and field-tested middle school mathematics curriculum, different from many existing mathematics curricula because it takes a problem-centered curricular approach to develop powerful mathematical concepts, skills, and procedures with a focus on the ways of mathematical thinking and reasoning. CMP emphasizes the following principles reflecting both research and policy stances in mathematics education regarding what truly supports mathematical learning and teaching: (a) curriculum should be built around a number of "big" mathematical ideas, (b) underlying concepts, skills, or procedures should be in an appropriate developmental sequence; (c) an effective curriculum should be coherent connecting investigation to investigation, unit to unit, and grade to grade; (d) focus of classroom instruction should be inquiry and investigation of mathematical ideas embedded in rich problem situations, (e) mathematical tasks should be the primary vehicle for student engagement, (f) mathematical ideas should be explored deeply enough to enable students to make sense of them, (g) curriculum should develop student ability to reason effectively with information represented in multiple formats (graphic, numeric, symbolic, and verbal) and to

interchange flexibly among these representations, and (h) curriculum should reflect the information-processing capability of technology and appreciate how technology is fundamentally changing the way that people learn and apply mathematics.

Most reforms in mathematics instruction can be reasonably characterized as standards-based (referring to the 1989 NCTM Standards) and inquiry-oriented (referring to the hands-on and minds-on discovery approach). Different instructional reforms employ different strategies to promote standards and discoveries in mathematics. Some of them are research-grounded reforms, such as QUASAR (Quantitative Understanding: Amplifying Student Achievement and Reasoning), a national project particularly aimed at improving mathematics instruction for socially disadvantaged middle school students (see Silver & Stein, 1996). The most influential of the research-grounded instructional reforms in mathematics may well be the Cognitively Guided Instruction (CGI). Based on their research, Dr. Thomas Carpenter and Dr. Elizabeth Fennema at the University of Wisconsin at Madison led the development of the CGI approach to teaching mathematics (e.g., Carpenter, Fennema, Franke, & Empson, 1999).

Essentially, CGI encourages mathematics teachers to utilize what they know about the mathematical understanding of their students to select or create mathematical problems, promote students to think about the problems, stimulate students with a well-designed sequence of questions to guide them gradually to approach or discover the solutions, and facilitate discussion and idea-sharing throughout the entire instruction. The CGI instruction basics for teachers can be roughly summarized as: (a) giving sufficient waiting or thinking time for students to respond, (b) allowing free use of all materials to assist problem solving, (c) creating context of problem solving relevant to students, (d) reading a problem multiple times as necessary, (e) focusing on thinking process rather than product, (f) asking for and probing into students' explanations to learn about their mathematical thinking, (g) analyzing wrong answers from students with the whole class, (h) sharing solutions and strategies with the whole class, (i) promoting students to compare solutions to identify best problem-solving strategies, and (j) delaying symbol manipulations.

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LEARNING AND TEACHING READING

Helping students become good readers is an important part of the education process. Students need to be able to gain information from a variety of texts, know how to access texts to solve problems, and be able to critically examine information presented through texts. However, providing reading instruction that develops such abilities can be a complex and challenging task. Therefore, this entry was designed to provide readers with some of the more prominent theoretical positions and instructional techniques that can be used to provide students with excellent reading instruction. This entry is meant to serve as a brief introduction and broad overview for teaching reading.

PREVALENT THEORIES IN READING INSTRUCTION

Exemplary reading teachers often have strong background knowledge in theories of reading and can apply them to their instruction (Pressley, Allington, Wharton-MacDonald, Block, & Morrow, 2001). Theoretical knowledge allows teachers to make more informed decisions about their instruction and helps them know why one technique may be better than another. Three theories are presented in this section: (a) schema theory, (b) socio-cultural theory, and (c) identity theory. Each theory offers a different way to understand the reading process and reading instruction.

Schema Theory. Schema theory states that individuals will draw on their knowledge of the world in order to help them understand what they read (Anderson, 2004). How well people can understand what they read is connected to the topic being presented and the amount of knowledge they hold about it. Different interpretations of text can result from different amounts and types of background knowledge on a given topic. Schemas exist for such areas as the content being presented in a text (people, ideas, and places), the processes for reading and comprehending (knowing how to identify words, summarize, locate the main idea), and for different genres of text (mysteries, autobiographies, web sites). Reading comprehension is likely to be limited if a person does

not possess sufficient background information for the information being presented.

Socio-Cultural Theory. Socio-cultural theory suggests that people's experiences at home, at school, and in their communities can influence their reading development. Students' views of reading, and the purposes of it, are often shaped at home before they enter kindergarten. When students read books or are asked to engage in reading activities, they draw on previous social and cultural experiences to help them understand what they should do and why. Students use their knowledge about what is valued to inform how they read and comprehend texts. Students from diverse cultural backgrounds may engage with reading activities in ways that are not valued by schools and that teachers consider unacceptable. Understanding that students' different approaches to reading are connected to their social and cultural backgrounds can allow teachers to provide more personalized assistance.

Identity Theory. Identity theory suggests that how students read texts and apply reading instruction will be connected to how they identify themselves as readers and how they want to be identified by their peers, teachers, or family members (Gee, 2002). In school, teachers often communicate what it means to be identified as a good or poor reader. Students who identify themselves as poor readers may disengage from reading because they are afraid that doing so will publicly reveal their weaknesses and allow a negative identity to be assigned to them. Teachers may interpret students' decisions as a desire not to learn and may respond by limiting the personal help they provide. Students who are identified as good readers or who show they are trying to become good readers are more likely to receive additional, personalized help.

IMPORTANT GOALS IN READING INSTRUCTION

An overall goal of reading instruction is to help students learn how to create new knowledge from what they read and apply it to specific problems in every day life. Helping students reach such a goal requires instruction in many small goals throughout their school careers. The critical goals in reading instruction discussed here are to develop students' (a) concepts about print, (b) phonics knowledge, (c) vocabulary knowledge, (d) fluency, and (e) comprehension abilities.

Concepts about Print. For beginning readers, developing concepts about print is often the first step in learning how to read. Concepts about print include understanding (a) about how to hold, open, and turn pages in books,



Because students' reading levels likely vary, the type of reading instruction they need also varies. RICHARD HUTCHINGS / PHOTO RESEARCHERS, INC.

(b) that text is read from left to right and top to bottom, (c) that printed words have meaning, and (d) there is a one-to-one match between spoken and written words (Tompkins, 2006). As students develop their concepts about print they learn how to interact with texts in ways that will help them gain meaning from them as they read. Students should have developed strong concepts about print by the end of kindergarten.

Phonics Knowledge. Phonics is the correspondence between letters and sounds (Stahl, 2002). Knowing the sound that the letter *s* makes and that this sound is different from the letter *n* is an example of phonics knowledge. Reading cannot take place without understanding the sounds letters make. Readers rely on their knowledge of phonics whenever they come across an unknown word and must sound it out.

Vocabulary Knowledge. Vocabulary knowledge is critical to students' success at reading. A central goal of vocabulary knowledge is to help students develop full word knowledge (Allen, 1999). Full word knowledge means

that students know multiple meanings for a given word and/or different ways a given word can be used. It is not necessary, or possible, to have full word knowledge for every word. For most words, students will have partial knowledge. They will know one definition for the word and be able to use it in a sentence. The more words students have at the partial and full knowledge level, the better their comprehension of text. Students who have limited partial and full word knowledge in the early grades often have reading difficulties later in school if their vocabulary is not fully developed.

Fluency. Fluency is the ability to read words accurately, quickly, and with expression (Rasinski, 2006). Students with poor fluency abilities read words slowly, in isolation, and often without any inflection. They tend to focus more on how to say the words and less on what the words in a sentence or paragraph mean. Students may read at faster or slower rates depending on the difficulty of the text being read, and their fluency abilities may change depending on the genre of the text being read. Most students should be able to read fluently by third grade.

Comprehension. Comprehending texts involves extracting meaning as well as creating it (Snow & Sweet, 2003). Students must be able to locate main ideas and facts within a text and use that information to further their understanding of a concept or idea. Comprehension strategies can be taught that assist students in making meaning from texts. Examples of comprehension strategies include visualizing, asking questions, and summarizing what was read.

CHALLENGES IN CREATING EFFECTIVE READING INSTRUCTION

Helping students meet the above goals requires providing them with effective reading instruction. Effective reading instruction, however, is not solely about teaching students a specific set of skills and providing opportunities for them to apply what they have learned. Teachers must often be responsive to numerous challenges, including (a) instructing students with a variety of reading abilities, (b) being able to differentiate instruction, and (c) finding appropriate texts.

In any classroom, teachers may have students reading on grade level as well as several years above or below. By fourth grade, many students are likely to be classified as struggling readers (Curtis, 2004). Struggling readers read one or more years below grade level but do not have an identified learning disability. They need additional comprehension instruction and texts on their current reading level (Allington, 2007; Duke & Pearson, 2002).

Because students' reading levels likely vary, the type of reading instruction they need also varies. Teachers need to assess students' strengths and weaknesses as readers and then create a plan of instruction that is appropriate for their needs. Not all students need the same type of instruction, read the same texts, or participate in the same activities. Such instruction requires a great deal of organization as well as detailed knowledge about assessment, cognitive reading processes, and reading instruction.

As teachers attempt to differentiate their instruction, they typically find that the textbooks they want students to read are too difficult for most of their students to comprehend, even those reading on grade level. Difficult texts can hinder students' abilities to learn content and improve as readers (Fordham, 2006). Teachers need to seek out additional texts that students can read and learn from with limited support.

EFFECTIVE TECHNIQUES IN READING INSTRUCTION

In teaching reading teachers can use a number of effective techniques. The techniques discussed here serve as an introduction to some of the more popular methods used in the early 2000s.

Word Walls. Word walls (Cunningham, 2000) are alphabetical lists of high-frequency words that are posted in the classroom. They help students develop their word recognition and fluency abilities. Walls are added to on a regular basis as new words are introduced. Examples of words that might be found on word walls are *a*, *no*, *of*, *she*, *has*, and *when*.

Repeated Readings. Repeated readings help to develop students' fluency, word recognition, concepts of print, and comprehension abilities (Topping, 2006). Students read texts or have texts read to them multiple times. When teachers read aloud, students can follow along, read aloud, or echo the teachers' words. Teachers may wish to point to the words as they read aloud. Students can also engage in repeated readings by reading with a partner or listening to a book on tape.

Centers. Centers allow students to practice previously taught reading skills on their own or with peers. Effective centers require students to read, write, and discuss what they are doing. For example, students might be asked to read a story on their own, create a written response, and then share and explain their response with a peer.

Guided Reading. Guided reading allows students to apply reading strategies they have been taught while reading texts that are an appropriate difficulty for them (Fountas & Pinnell, 1996). Teachers work with four to six students who need similar types of reading instruction. Teachers first introduce a text that students can read on their own with little support. Teachers may provide a brief lesson that focuses on one or two strategies they want students to apply when reading. Teachers observe the students reading and provide additional assistance as needed. As students progress, they read more difficult books and use more strategies.

Authentic Instruction. Authentic instruction (Duke, Purcell-Gates, Hall, & Tower, 2006) can improve students' comprehension of non-fiction texts and increase their understanding of text features such as headings, indexes, and table of contents as early as second grade. Students read and use non-fiction texts in ways that mirror how texts are used outside school. For example, students might choose to read non-fiction texts in order to answer their own questions about the world. Authentic instruction helps students learn how (a) to generate their own questions about a topic being studied and then (b) use a variety of texts to locate their answers.

Literature Circles. In literature circles, students come together in small groups to read and discuss a common text (Daniels, 2001). Students read a selected portion of

the text, complete a written response, and engage in a discussion with group members. Students' responses can include: (a) summarizing, (b) creating a picture, (c) making connections to other texts or experiences, or (d) developing meanings for new vocabulary.

Literature circles help students learn basic reading skills such as how to summarize and locate main ideas in texts. They also help students learn more complex skills, including how (a) to discuss how they made sense of a text, (b) support their interpretations of text, and (c) make connections across multiple texts.

ASSESSING READING ABILITIES

Assessing students' reading abilities allows teachers to understand their strengths and weaknesses as readers and can be used to inform reading instruction. The assessments presented here are ones that teachers can do on their own and with few materials. Each provides information about students' abilities as it pertains to one or more of the five goals discussed earlier.

Running Records. Running records assess students' fluency and word recognition abilities (Davenport, 2002). Teachers listen to students read a portion of text aloud. They place a check mark next to the words students read correctly and note any miscues made. Miscues are "unexpected responses that do not match the text" (Goodman, 1994, p. 1096) and are not considered to be mistakes. Miscues are based on students' current knowledge about the topic they are reading as well as how language is constructed. Teachers review their notes to examine what, if any, miscues students made when reading and look for patterns that may exist.

Retelling. Retellings provide information about how well students (a) comprehend passages, (b) can identify story elements in narratives, (c) can identify main ideas, and (d) can communicate the passage in an order that makes sense (Gredler & Johnson, 2004). Students read a text silently and then explain the text as though they were talking to someone who had never read it before. If students leave out information, teachers may ask them a question to see if they can identify a particular aspect and then note that the help was provided.

Informal Reading Inventories. Informal reading inventories (IRI) allow teachers to determine the level of text students can read on their own. They also provide teachers with information about students' fluency, word recognition, and comprehension abilities. IRIs allow teachers to develop a broader picture of students' abilities to read and comprehend text (Cooper & Kiger, 2008).

In an IRI, students read aloud a passage for which they can accurately read a minimum of 90 percent of the words. Students read individual word lists, written from a pre-primer through twelfth-grade level, to determine the level of the passage they should read. Teachers conduct a running record as the passage is read. Students then retell the passage. Finally, teachers engage students in a series of comprehension questions which range in difficulty. Students' responses to the questions can provide insight about how well they can locate basic facts in text and make inferences.

Narrative Comprehension. Narrative comprehension assessments help determine young children's abilities to comprehend narrative texts (Paris & Hoffman, 2004). The assessment can be used with children who may or may not be able to read. Students examine wordless picture books, explain what they think is taking place, and answer comprehension questions. The assessment shows how well children can recall important details from text, make inferences, and make connections across the story.

RESEARCH BASED CURRICULUM PROGRAMS

There are numerous research-based curriculum programs teachers can use for reading instruction. The ones described here help students develop the goals described earlier and also draw on many of the effective teaching techniques. Teachers may find that these programs provide ways to address some of the instructional challenges they may encounter.

Concept-oriented Reading Instruction (CORI). CORI increases elementary students' abilities to read science texts while increasing their science knowledge and motivation (Guthrie, Wigfield, & Perencevich, 2004). Students receive instruction on how to apply comprehension strategies to science texts and learn how such skills as summarizing, asking and answering questions, and locating information. As students read and learn about science, their intrinsic motivation, or personal desire to learn, is expected to increase. In the CORI program, students participate in activities, including (a) engaging with the world outside school, (b) reading a variety of texts, and (c) working with others. The CORI program follows a consistent pattern of instruction that is intended to help students develop in each of these areas.

Four Blocks. The Four Blocks program helps beginning readers learn how to read and can also assist students in third and fourth grade who may have reading difficulties (Cunningham, Hall, & Sigmon, 2000). It is made up of four different approaches that students experience each

day: (a) guided reading, (b) self-selected reading, (c) writing, and (d) working with words. The Four Blocks program was designed to help teachers work with students who vary in their reading abilities but without relying on ability grouping. The Four Blocks approach helps students develop their phonics, comprehension, and fluency abilities.

Open Court Reading. The Open Court Reading program is a commercially produced series of basals for students in grades K-6 (McGraw Hill, 2002). The reading program was based on research findings that support students' development as readers. Teachers can use a script when teaching lessons.

In kindergarten and first grade, the emphasis is on teaching decoding skills. The emphasis on decoding often results in students having strong decoding abilities and a greater understanding of sound-letter relationships. Beginning in second grade, a greater emphasis is placed on developing comprehension and fluency. The program is often criticized for failing to help students develop abilities to discuss texts and do more than comprehend at a literal level (Wilson, Martens, & Arya, 2005). However, Open Court has also been recognized for aligning its instruction with reading research.

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Leigh A. Hall

LEARNING AND TEACHING SCIENCE

In 1983 the National Commission for Excellence in Education released its report, *A Nation at Risk*, announcing that U.S. schools had undergone a precipitous 20-year decline in the quality of mathematics and science education. The result was an intense new focus on research into how children learn science and how best

to teach it, culminating with the release of *Benchmarks for Science Literacy* (BSL) in 1993 by Project 2061 of the American Association for the Advancement of Science (AAAS) and *The National Science Education Standards* (NSES) in 1996 by the National Research Council (NRC) of the National Academy of Sciences. States and local school districts began instituting reforms and setting new standards.

However, after 15 years of standards-based reform American students exhibited little improvement in science achievement, and the achievement gap between majority students and economically disadvantaged and non-Asian minority students remained large. As the first decade of the 21st century neared its end it was apparent that 25 years of intensive research into learning and teaching science had not been effectively translated into classroom practice.

GOALS FOR SCIENCE LEARNING

Although there are ongoing efforts to encourage young people particularly females and minorities to pursue careers in science and technology, most researchers agree that the primary goal of K-12 science learning should be the creation of a scientifically literate population. Scientific literacy can be defined as a basic understanding of science, an appreciation of how science shapes society and culture, and the ability to reason scientifically. Many American adults lack the basic understanding of science that is required for making informed decisions about the many scientific issues affecting their lives. Therefore some educators go further, defining the primary goal of science education as providing students with the information and tools to become lifelong science learners who can adapt to the technological innovations that will be at the center of life in the 21st century.

For many educators learning goals have become synonymous with standards national, state, and local school district determinations of what students should know, understand, and be able to do in scientific subjects at specific grade levels. National standards are delineated in the BSL and NSES.

The 2007 NRC report, *Taking Science to School*, cites the development of scientifically proficient students as a key goal: "Students who are proficient in science:

1. know, use, and interpret scientific explanations of the natural world;
2. generate and evaluate scientific evidence and explanations;
3. understand the nature and development of scientific knowledge; and;
4. participate productively in scientific practices and discourse" (p. 36).

K-12 science education standards usually cite scientific thinking as a primary educational objective, and competence in scientific investigation as a goal from the earliest grades. According to these standards students should be able to:

- Formulate a question;
- Design an investigation;
- Analyze data;
- Draw conclusions.

HOW STUDENTS LEARN SCIENCE

It has been apparent since at least the late 1970s that traditional methods of teaching science lectures, textbooks, memorization of facts, theorems, and formulas have little to do with learning science. Furthermore with the explosion in scientific knowledge in the latter half of the 20th century, information was often obsolete before it could even be taught. Rather, a large body of research has clearly demonstrated that children learn science by doing science a process called inquiry-based learning, a form of constructivist instruction. With inquiry-based learning students investigate and discover on their own, in addition to reading and receiving instruction and guidance.

Inquiry-based science learning generally begins with observing, describing, and reflecting on objects and phenomena, leading to the formulation of questions and identifying assumptions about those objects and phenomena. Students then acquire more knowledge, using books and other sources to determine what is already known from experimental evidence. The next step in inquiry-based learning is to test explanations in a variety of ways. Students plan investigations and use tools to collect, analyze, and interpret data. They propose explanations, make predictions, and communicate their ideas, results, and conclusions.

Hands-on or exploratory learning stresses the importance of scientific experiences for developing skills. For young children these skills include observation and comparison, measurement, and classification, in addition to communication. More advanced skills involve inferring relationships, formulating hypotheses, and predicting outcomes. Students learn to identify and control variables, methods of gathering, organizing, and recording data, and how to draw conclusions.

CONCEPTUAL CHANGE

In contrast to the old-fashioned view that young children think in simple concrete terms, research has shown that the thinking of even very young children is quite sophisticated and that they are capable of thinking in both concrete and abstract terms. They utilize a range of reasoning processes including causal reasoning and

distinguishing between reliable and unreliable sources of information that form the basis of scientific thinking.

Perhaps most importantly a large body of research has shown that children do not start school as blank slates upon which scientific knowledge can be written. Rather, children come to school with their own conceptual resources, already knowing a great deal about the natural world and having formulated their own scientific ideas. However, children also vary greatly in their early learning experiences and opportunities, which may be influenced by race, ethnicity, language, gender, culture, and socioeconomic background. Thus they differ in their conceptual resources and in what they are capable of learning at a given age.

Because many scientific concepts are not intuitive, children often have deeply entrenched misconceptions about nature, and these misconceptions often prove to be barriers to learning science. In the late 1970s cognitive researchers began interviewing students to assess their understanding of scientific concepts. They found that many students had trouble, not because the concepts were inherently difficult, but rather because they conflicted with the students' entrenched misconceptions. Furthermore, the memorization of scientific facts and formulas could disguise these underlying misconceptions. Among the topics about which students often hold misconceptions are force and motion, the particulate theory of matter, heat and temperature, electricity, optics, and evolution.

Learning science requires not just knowledge of key facts and concepts but an understanding of how facts and concepts relate to each other and their implications and applications. This may require a large-scale reorganization of knowledge and in-depth conceptual change to overcome prior misconceptions. These processes take time and require that children work with the same ideas and concepts in different ways over weeks, months, and years. According to Posner and colleagues (1982), four conditions must be met for conceptual change to occur: Students must be dissatisfied with their current conceptions because they conflict with observations or contain discrepancies; students must understand the new idea; they must be able to reconcile the new idea with their own ideas; and they must find the new idea useful and amenable to further testing.

Strike, Posner, and colleagues' general model of conceptual change applied the philosophy of science to the learning of science. Since then the conceptual change approach has become a basic tenet of teaching science. By first assessing prior knowledge, students' knowledge can be built upon, and misconceptions and potential misunderstandings can be addressed. The goal is for students to discover or recreate concepts on their own. Posner and colleagues proposed that having students work through problems with different explanations and compare the results led the students to recognize the shortcomings of their explanations and strengthened the scientific concept.

FURTHER THEORIES OF SCIENCE TEACHING

In addition to the importance of conceptual understanding, most contemporary theories of science teaching involve support for constructivist practices active, inquiry-based, and collaborative strategies that utilize experimentation and other scientific methods to teach scientific reasoning within the context of specific science content. Because science is, in essence, a social process, research suggests that it should be taught as such, with emphasis on working in groups and whole-class and small-group discussions, questioning, and communication that enhance the development of scientific literacy.

Scientific discussions, explanations, and evaluation of evidence differ from those activities in other subjects and in everyday life. Students need instructional support to learn the language and practices of scientific experimentation, interpretation, and discussion. Many attempts at hands-on discovery learning have proved unproductive due to lack of guidance. In constructivist inquiry-based learning the teacher acts as a coach, introducing basic information and new concepts as required and guiding group discussions.

Finally, there is a consensus among researchers that science curricula, textbooks, national, state, and local standards and assessments contain far too many disconnected topics. Most research indicates that it is far more productive to focus on core ideas, which are explored in depth progressively through grades K-8.

EFFECTIVE INSTRUCTIONAL STRATEGIES

There exists a large body of research on effective means for promoting conceptual change. Building from misconceptions can be effective: For example, young children may find that their preconceived ideas about why weather changes conflict with their observations, so the teacher introduces the concepts of air movement and weather fronts. In a conceptual change approach the teacher provides an introduction, including a review and motivating experiences. This is followed by focus, in which the students observe an event, pose a problem, and formulate ideas and explanations. The challenge presents a conflicting question or discrepancy and the students then develop new ideas. Application involves solving problems using the new ideas and engages the students in discussion and debate. Finally, the teacher or students, or both, summarize the results and connect them with other lessons.

Discovery argumentation, using cycles of model-based reasoning, has been found to be effective with students from elementary school through high school. The *bridging analogies* strategy introduces a target situation in which the

students' initial intuition conflicts with a scientific principle. This is followed by an *anchoring intuition*, a situation in which intuition agrees with scientific principle. At first the students see the two situations as completely different. A series of bridging analogies or intermediate models are then presented in which the situations are intermediate between the target and the anchor. Following cycles of reasoning the students develop a new model that they can test. Nuthall found that upper-elementary students required three or four experiences with new scientific ideas before the concepts enter their long-term memory.

Know-Want-Learn (KWL) charts help students visualize what they already know and what they want to learn and then conclude with what they have learned. Hershberger and colleagues (2006) have modified KWL to Know-Learning-Evidence-Wonder (KLEW), emphasizing observation, evidence, and further investigation. Yet another variation includes "know and think," to encourage students to share their initial ideas and realize that what they think they know can change as a result of inquiry.

Research indicates that from the earliest grades designing and conducting experiments and investigations helps students understand scientific concepts. With guidance students can follow the scientific method by formulating hypotheses and designing and carrying out experiments and collecting evidence that is used to evaluate the hypotheses. This process conforms to several of the teaching guidelines presented in the AAAS's Project 2061 research-based *Science for All Americans* (1989):

- "Teaching should be consistent with the nature of scientific inquiry."
- "Science teaching should reflect scientific values."
- Scientific knowledge should be presented in the context of the processes by which it was arrived at.

Learning-cycle approaches can actively engage students in the processes of science through collaborative inquiry into interesting and familiar phenomena. First fully described in 1967 by Karplus and Thier, the learning-cycle approach alternates hands-on exploration and applications and "minds-on" activities through interactions with the teacher, other students, and texts. Over the years numerous studies have supported the effectiveness of the learning cycle, particularly when all three phases of the cycle are utilized, and exploration precedes the introduction of concepts and terminology.

Rodger W. Bybee's 1997 5-E model is a learning-cycle modification: Engage, Explore, Explain, Elaborate, and Evaluate. The Launch, Explore, Summarize (LES) model is a condensed version of the 5-E model. Aaron D. Isabelle (2007) has described applying the "storyline approach" to LES to incorporate conceptual change.

Using questions, objects, or visuals the teacher elicits the students' prior knowledge and discusses the concept addressed in a story. The teacher then reads a story from the history of science, discusses the factual and fictional aspects of the story, and connects the ideas in the story with the original discussion.

Studies have repeatedly found that discussion is an important science learning tool for even the youngest students. Effective "talking science" can include practice using scientific terms in sentences, discussing intuitive theories, reading different types of science writing, and translating between scientific and colloquial questions and statements.

Finally, the guidelines set forth in *Science for All Americans* include:

- Teaching should include the history of science and societal and multicultural perspectives.
- Inquiry should lead to a satisfying conclusion.
- Curiosity and creativity should be fostered.
- Questioning should be encouraged and dogma avoided.
- The aesthetics of scientific phenomena should be emphasized.
- Local resources should be utilized.
- "Teaching should take its time."

Consistent with this last point is a recommendation from researchers and reformers that students should study in great depth the core explanatory ideas in science rather than quickly traversing many different ideas, which permits only shallow understanding.

APPROPRIATE ASSESSMENT

Research has shown that large-scale standardized tests alone are not a valid method for assessing scientific understanding. Generally these tests measure knowledge of discrete pieces of information rather than structured knowledge of science. However ongoing, appropriately designed assessment is an important component of science teaching and learning. Performance-based or alternative assessments may include:

- Performing a task or experiment
- Describing an exploration or the solution to a problem
- An essay
- A portfolio
- Student-teacher discussions
- Worksheets
- Journals

Formative assessment is used by teachers to adapt instruction and by students to improve learning. Formative assessment involves a three-step feedback process:

- Setting a learning goal
- Assessing the gap between the goal and the student's understanding
- Using feedback to eliminate the gap.

For example, a teacher may learn from a series of questions that students have not understood a concept and decide to modify a subsequent lesson to reinforce that concept. Likewise, students may modify their own work after comparing it to the teacher's example.

Achievements to be assessed include:

- Inquiry skills
- Knowledge and understanding of facts, concepts, principles, laws, and theories
- Understanding of the nature and functions of science
- Scientific reasoning abilities
- Using science to make decisions and develop opinions on issues
- The ability to communicate clearly about science.

The Lawrence Hall of Science's Science Education for Public Understanding Program (SEPUP), an issue-based 6-12 curriculum, works with the University of California's Berkeley Evaluation and Assessment (BEAR) Center. The SEPUP/BEAR system scores students on five concepts and abilities:

- Designing and conducting investigations
- Identifying objective scientific evidence and evaluating various solutions to a problem on the basis of evidence
- Understanding concepts and their problem-solving applications
- Communicating scientific information, including explaining methodologies, presenting results, and justifying conclusions
- Group interactions including collaborating on tasks and contributing ideas.

CHALLENGES TO EFFECTIVE INSTRUCTION

Research has consistently identified teacher proficiency as a major challenge in science education. Most K-8 teachers have little background in science and little training in teaching science. Schools often struggle just to teach basic literacy and math skills, and the science curriculum may

be nonexistent. Many teachers tell researchers that the major impediments to their science teaching are their own lack of knowledge combined with inadequate facilities, supplies, and preparation time. Furthermore, children arrive at school with very different experiences and attitudes toward science. Recognizing and addressing these differences poses a special challenge to teachers.

The inquiry-based approach, which requires teachers to guide student experimentation and discussion while incorporating specific learning goals, is a major paradigm shift for many teachers. In addition preparation for government-mandated high-stakes standardized testing and the demand that teachers strictly adhere to applicable science standards are often incompatible with student-centered, hands-on science instruction.

Finally, most science curricula and textbooks provide neither continuity for students nor guidance for teachers. Project 2061's analysis of science textbooks found them to be of almost uniformly poor quality, superficially covering a large number of topics with little attention to concepts. Although researchers agree that the science curriculum is far too broad, there is little agreement about which topics to emphasize and which to eliminate.

RESEARCH GROUNDED CURRICULUM PROJECTS

Concept-Oriented Reading Instruction (CORI) is a research program that integrates science inquiry and reading using the following support strategies to motivate students:

- Student autonomy
- Competence
- Learning goals
- Real-world interactions.

Elementary students are introduced to a complex domain such as ecology or the solar system. After several weeks they select a specific topic within the domain and choose related books to read. They receive help in finding and using resources and communicating what they have learned. Students also participate in related activities such as field trips, collecting, and experimentation. In a study of third and fifth graders in three schools, CORI students, as compared with students in the traditional science program,

- Reported greater interest in reading science
- Exhibited better reading comprehension of science texts
- Scored higher on standardized tests.

Several innovative curricula connect students with other students and with professional scientists. In the Global Learning and Observations to Benefit the Environment (GLOBE) project K-12 students worldwide study earth sciences in partnership with scientists. GLOBE has been shown to improve math, science, and geography skills, and students and teachers report increased interest in and awareness of environmental issues and satisfaction at having contributed to scientific research.

The Web-based Integrated Science Environment (WISE), developed by Marcia Linn and her colleagues, uses browser-based inquiry activities that enable middle and high school students to critique evidence, compare scientific arguments, and design solutions to scientific problems. WISE projects are interdisciplinary scientific issues and include hands-on data collection, online modeling, and design activities, as well as peer interaction and collaboration. The Center for Learning Technologies in Urban Schools (LeTUS) has developed very influential curriculum projects. The center is a collaboration of researchers at the University of Michigan and Northwestern University with Detroit and Chicago public schools. The center has developed inquiry-based instruction that has been shown to promote growth in conceptual understanding and reasoning. Students engage in projects around “driving questions,” core explanatory questions about interesting topics that motivate inquiry. The North Dakota State University World Wide Web Instructional Committee (WWWIC), an interdisciplinary research team, has developed multi-user, interactive virtual environments (IVEs) for teaching high-school science. In “Geology Explorer” students examine an alien planet and conduct geologic tests. In “Virtual Cell” students enter a simulated cell and perform biological experiments. A decade of research has shown that IVEs improve student achievement and problem-solving skills.

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Margaret Alic

LEARNING AND TEACHING WRITING

Writing is a very demanding and complex task. Even a seemingly simple text, such as *Cat in the Hat*, can require considerable effort and expertise. It took Dr. Seuss well over a year to write the book, and he noted that “every word is a struggle every sentence like a pang of birth.”

Writing is a goal directed and self-sustained activity requiring the skillful management of the writing environment; the constraints imposed by the writing topic; the intentions of the writer(s), and the processes, knowledge, and skills involved in composing (Zimmerman & Reisemberg, 1997). It entails much more than this, however, as writing is a social activity involving either an implicit or explicit dialogue between writer(s) and reader(s). Writing is further shaped by the community of the writer. For example, written discourse differs considerably amongst a community of friends sharing ideas via email and texts written by biologists (Nystrand, 2006). Moreover, writing competence in one social community does not ensure competence in another. For instance, a good technical writer may not be a good novelist. What and how people write is also influenced by the cultural, societal, institutional, political, and historical background in which they are situated (Schultz & Fecho, 2000). To illustrate, students’ concepts about writing are shaped, at least in part, by institutional decisions about pedagogy and curriculum. If a school’s writing program places a heavy emphasis on correct form, students’ revising efforts will most likely involve editing. A different approach to revising is likely, though, if form is deemphasized and meaning and process are stressed.

WRITING THEORIES AND MODELS

Given its complexity, it is not surprising that there is currently no model or theory of writing that fully or adequately captures it. One conceptual approach to studying writing focuses mostly on the individual writer and concentrates on understanding the cognitive and the motivational processes involved in composing (Graham, 2006). This cognitive or cognitive/motivational approach is exemplified in an influential model of writing developed by Hayes (1996). In his model, he takes into account, at least in part, the interaction between the task

environment for writing and the internal capabilities of the writer. The task environment includes both a social component (e.g., the audience, other texts read while writing, and collaborators) as well as a physical component (e.g., text read so far and the writing medium, such as a word processor).

Internal factors include four main elements. First, cognitive processes: text interpretation, reflection, and text production. These processes allow the writer to form an internal representation of the writing task that can be acted upon; devise a plan to reach one or more writing goals; draw conclusions about the audience and possible writing content; use cues from the writing plan or text produced so far to retrieve semantic information that is then turned into written sentences; and evaluate plans and text and modify them as needed. Second, motivation, which includes the goals, predispositions, beliefs, and attitudes that influence the writing process. Third, long-term memory—knowledge of the writing topic and audience as well as linguistic and genre knowledge, including task schemas that specify how to carry out particular writing tasks. Fourth, working memory, which serves as an interface between cognitive processes, motivation, and memory, providing a space for holding information and ideas for writing as well as carrying out cognitive activities that require the writer’s conscious attention.

In the model proposed by Hayes (1996) only limited attention is devoted to the social nature of writing. The influence of writing community, culture, society, institution, politics, and history are mostly ignored. One or more of these factors are captured in sociocultural theories of writing. For example, Russell (1997) developed a theory for explaining how macro-level social and political forces influence micro-level writing actions and vice versa. A basic unit in this model is an activity system, which examines how actors (an individual, dyad, or collective—perceived in social terms and taking into account the history of their involvement in the activity system) use concrete tools (e.g., writing) to accomplish some action with some outcome (this is accomplished in a problem space where subjects use tools in an ongoing interaction with others to shape an object over time in a shared direction).

Russell’s theory also employs the concept of genre, “as typified ways of purposefully interacting in and among some activity system(s)” (p. 513). Genres are stabilized through regularized use of tools within and among individuals, creating a relatively predictable way of interacting with others, but they are only stabilized-for-now structures, as they are subject to change depending upon the context. Newcomers to an established activity system appropriate some of the routinized tools used by others (e.g., a particular structure for writing), but interactions between and among individuals and activity systems can change typified ways of acting



Primary grade students mastering basic writing skills. © PHOTOCRETE, 2008. USED UNDER LICENSE FROM SHUTTERSTOCK.COM.

(i.e., genres), as they may be modified or abandoned in response to changing conditions. Activity theory provides a method for describing and analyzing activity systems for writing and how they interact with macro-level activity systems involving academic discipline, culture, institution, society, and so forth.

To illustrate activity theory in action an example is given below of how political, institutional, societal, community, cultural, and historical factors might influence what happens in a second-grade class focusing on story writing. In this particular instance, the teacher's decision to concentrate on story writing was shaped by the district curriculum guide and the state's high-stakes testing program (story writing was emphasized in both) as well as the teacher's and her students' interest in story telling. The way in which story writing was introduced and taught was influenced by the teachers' beliefs about how to teach (which was previously influenced by her teacher preparation program, her own teachers as a child, and the culture of the school). In providing story writing instruction, the teacher used the same general routinized approach that she had applied when teaching personal narratives and other types of writing. Students also continued to generate papers using the same general script they had been using since the

start of the school year: selecting a topic, briefly planning what to say, making a draft, sharing it with a peer, revising and editing it, and sharing part or all of it with the class and at home.

While this script for writing was followed by most students, some of them modified it by eliminating a step (e.g., planning) or adding ones (e.g., sharing plans with a peer). The last of these modifications had a ripple effect in the classroom, as almost all of the students started sharing their plans with a peer. To provide students with concrete examples of stories, the teacher read traditional stories to the children (stories taken from her own dominant culture). However, one child brought to class a book of stories from Africa. He asked the teacher if they could try writing stories like those in his book. This request changed the focus of story writing in the class, as the teacher encouraged students to write stories from cultures other than their own, and several of the students' parents were asked to share their favorite stories from their culture with the class.

WRITING DEVELOPMENT

Not surprisingly, these two basic approaches to conceptualizing writing have led to different views of writing

development. For example, Graham (2006) argued that four catalysts spur writing development. These involve changes in writer's strategic or self-regulatory behaviors (e.g., becoming more sophisticated in planning), motivation (e.g., heightened sense of efficacy about one's writing capabilities), knowledge (e.g., increased knowledge about the attributes and structures of different types of writing), and skills (e.g., automatization of handwriting and spelling and proficiency in sentence construction). These catalysts all reside within the individual, and this approach to development is consistent with cognitive/motivational theories of writing.

In contrast, Schultz and Fecho (2000) offer a different view of writing development—one that is consistent with sociocultural theories of writing. They argue that writing development reflects and contributes to the social, historical, political, and institutional contexts in which it occurs; varies across the school, home, and work contexts in which it is situated; is shaped by the curriculum and pedagogical decisions made by teachers and schools; tied to the social identity of the writer(s), and is greatly influenced by the social interactions surrounding writing.

These two approaches (and the theories underlying them) clearly privilege different aspects of writing and writing development. However, neither is complete, as cognitive/motivational views pay relatively little attention to context, and sociocultural views do not adequately address how individual factors shape writing development.

LEARNING GOALS AND TEACHING WRITING

The primary learning goals in schools during the primary grades are for students to master basic writing skills (such as handwriting, spelling, grammar, and sentence construction); begin to develop the strategic process needed to write effectively (e.g., planning, gathering and organizing information, monitoring, evaluating, revising, and so forth), acquire fundamental knowledge about writing (e.g., knowledge about the characteristics of good writing, needs of audiences, and so forth), learn to use electronic tools for composing (e.g., word processing and publishing tools), start to develop a life-long love for writing, and use writing for various purposes (e.g., communicate, inform, entertain, persuade, reflect, and so forth).

As students move into middle and high school, these same goals remain in play (although it is typically assumed that students have mastered some basic skills such as handwriting and spelling), with an emphasis on increasing students' competence as writers. Although students continue to write for a variety of purposes, using writing as a method for displaying subject-matter knowl-

edge and as a tool for learning about such content becomes more prevalent. In some content areas (e.g., history), discourse genres typically used by that academic profession may be emphasized. At the college level, instructors may continue to emphasize more general writing development (especially for weaker writers), but as students enter classes in their majors, it is expected that they will learn the discourse styles and genres of that academic domain.

While states, school districts, and most schools have relatively clear goals for what students are to learn, there is no consensus on how to teach writing. The most prominent approach to writing instruction in the United States is the process approach (this is the only research-grounded general approach to writing instruction that has been extensively studied). This method is based on both cognitive/motivational and sociocultural views of writing. It involves extended opportunities for writing; writing for real audiences; engaging in cycles of planning, translating, and reviewing; personal responsibility and ownership of writing projects; high levels of student interactions, creation of a supportive writing environment; self-reflection and evaluation; and personalized individual assistance and instruction. This approach may only be effective, however, with teachers who are committed to its use and are trained in how to implement it. In a review of 21 studies, Graham and Perin (2007) found that this approach had little to no impact when these conditions were not met.

One concern with the process approach is that there may not be enough emphasis on explicitly teaching skills and strategic processes. The available empirical evidence indicates that directly and systematically teaching sentence construction skills and strategies for planning, revising, and editing as well as summarizing information can have a positive impact on improving the quality of students' writing (Graham & Perin, 2007). There is also some evidence that embedding more systematic instruction within the context of the process approach has a value-added impact on students' writing.

Students' writing skills can also be enhanced by providing them with assistance that helps them carry out one or more writing processes. Effective forms of support include clear and reachable writing assignment goals; help from peer(s) to carry out some aspect of the writing process; activities that help students generate, organize, and evaluate possible ideas for writing; examples of good writing that serve as a model for students; and technological supports such as word processing (Graham & Perin, 2007).

At present, it is not clear how these forms of effective writing practice should be combined or what amount of each should be provided. It is important to note that the

identification of evidence-based practices in writing is far from complete. There are many practices in which there is at least some empirical evidence to support their effectiveness (this includes practices such as teaching vocabulary as a way to improve writing and having students assess their writing using a rubric). It is also certain that there are many scientifically untested practices used by teachers that will prove to be effective when evaluated by researchers. The study of exceptional teachers of writing provides one possible approach for identifying practices that merit such assessment.

There is one research-grounded treatment that has a strong impact on improving how well students write, especially struggling writers. This involves explicitly teaching students how to plan, revise, and edit their papers (teachers model how to use strategies and provide students with guided practice aimed at promoting effective and independent use). In 20 experimental studies reviewed by Graham and Perin (2007), such instruction improved the quality of students' writing in every single investigation. Particularly effective was a specific model for teaching writing strategies. The Self-Regulated Strategy Development model (see Harris, Graham, & Mason, 2006) not only involves modeling and guided practice, students are also taught the knowledge and skills needed to apply the strategies as well as procedures for regulating their use. Furthermore, this instruction is criterion- instead of time-based. This means that instruction continues for youngsters until they reach mastery, instead of providing a set number of instructional sessions.

ASSESSMENT AND EVALUATION OF WRITING

Many procedures used to assess and evaluate writing quality are drawn from cognitive theories of writing. A cognitive approach to writing supposes that text production is a finalized and complete activity, in which several complex cognitive processes are activated. Therefore, assessment and evaluation of writing quality relies on the final product. Past research has focused on two measures of writing quality: subjective and objective. Subjective (or qualitative) measures use raters to evaluate writing quality based on one or more scales, whereas objective (or quantitative) measures consist of countable indices of writing sub-components.

Holistic, analytic, and primary-trait scoring are the three main subjective methods of evaluating writing quality. Frequently used, holistic scoring reflects a rater's overall impression of the writing, compared to other writing samples in the group. Holistic scoring is norm-referenced; that is, it provides a single score that ranks students within a particular group. Some holistic scoring methods also are criterion-referenced, using pre-determined characteristics

of writing quality in the scoring process. Holistic scoring is the most economical method of scoring direct writing assignments (Scherer, 1985). One drawback to holistic scoring is that it does not provide instructional guidance for areas of concern within a writing sample.

Analytic scales and primary-trait scales address the need for assessment to inform instruction. Analytic scales are criterion-referenced and provide separate scores in pre-determined areas of good writing, such as organization or development of the composition. They are the most reliable of all direct scoring assessment procedures (Scherer, 1985), although they take longer to score. One specific analytic scale, 6 Traits (and its later version: 6 + 1 Traits) has been used extensively in elementary and secondary schools. The 6 + 1 traits involve ideation, organization, voice, vocabulary sentence structure, conventions, and publication. Although developed for assessment, 6 Traits has been used as a method for writing instruction (see Graham & Perin, 2007, for a meta-analysis on the use of rubrics as an instructional method) and curriculum alignment, despite a lack of empirical research supporting its use for these situations.

Similar to analytic scales, primary trait scales also are criterion referenced. However, they differ from analytic scales in that the scoring guide is developed based on the specific purpose of each writing assignment. They can be used to assess the primary goal of the writing assignment (e.g., coherence of an argument) or to reflect genre-specific requirements (e.g., plot development).

Although in widespread use in both teaching and research, subjective measures of writing quality require scorer judgment and may be unreliable if extensive training and scoring directions are not provided. Other factors increase the variability of human scorers, such as fatigue, mood, and motivation (Freedman & Calfee, 1983). Computer-based scoring can parallel human graders; however, some scholars object to the validity of automated essay scoring (e.g., Ericsson & Haswell, 2006).

Reflecting a more sociocultural theory of writing, portfolio assessment collects several writing samples across different writing purposes and genres to gain a broader view of a student's writing ability. A good model of portfolio assessment includes the final product along with the drafts and revisions, allowing teachers to evaluate progress from start to finish. Some researchers advocate that portfolio assessment encourages students to develop writing over multiple occasions, rather than just a single sitting. Others believe that portfolios encourage more collaboration with peers rather than being teacher-centered, and that they are more consistent with teaching pedagogy (Murphy, 1994). Some districts and states collect student writing portfolios and then assess the written compositions using holistic, analytic, or primary-trait scoring methods. One concern

with portfolio assessment is the time and cost to gather and evaluate each student's writing, whether in the classroom or in large-scale testing.

Objective measures of writing include the number of words written, percentage of correctly spelled words, or percentage of correct word sequences, among others. Objective measures are moderately correlated with subjective measures of writing quality (Espin, Shin, Deno, Skare, Robinson, & Benner, 2000); however, they often focus on one aspect of writing and serve as indirect measures of writing quality. Generally, these measures have been used in formative evaluation, allowing teachers to make changes to a student's instructional program based on frequent assessment.

Concerns over how to adequately assess and evaluate the quality of student writing have plagued the field for decades. The multiple purposes of writing, a lack of agreement on how to teach writing, and the increase of large-scale writing assessment have contributed to the debate. Any writing assessment method must meet standards of reliability and validity, while addressing legitimate needs for efficiency and a linkage between assessment and instruction.

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LEARNING DISABILITIES

Children and adults classified as learning disabled (LD) are individuals of normal intelligence who suffer mental information processing difficulties that influence their academic performance. Several types are referred to as LD, reflecting a heterogeneous group of individuals with intrinsic disorders that are manifested by specific difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities (Hammill, 1990). These definitions assume that the learning difficulties of such individuals are as follows:

1. Not due to poor instruction, but to specific psychological processing problems (e.g., remembering the association between sounds and letters) deriving from a neurological, constitutional, and/or biological base;
2. Not due to inadequate opportunity to learn, general intelligence, or to significant physical or emotional disorders;
3. Not manifested in all aspects of learning but specific to an academic behavior, for example, deficits in reading, but not arithmetic.

In several LD studies, children and adults with LD are operationally defined as having general IQ scores above 85 and standardized reading and/or math scores below the 25th percentile. The incidence of children with LD is conservatively estimated to reflect 2% of the public

school population. LD is the largest category of children served in special education.

ASSESSMENT ISSUES

Problems of definition have severely affected the field of LD as a discipline because considerable latitude exists among psychologists in defining LD. This latitude is influenced by social/political trends as well as non-operational definitions of LD. The field is further exacerbated by the fact that the number of individuals classified with LD increased dramatically between 1985 and the early 2000s.

One impediment to advances in the field is unresolved issues related to discrepancy and another related to the importance of IQ. Traditionally, studies of children with LD have relied primarily on uncovering a significant discrepancy between achievement in a particular academic domain and general intellectual ability. The implicit assumption for using discrepancy scores is that individuals who experience reading, writing, and/or math difficulties, unaccompanied by a low IQ, are distinct in cognitive processing from slow or low achievers (e.g., Fletcher et al., 1992). This assumption is equivocal (e.g., Hoskyn & Swanson, 2000; Stuebing et al., 2002). Many studies have compared LD children with reading disabilities (RD, i.e., children with discrepancies between IQ and reading) with non-discrepancy defined poor readers (i.e., children whose IQ scores are in the same low range as their reading scores) and found that these groups are more similar in mental processing difficulties than different (Hoskyn & Swanson, 2000; Stuebing et al., 2002). As a result, some researchers have suggested dropping the requirement of average intelligence, in favor of a view by which children with reading problems are best conceptualized as existing at the extreme end of a continuum from poor to good readers (Stanovich & Siegel, 1994).

With the Individuals with Disabilities Education Improvement Act (IDEA, 2004), the United States federal government recognized potential problems with the IQ-discrepancy method by formally stating that the IQ-achievement discrepancy method was not necessary for LD diagnosis. To facilitate identifying children with LD, three criteria were added to the law:

States are not required to use a severe discrepancy between intellectual ability and achievement.

The procedure must include a process in which the children's response to scientifically based research interventions is considered in the assessment process.

States are permitted to use alternative research-based procedure to determine a specific learning disability.

Changes in the law were based on the assumption that IQ levels in children with low reading scores were irrelevant to a valid classification of LD. One alternative approach is referred to as response to instruction (RTI).

The goal of RTI is to monitor the intensity of instruction and make systematic changes in the instructional context as a function of a student's overt performance. This is done by considering various tiers of instructional intensity. As of 2008, RTI as an assessment approach for defining LD has a weak experimental base. There have been no controlled studies randomly assigning children seriously at risk for LD to assessment and/or delivery models (e.g., tiered instruction vs. special education (resource room placement) that have measured outcomes on key variables (e.g., overidentification, stability of classification, academic and cognitive growth in response to treatment). In addition, different states and school districts variously interpret how RTI should be implemented further undermining any uniformity between the science of instruction and assessment of children at risk for LD.

The validity of using discrepancy as a basis for defining LD, however, is not easily confirmed. Hoskyn and Swanson (2000) found in a synthesis of the literature that although children with RD and poor readers share some deficits in phonological processing and automaticity (naming speed), the RD group's performance was superior to poor readers on measures of syntactical knowledge, lexical knowledge, and spatial ability (also see Fuchs et al., 2000). Another finding was that cognitive differences between the two ability groups are more obvious in the earlier grades. Perhaps more important, a meta-analysis of the intervention literature (Swanson & Hoskyn, 1998) found that students with LD and low achievers differ in the magnitude of their responsiveness to treatment. Review of several intervention studies suggests that students who have low reading scores (25th percentile) but average IQ scores were less responsive to interventions than children whose reading and IQ scores were in the same low range (25th percentile) (also see Swanson & Hoskyn, 1998, pp. 300-301).

Typically, researchers who study the processing difficulties of children with LD do not use discrepancy criteria (Swanson, 1989). The majority of researchers rely on cut off scores on standardized measures above a certain criterion of general intelligence measures (e.g., standard score > 85) and cut-off scores below a certain criterion (e.g., standard score < 85) on primary academic domains (e.g., reading and mathematics).

SUBTYPES

Because of the heterogeneity of individuals classified as LD, several subtypes have been discussed in the literature. However, some subtypes have been considered invalid because (a) the particular subtypes do not respond differently to instructional programs when compared to other subtypes, and/or (b) the skills deficient in a particular subtype is not relevant to the academic areas important in the school context.

There are two subtypes, however, with extensive research that are relevant to the school context: reading disabilities and mathematical disabilities. These subtypes are defined by standardized (normed referenced) and reliable measures of intelligence and achievement. The most commonly used intelligence tests are from the Wechsler measures and common achievement tests that include measures of word recognition or identification (i.e., Wide Range Achievement Test, Woodcock Reading Mastery Test, Kaufman Test of Educational Achievement, Peabody Individual Test) and arithmetic calculation (all the aforementioned tests and the Key Math Diagnostic Test). In general, individuals with IQ scores equal to or above a Full Scale IQ score of 85 and reading subtest scores equal to below the 25th percentile and/or arithmetic subtest score equal to or below the 25th percentile constitute two high incidence disorders within LD: reading disabilities and math disabilities.

In terms of reading disabilities, Siegel (1989; 2003) argues that fundamental to evaluating reading disabilities is focus on word recognition measures because they capture more basic cognitive processes and responses than reading comprehension. Her research shows that difficulties in phonological processing are fundamental problems for children with reading disabilities, a problem that continues to adulthood. She also indicates that there is no evidence to suggest that development of decoding skills is a result of a specific instruction in grapheme-phoneme conversion rules. Her work and the work of others find that there are three processes critical in analysis of reading disabilities: those related to phonological processing (ability to segment sounds), syntactical processing, and working memory (combination of transient memory and long term memory).

In terms of math disabilities, Geary (1993, 2003) finds that children with arithmetic problems do not necessarily differ from academically normal peers in terms of the types of strategies used to solve simple arithmetic problems. Differences, however, are found in the percentage of retrieval and counting errors. Children with math disabilities have long-term memory representations of arithmetic facts that are not correct. He provides taxonomy of three general subtypes of mathematical disability: those related to procedural errors,

those related to semantic memory, and those with visual/spatial difficulties. He indicates that the ability to retrieve basic arithmetic facts from long-term memory is a defining feature of math disabilities.

HISTORY AND INSTRUCTIONAL TRENDS

The term *learning disabilities* was first introduced in a speech by Samuel Kirk delivered in 1963 at Chicago Conference on Children with Perceptual Handicaps. Clinical studies prior to 1963 showed that a group of children who suffered perceptual, memory, and attention difficulties related to their poor academic performance but who were not intellectually retarded, were not being adequately served in the educational context.

Regarding the history of LD as a field, Wiederholt (1974) indicated that its unique focus was on identifying and remediating specific psychological processing difficulties. Popular intervention approaches during the 1960s and 1970s focused on visual-motor, auditory sequencing, or visual perception training exercises. Several criticisms were directed at these particular interventions on methodological and theoretical grounds.

By the late 1970s, dissatisfaction was expressed with a processing orientation to remediation of learning disabilities and with the influence of federal regulations in the U.S. (Public Law 94-142) remediation programs focused on basic skills such as reading and mathematics. The focus on basic skills rather than psychological processes was called direct instruction. The mid 1980s witnessed a shift from the more remedial-academic approach of teaching to instruction that included both basic skills and cognitive strategies (ways to better learn new information and efficiently access information from long-term memory). Children with LD were viewed as experiencing difficulty in regulating their learning performance. An instructional emphasis was placed on teaching students to check, plan, monitor, test, revise, and evaluate their learning during their attempts to learn or solve problems.

The early 1990s witnessed a resurgence of direct instruction intervention studies, primarily influenced by reading research, which suggested that a primary focus of intervention should be directed to phonological skills. The rationale was that because a large majority of children with learning disabilities suffer problems in reading, some of these children's reading problems are exacerbated because of lack of systematic instruction in processes related to phonological awareness (the ability to hear and manipulate sounds in words and understand the sound structure of language). This view gave rise to several interventions which emphasized phonics instruction and intense individual one-to-one tutoring to

improve children's phonological awareness of word structures and sequences.

SCIENTIFICALLY BASED TREATMENTS

Some experimental research shows that children with LD can be assessed and significant gains can be made in academic performance as a function of treatment (see Vellutino et al., 2004). However, considerable evidence suggests that some children with normal intelligence when exposed to the best instructional condition fail to efficiently master skills in reading, mathematics, and/or writing (e.g., Fuchs & Fuchs, 1998; Torgesen, 2000). Some literature suggests that LD individuals are less responsive than generally poor readers to intervention (e.g., Swanson & Hoskyn, 1998) and these academic problems persist into adulthood (e.g., Ransby & Swanson, 2003). Further, these difficulties in academic mastery reflect fundamental deficits in processing, such as phonological processing and working memory (Swanson & Siegel, 2001).

Swanson, Hoskyn and Lee (1999) provided a comprehensive analysis of the experimental intervention literature on LD. Their synthesis of methodologically sound studies (those with well-defined control groups and clearly identified LD samples) found that positive outcomes in remediating academic behaviors (e.g., reading, writing, mathematics) were directly related to a combination of direct and strategy instructional models. These models included a graduated sequence of steps with multiple opportunities for overlearning the content and skills, cumulative review routines, mass practice, and teaching of all component skills to a level that shows mastery. The interventions involved (a) teaching a few concepts and strategies well rather than superficially, (b) teaching students to monitor their performance, (c) teaching students when and where to use the strategy in order to enhance generalization, (d) teaching strategies as an integrated part of an existing curriculum, and (e) providing teaching that includes a great deal of supervised student feedback and practice.

Swanson (2000) found that two critical instructional components underlie successful instructional interventions for children with LD. One component was explicit practice that includes activities related to distributed review and practice, repeated practice, sequenced reviews, daily feedback, and/or weekly reviews. The other component was advanced organizers, and these studies included activities (a) directing children to focus on specific material or information prior to instruction, (b) directing children about task concepts or events before beginning, and/or (c) the teacher stating objectives of instruction.

SEE ALSO *Attention Deficit Hyperactivity Disorder (ADHD); Direct Instruction; Individualized*

Education Program (IEP); Learning and Teaching Mathematics; Learning and Teaching Reading; Meta-Analysis; Special Education; Strategies Instruction.

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*H. Lee Swanson
Danielle Edelston*

LEARNING IN INFORMAL SETTINGS

Educational research typically explores how and what students learn and tends not to examine where students learn. The assumption is people learn in school. With some notable and impressive exceptions (e.g., Resnick, 1987), the subject of setting for learning simply has not been of critical importance to educational researchers. However, it is the central question for researchers who study learning in informal settings.

School is a physical setting operating roughly from nine in the morning until three in the afternoon for thirteen years of childhood. It is the formal setting for learning. But what are informal learning settings? Any visitor to the Metropolitan Museum of Art or to the Vatican would be amused to hear them referred to as informal. Should three friends exploring a neighborhood creek on a Saturday afternoon be as participating in an informal learning setting, or should some notion of structure and intentionality be included in defining such settings?

By structure, researchers assume that the informal learning does not simply happen in some place and time other than school, but that such places have reasonable physical and temporal boundaries. There has to be some sense of a setting to informal learning settings. Thus, they can be a museum, a concert auditorium, a farm, even a baseball field, but probably they are not parks, the dinner table during an interesting discussion, or a toy store.

This distinction leads to the notion of intentionality. Not all museum visits have learning as a goal, and a visit to a toy store could possibly be primarily educational in nature. It depends in part on the purpose for the visit. Jackson (1968) writes about intentionality as being a key distinguishing feature of teaching, and the concept generalizes well here. Many settings can provide the opportunity for learning, but not all do, nor do all settings at all times. Thus, informal settings for learning may be defined here as those circumstances outside school in which learning is clearly at least one of the goals of the event.

An informal learning setting should be a setting bound by space and time, and its intended use should be educational during the activities under consideration, for example, a class trip to a natural history museum to learn about the First Nations people who lived in the area and that the class is studying in school. It could be a small group of students going to an art museum to look at Islamic art in relation to a special report that they are writing on geometry. Or it could be a high school cooperative vocational program in which students enhance applied mathematics skills.

Informal learning settings have structure and intentionality. But should the term also include individuals of school age who are learning school-related subject matter (perhaps broadly defined) on their own in informal settings, what Falk and Dierking call “free-choice learning” (Dierking & Falk, 2003; Falk, 2005)? This would then



Students learning about art at a museum. GETTY IMAGES.

include family outings to informal learning settings, and programs developed by institutions to teach children in various areas, but that are not directly related to schools themselves. Finally, there is the increasingly looming question of the Internet. At the Timeline of Art History section of the Web site maintained by the Metropolitan Museum of Art, one can spend weeks learning about cultures from all over the world and all through the history of humankind. Should the definition of informal learning settings include virtual locations as well as physical ones?

These possibilities have been presented for two purposes: first, to limit what will be discussed in the remainder of this entry; and second, and the more important part, to suggest the incredible variety, potential, and power of learning in informal settings. There is a spectrum of possible definitions of learning in informal settings. At what might be called the narrow end of the spectrum, the definition from the perspective of the individual might be: "I am at this place at this time to learn something that is related somehow to what I am learning in school." At the broad end, the perspective might be: "I am not in school and yet I am learning." Although the broader end is clearly the more intriguing one, the narrower end is of great concern to those who are interested in building strong and useful relationships between schools and cultural institutions (and other institutions), and this relationship is the focus here. It is strongly related (perhaps identical) to Eshach's 2007 notion of non-formal learning. Eshach differentiates formal learning (school-based), informal learning (everything individuals learn outside of school), and non-formal learning (learning in a planned situation or organization, but not in school).

LIMITED RESEARCH

Traditionally, school learning in informal settings has been characterized by the one-time school trip visit to the museum, zoo, local company, or performing arts venue. Often, preparatory activities and auxiliary materials accompany such visits. But research literature says little regarding the efficacy of such programs to produce what might be called school-based learning. Griffin (2004) reviewed the literature on such trips and finds that in terms of statistically significant gains on cognitive measures related to school subjects, the evidence is equivocal at best. Bowker (2002) looked at factors that influence learning in museums and again found that the literature does not speak with a single voice. There are some indications of generalizable findings, such as the need for students to have some time on their own in a school visit and the strong possibility that the increase in interest associated with museum visits pays off in subsequent classroom learning (Borun, Flexer, Casey, & Baum,

1983). But, in general, the conclusion one has to reach is that there simply is not a whole lot of literature demonstrating the efficacy of the single-trip museum visit in terms of the kinds of learning that are valued in schools.

Although perhaps a bit depressing, this finding is not particularly surprising. There are a number of natural constraints on finding such effects, including the difficulty of studying the phenomenon in a rigorous fashion, the limited time frame of the museum encounter, and the frequent lack of congruence between what the museum has to offer and what the students are learning in school. The question that is raised by the paucity of research documenting the efficacy of school/museum interactions is: Do museums actually contribute to the learning of school-related material? That is, is the research scarce because it is hard to produce, or is it scarce because there is no real learning?

REFRAMING THE QUESTION

Basically, the answer to that question is that it is the wrong question. It is the wrong question for researchers and evaluators to have asked, and to a degree, the wrong questions for museum educators to have tried to live up to. For too many years, those concerned with education in informal settings have tried to show that museums can lead to higher test scores of one form or another. But the logical linkage between what a museum has to offer and what is measured on school tests is tenuous, and the path from one to another is often tortuous. This is not meant as a critique of either cultural institutions or the institution of school testing; both have their place. It is simply a statement that it is hard to find one's way from one place to another. As an example of the nature of the problem, a federally funded, three-year project at the Isabella Stewart Gardner Museum found that students in the project used critical thinking skills more in looking at art than children not in the program but that there was no discernible effect on standardized test scores (National School Boards Association, 2007). And this was for an extensive program. When one considers the additional constraints of a one-time visit to a museum, complete with bus trips, packed lunches, lining up, getting coats off and back on again, the difficulty in finding statistically significant findings on test scores comes more into focus.

Fortunately, better questions are being posed in the early 2000s. Researchers have stopped looking at informal learning settings as adjuncts to schools and have begun looking at them for what they can offer and excel at. Schauble and her colleagues argue that researchers need to include issues such as the sparking and maintenance of motivation and personal development when considering the impact of museum visits (Schauble et al.,

1996). Hooper-Greenhill (2004) addresses this issue as well, arguing that researchers need to consider broader educational goals, which she calls generic learning outcomes, instead of more subject or unit-within-subject specific goals. Citing efforts by Great Britain's Economic and Social Research Council

Teaching and Learning Research Programme, she lists (among others) as possible goals:

- positive identities of students as learners
- knowledge and skill acquisition
- acquisition of values and dispositions of a learning society
- development of personal, community and societal concerns

One might reasonably ask if these are properly school-related learnings. Perhaps in a No Child Left Behind world, one might have difficulty in finding such statements in the masses of standards that define each state's desiderata for student growth. But the list cited in Hooper-Greenhill aligns quite nicely with New Zealand's "Key Competencies," the centerpiece of its national curriculum document (Ministry of Education, 2007):

- Thinking
- Using language, symbols, and texts
- Managing self
- Relating to others
- Participating and contributing

It is perfectly reasonable to wonder, at this point, if museum education researchers have such difficulty in documenting small and specific effects, why would one expect to find broader effects. The answer is that is what museums do, when they are working well. They engender broader considerations and ideas, cause people to reflect beyond the visit, and encourage people to think in ways that perhaps they had not before. Although it is entirely possible to visit a museum and not be intrigued by anything in the collection, Carr (2006) argues that the very existence of objects of value and veneration should engender questions in the visitor. The visitor may ask about who made the artifacts, why they are important, and why they are displayed in a museum. Visitors may wonder about what the display means to them personally and how the displayed objects related. When individuals start to ask such questions and seek answers to them, learning occurs in various ways. First, knowledge is gained from the content and context of the objects themselves. Second, there is skill development in learning how to find answers to questions. Third, individuals often place themselves in the context of the objects,

leading to an exploration of a sense of community and identity.

DOCUMENTING A REVISED PERSPECTIVE

If, indeed, one can argue successfully that the learning that occurs in museums is of this broader and more substantial kind, how might one go about documenting such learning? This is a serious challenge, but one worth taking up. And there have been several promising starts. Leinhardt and Crowley (2002) begin from the perspective that one should be open to capture the learning as it occurs in the informal learning setting as opposed to determining what that learning should be a priori and then seeing if one can find the preconceived learning. This is a remarkable insight and one that might be well extended to learning in schools as well. Their approach to finding that learning is to have museum visitors fitted with recording devices so that they can listen to their conversations with others as they go to a museum, visit it, and return home from their visit. Leinhardt and Crowley call their approach, "learning conversations." Although their approach is costly, time-consuming, and can only sample very few participants, their results are nonetheless impressive. It is clear from their research that individuals in informal learning settings engage in conversations during and following visits that reflect authentic engagement with museum artifacts. They argue convincingly that the scope and level of these conversations, in comparison to conversations prior to the experience, are the types of experiences that lead to meaningful learning.

Bamberger and Tal (2007) utilized multiple observations in looking at the effects of choice on student learning. They video taped museum visits, conducted semi-structured interviews, and used questionnaires (the authors refer to them as worksheets). The data were coded so as to allow for assessment of those activities known to be related to student learning: student questioning, linkage to prior knowledge, scaffolding. As with the Leinhardt and Crowley approach, the authors did not look for specific learnings, but for the evidence of learning in general.

Finally, Smith and Waszkielewicz (2007) found that individuals (adults in this case) in an art museum were more likely to rate themselves highly in terms of thinking about interpersonal, intrapersonal, and societal concerns and issues while in the middle of a museum visit than at the beginning or the end of the visit. Like the two studies mentioned above, these authors gathered information on visitors during the museum visit. Their approach, however, used a fairly standard questionnaire format that allowed for the gathering of a quite large sample and replication over two museums using the same approach.

The research on learning in informal settings may not yield exactly what one might anticipate or, at the outset, even hope for. But as is so often the case in research, the new horizons are more intriguing than the old ones. As researchers learn that informal learning settings may or may not provide much support for acquiring everyday school objectives (as important as they are), they learn that they may well support broader and deeper goals. Educators look for growth in personal development, the ability to analyze and critique, a sense of belonging to structures and communities larger than one's own immediate group; they hope to make ties to the past and make conscious hope for better futures. What they find will almost certainly be different from what they envision, but the trip should be an enjoyable and rewarding one.

SEE ALSO *Guided Participation; Sociocultural Theory.*

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Jeffrey K. Smith

LEARNING STYLES

Learning styles theory is based on the understanding that differences between individuals' processing capabilities lead to significantly different learning requirements. Learning style theorists argue that these capabilities are fairly fixed, and most of the proponents believe that, in order for individuals to be successful learners, instruction needs to be matched to the individuals' learning preferences. While there is intuitive appeal in the notion that designing instruction to meet individual learning styles leads to improved academic achievement, there is a dearth of evidence to indicate that this concept has any validity. In fact, rather than increasing success in the classroom, research indicates that attempts to match instruction to specific learning styles fails to lead to improvements in student learning. Further, by limiting rather than expanding the range of educational approaches provided to learners, the use of learning styles has the potential to increase, rather than alleviate, the difficulties students experience in their learning.

LEARNING STYLES DESCRIBED

According to Vicki Snider (1990; 1992), learning styles are an outgrowth of the process approaches of the 1960s and 1970s although the construct is meant to describe differences between learners rather than to identify disorders (e.g., visual or auditory preferences rather than a visual-processing disability). Learning styles based education is also considered to be a form of aptitude-treatment interaction. Aptitude-treatment interactions are meant to identify individuals' distinct characteristics (aptitudes) and match these with specific treatments (for example, instructional approaches) in order to produce statistically improved outcomes (in this case, significantly improved learning).

The learning styles construct also encompasses a range of models, including learning preferences (for example, global versus analytical or visual versus auditory learners), cognitive styles (e.g., field dependence versus field independence or reflective versus impulsive), and personality types (e.g., the Myers-Briggs types). This range of models makes it difficult to develop a consistent definition of learning styles. However, there are two traits that appear to be constant across most descriptions of learning styles. First, learning styles are generally seen as fixed; that is, individuals have certain aptitudes that result from their natural tendencies or predispositions. Second, by matching learners with particular attributes to complementary instructional approaches, it becomes possible to increase their ability to process information.

So, for example, in terms of natural predispositions, field dependent individuals are identified by the difficulty they experience differentiating a particular item, or figure, as distinct from a complex background, or the surrounding field. Field independent individuals, by contrast, can be identified by their ability to readily distinguish between the two. Continuing with this example, field dependent individuals are considered to be social learners who benefit from collaboration and extrinsic motivation, whereas field independent individuals are considered to be independent learners who are intrinsically motivated and work best on their own. The argument continues that, by designing learning opportunities that take into account these innate preferences, it should be possible to improve the learning of both types of students.

ACADEMIC USEFULNESS

According to Ronald Hyman and Barbara Rosoff, in order to be a useful addition to the field of education, there are certain criteria that the learning styles construct would need to meet. First, the concept of learning styles needs to be clearly defined, both to allow ready identification of particular types of learners and to ensure effective communication regarding how best to meet these various learners needs. Next, it is important that accurate and efficient assessment measures be created to enable the easy identification of these distinct learning styles. Finally, there would need to be specific instructional approaches that lead to improved academic achievement when matched to students with a particular learning style (and, following from this, that are ineffective when matched with students who demonstrate alternative learning styles). Unfortunately, despite decades of research, the field of learning styles based education has failed to make significant progress in any of these areas.

Inconsistency of Definitions. There are numerous learning style models (71 according to a major review by

Coffield and his colleagues), many of which differ in terms of the attributes their proponents identify as critical to individual differences. In fact, although there is some degree of overlap, the advocates of these various models focus on an extensive array of qualities that they believe to be central to improving academic achievement. For example, some models look at environmental (e.g., temperature and sound), emotional (e.g., motivation and persistence), sociological (e.g., working alone or with others), and physical traits (e.g., time of day and need for mobility). Others consider the dimensions of perception (concrete or abstract) and ordering (sequential or random). Yet others define learners on two independent dimensions, cognitive organization (holistic or analytic) and mental representation (verbal or imagery). Ultimately, the fact that there are so many different models with such disparate views of what constitutes learning styles makes it nearly impossible to develop a cohesive definition upon which the field can build.

Assessing Learning Styles. In terms of the effectiveness of learning styles assessments, there are two ways in which these measures are problematic. The first and more serious issue is that, without a unifying definition of learning styles, it is impossible to develop a cohesive means of evaluating the construct. In other words, given the fragmented nature of the field, it is unclear how valid any assessment measure could be. Despite this problem, assessment measures have been developed for a number of individual models. However, Steven Stahl notes that these are generally considered to have low reliabilities for standardized procedures; for example, when individuals complete a particular evaluation at two different points in time (test-retest), the results are very often inconsistent. There are two possible explanations for this difference; either individuals' learning styles change quite significantly over relatively short periods of time or the assessments themselves fail to measure what they are meant to measure. Either way, the disparity undermines confidence in these assessments.

The Usefulness of Learning Styles. Given the above critique, it is apparent that the concept of learning styles is problematic. In fact, from the late 1970s onward, a number of major literature reviews set out to evaluate the research conducted on learning styles (or its predecessor aptitude-treatment interactions). Each of these reviews independently reached the same conclusion: There is a striking lack of evidence indicating that the matching of learners with particular modes of instruction, whether based on self-reported or observed learning preferences, is an effective means of improving academic achievement.

For example, both Vicki Snider (1992) and Steven Stahl discuss numerous attempts to improve learners'

reading ability by matching students who demonstrate particular types of modality preferences with the corresponding form of reading instruction. In these studies, visual or global learners have been taught using either whole word or whole language methods and auditory or analytic learners have been taught using a decoding or phonics-based approach. Results indicated that, despite the attempts to match children to the instructional approach that best complements their learning styles, there was no effect on reading achievement. One reason may be that, rather than possessing a particular learning style, students have different instructional needs at different points in their development.

According to many literacy researchers, early or emergent readers have been shown to benefit from more holistic approaches that emphasize concepts of print, language experience, and phonemic awareness. Once students have established these concepts, a focus on word recognition through phonics or decoding instruction is appropriate. As students develop comfort with the alphabetic principle, another shift occurs, and students consolidate their understanding of letter-sound correspondences and begin to develop their reading fluency. Using the most popular model for reading styles to describe what is occurring during these stages, the same student could be classified as a global or visual learner at the emergent stage, an analytic or auditory learner as the focus shifts to word recognition, and finally a global or visual learner again as the individual starts to develop reading fluency. Rather than arguing that students respond to a single type of instruction, it becomes apparent that what constitutes appropriate instruction changes as learners' needs change.

MULTICULTURAL LEARNING STYLES

Another problem that arises with the learning styles construct involves its application to broad cultural classifications. Advocates of this argument propose that students from various ethnic and cultural groups learn in fundamentally different ways from one another and that the education gap that exists between more successful white students and their lower achieving peers from different cultures (e.g., African American, Hispanic, Native American) is the result of culturally incompatible teaching. However, Craig Frisby argues that this contention is based upon several flawed assumptions; these range from the notion discussed above that learning styles and learning styles assessments are valid and reliable to the view that the members of various cultures must be taught in unique ways in order to demonstrate academic success. For example, according to some theorists, students from certain cultures prefer one modality over another and learn best when instruction is matched to those prefer-

ences. That is, some students are said to favor a lecture format and prefer having their work laid out in a step-by-step manner (analytic or auditory learners), whereas others are said to learn better when they have the opportunity to derive information through graphics and their material is presented holistically (global or visual learners), and still others are said to need to reinforce what they are learning through physical approaches in order to be successful (kinesthetic or tactile learners).

However, it is likely that students learn best, not as the result of a dominant processing preference being matched to its corresponding instructional approach, but as a result of educators' designing instructional approaches that are appropriate for the learning requirements of a particular situation. So that even auditory learners will develop a deeper understanding of, say, certain scientific concepts when given the opportunity to see a demonstration of that concept, than when they simply hear about that concept through a lecture. Similarly, most visual learners will develop a richer appreciation of a musical score after hearing a recording of it than they would after reading a critique of it. Likewise, although only some learners are classified as kinesthetic learners, it seems unlikely that individuals with other learning styles preferences will become competent at tennis simply by watching other players play the game or by learning about the steps involved in a serve without actually practicing it. Using these examples, it seems reasonable to argue that the modality people prefer has more to do with the nature of a given task than it has to do with individuals from certain cultural backgrounds having a cluster of learning requirements that develop out of a set of predetermined learning preferences.

ALTERNATIVES TO LEARNING STYLES

If learning styles are not the key to improved academic achievement, then what is? There are several educational approaches that can assist all learners, but are especially effective for those learners who are experiencing difficulties in the classroom. First, Vicki Snider (1990) suggests that teachers incorporate instruction that makes use of multiple modalities. Multimodality instruction differs from modality matching in that it incorporates visual, auditory, and tactile processing rather than just relying on one of these elements; such instruction has been shown to be effective with a range of learners, including those who are struggling with a particular curriculum. Second, when students encounter difficulty with their learning, rather than simply re-presenting the information in the same manner, teachers should consider where breakdowns may be occurring and how alternative ways of presenting the information can help students better

develop their understanding of the material at hand (e.g., scaffolding, the presentation of additional examples, collaborative discussions).

Finally, instruction in cognitive strategies should be considered in concert with these other instructional methods. Barak Rosenshine defines cognitive strategies as approaches, such as question-generation and summarizing, which help students succeed with complex learning tasks, such as comprehension, problem solving, and writing. What is important about cognitive strategies is that, unlike learning styles, there is a substantial body of research to demonstrate that these approaches lead to greater academic achievement and that this achievement occurs with a range of learners across ages, gender, culture, and socioeconomic background. Perhaps more importantly, each of these three principles can be integrated into any learning environment without relying on the limitations of learning styles or learning styles based education.

SEE ALSO *Cognitive Strategies; Metacognition.*

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Melanie R. Kubn

LONGITUDINAL RESEARCH

Educational researchers and practitioners are often interested in questions about how individuals grow and develop over time. For example, how rapidly does a student's understanding of various mathematical concepts change during secondary school? (Ai, 2002). To effectively answer such questions, *longitudinal data* (Singer & Willett, 2003) must be collected in which the same information may be obtained from individuals at different times. For example, to study the development of mathematics achievement during secondary school, yearly mathematics achievement tests could be administered. Longitudinal data is contrasted with *cross-sectional data*, in which information is collected from individuals at one point in time (e.g., mathematics achievement tests of children of different ages at the same point in time). While cross-sectional data is easier to collect than longitudinal data, it cannot be used to accurately answer questions about change.

This entry provides an example of the use of longitudinal data to study change in mathematics achievement during secondary school. The research addresses the following questions:

1. How much does mathematics achievement change during secondary school?
2. In what ways do trajectories of mathematics achievement differ across students?
3. Does mathematics achievement development differ as a function of student race?

These questions are addressed by fitting a statistical model called the *multilevel model for change* to five years of mathematics achievement data collected as part of the *Longitudinal Study of American Youth* (LSAY), a national longitudinal study of U.S. secondary school students (Miller, Kimmel, Hoffer, & Nelson, 2000). LSAY data were collected from 5,945 students over 7 years, beginning in the fall of 1987 when the students were in either 7th or 10th grade. A primary focus of the LSAY was on measuring students' mathematics achievement over time, using items from the National Assessment of Educational Progress. Here, in the example, are analyses of mathematics achievement data from a sub-sample of 1,322 White and African American students between 7th grade and 11th grade, asking about the effects of race on changes in the mathematics achievement over time.

THE MULTILEVEL MODEL FOR CHANGE

When studying change over time, the first questions are about each person's individual change trajectory. For example, does a particular student's mathematics achievement

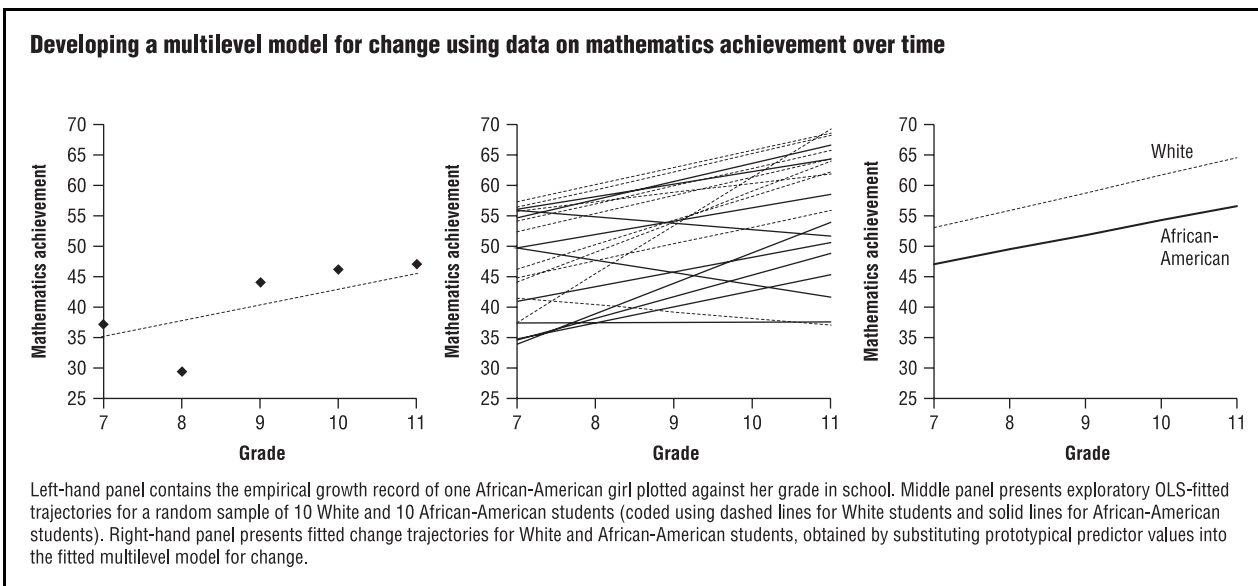


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

improve rapidly during secondary school? Does another student’s achievement increase less rapidly? Might yet another student’s achievement actually decrease over time? These questions are addressed with the *level-1 statistical model*, or individual growth model, which represents the change that, according to the hypothesis, each member of the population will experience during the time period under study.

To develop an understanding of the level-1 model, the left-hand panel of Figure 1 should be considered, in which the researchers have plotted the mathematics achievement (MATHACH) of one African American girl from the dataset against her grade, between 7th and 11th grade. For this girl, mathematics achievement improves steadily over time. This upward trend is summarized in the empirical growth record by superimposing a fitted ordinary least squares (OLS) “achievement on grade” linear regression line. Observations based on this plot suggest two important components of this level-1 statistical model. First, the model should capture systematic underlying change in mathematics achievement over time (represented by the fitted growth trajectory plotted in Figure 1). Second, the model must account for differences between observed values of mathematics achievement (represented by the datapoints plotted in Figure 1), and the predicted values from the fitted growth trajectory. These observations lead the researchers to hypothesize the following level-1 model:

$$Y_{ij} = [\pi_{0i} + \pi_{1i}(GRADE_{ij} - 7)] + \epsilon_{ij} \quad (1)$$

This model asserts that, in the population of students from which this sample was drawn, Y_{ij} , the observed value of *MATHACH* for student i at time j is constituted from two important parts. The first part in brackets in equation (1) describes the underlying true change for this student as a linear function of his (or her) grade in school ($GRADE_{ij}$). This trajectory is characterized by two individual growth parameters, π_{0i} and π_{1i} , which determine its shape for the i th student. The intercept, π_{0i} , represents student i ’s true mathematics achievement in 7th grade. (This interpretation applies because the researchers centered *GRADE* in the level-1 model by subtracting the constant “7” from it.) The slope, π_{1i} , represents the yearly rate of change of student i ’s true mathematics achievement. The second part of the level-1 model is a random error term (ϵ_{ij}), which accounts for the difference between individual i ’s true and observed value of *MATHACH*, on occasion j . This level-1 residual represents that part of student i ’s value of *MATHACH* at time j not predicted by grade level.

In specifying a level-1 model, it is implicitly assumed that all students’ true individual change trajectories have a common algebraic form, here represented by a straight line. But because all the students have their own value of the intercept and slope parameters, everyone does not necessarily follow exactly the same trajectory. Students’ true mathematics achievement levels in seventh grade may vary, as may their rates of true change in achievement. Therefore, we may study inter-individual differences in individual growth trajectories by studying inter-individual variation in individual growth parameters. These observations form the foundation of the *level-2 statistical model*.

At level-2 the “between-person” or inter-individual level questions are asked about predictors of change. Here, in the mathematics achievement example, at level-2 it was asked whether the average African American seventh grader has lower mathematics achievement than the average White seventh grader, and also whether rates of change in mathematics achievement differ as a function of race. These questions are addressed by modeling the relationship between inter-individual differences in the change trajectories (i.e., intercept and slope parameters) and student characteristics (here, race). To develop an intuition about the level-2 model, the middle panel of Figure 1 should be examined. It represents an exploratory analysis in which the researchers have plotted fitted OLS individual growth trajectories for a random subset of 10 White and 10 African American students (solid lines represent African American students and dashed lines represent White students). As noted for the single student in the left panel, mathematics achievement increases over time for most students. In addition, African American students seem to have generally lower mathematics achievement scores in seventh grade than do White students, and their rates of increase in achievement over time are not as large. But the substantial inter-individual heterogeneity in growth trajectories within groups should also be noted. Not all African American students have lower intercepts than do White students; many of them have higher mathematics achievement in seventh grade. Similarly, not all African American students have less steep slopes; some of them have very rapid increases in mathematics achievement over time. Furthermore, within both groups there are students whose mathematics achievement actually decreases over time.

The level-2 model must simultaneously account for both these general patterns (the between-group differences in intercepts and slopes) and inter-individual heterogeneity that remains within groups. This suggests that an appropriate level-2 model would have outcomes that are the level-1 individual growth parameters themselves (the π_{0i} and π_{1i} parameters from equation (1)). In addition, the level-2 model must specify the relationship between each individual growth parameter and predictor *AFAM* (0 = White, 1 = African American). Finally, the level-2 model must allow even individuals who share common predictor values to differ in their individual change trajectories, by permitting random variation in the individual growth parameters across students. These considerations lead to the following level-2 model:

$$\begin{aligned} \pi_{0i} &= \gamma_{00} + \gamma_{01} AFAM_i + \zeta_{0i} \\ \pi_{1i} &= \gamma_{10} + \gamma_{11} AFAM_i + \zeta_{1i} \end{aligned} \tag{2}$$

Equation (2) has two main components which simultaneously treat the intercept (π_{0i}) and the slope (π_{1i})

of a student’s growth trajectory as level-2 outcomes that are associated with predictor *AFAM*. The level-2 model contains four parameters known collectively as the fixed effects γ_{00} , γ_{01} , γ_{10} , and γ_{11} that capture systematic inter-individual differences in change trajectories. In equation (2), γ_{00} and γ_{10} are level-2 intercepts; γ_{01} and γ_{11} are level-2 slopes. γ_{00} represents the average true seventh grade mathematics achievement for White students in the population, while γ_{01} represents the hypothesized population difference in average true initial status between African American and White students. Similarly, γ_{10} represents the population average true annual rate of change in mathematics achievement for White students, while γ_{11} represents the hypothesized population difference in average true annual rate of change between African American and White students. The level-2 slopes, γ_{01} and γ_{11} , jointly capture the effects of *AFAM*. If γ_{01} and γ_{11} are non-zero, the average population trajectories in true mathematics achievement differ between the two racial groups; on the other hand, if γ_{01} and γ_{11} are both 0, then the trajectories do not differ by race. These two level-2 slope parameters therefore address the question: What is the difference in the average trajectory of true change in mathematics achievement between White students and African American students?

Results of fitting a multilevel model for change to data (n=1,322)

		Parameter	Estimate (s.e.)
Fixed Effects			
Initial status, π_{0i}	Intercept	γ_{00}	53.02*** (0.26)
	AFAM	γ_{01}	-5.93*** (0.80)
Rate of change, π_{1i}	Intercept	γ_{10}	2.87*** (0.08)
	AFAM	γ_{11}	-0.48* (0.23)
Variance Components			
Level-1:	Within-person, ϵ_{ij}	σ_{ϵ}^2	37.17*** (0.86)
Level-2:	In initial status, ζ_{0i}	σ_0^2	59.05*** (3.23)
	In rate of change, ζ_{1i}	σ_1^2	3.19*** (0.29)
	Covariance between ζ_{0i} and ζ_{1i}	σ_{01}	6.18*** (0.69)

~ p < .10; * p < .05; ** p < .01; *** p < .001

This model predicts mathematics achievement between grades 7 and 11 as a function of (GRADE-7) at level-1 and race (AFAM) at level-2.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

An important feature of both the level-1 and level-2 models is the presence of the residuals (ϵ_{ij} at level-1 and ζ_{0i} and ζ_{1i} at level-2). As is the case with most residuals, researchers are usually less interested in their specific values than in their variability. Level-1 residual variance, σ_{ϵ}^2 , summarizes the scatter of the level-1 residuals around each person's true change trajectory, in the population. The level-2 residual variances, σ_0^2 and σ_1^2 , summarize the population inter-individual variation in true individual intercept and slope around their averages that is left over after controlling for the effect of *AFAM*.

As a final question at level-2, the researchers consider a potential association between seventh grade mathematics achievement and change in achievement. For example, do students with higher seventh grade mathematics achievement also experience larger gains in achievement? The researchers permit this possibility by allowing the level-2 residuals to be correlated. Their population covariance, σ_{01} , summarizes the association between true seventh grade math achievement and true rate of change in achievement, controlling for race.

INTERPRETING THE FITTED MULTILEVEL MODEL FOR CHANGE

Estimates from the fitted multilevel model for change are presented in Table 1. Substituting the $\hat{\gamma}$'s from Table 1 into the hypothesized level-2 model in equation (2), the following fitted level-2 model is obtained:

$$\begin{aligned} \hat{\pi}_{0i} &= 53.02 - 5.93AFAM_i \\ \hat{\pi}_{1i} &= 2.87 - .48AFAM_i \end{aligned} \tag{3}$$

The first part of this fitted model describes the estimated effects of *AFAM* on true seventh grade mathematics achievement; the second part describes its estimated effects on the annual rate of true change in mathematics achievement. Beginning with the first part of the fitted model, it is estimated that true seventh grade mathematics achievement for the average White student is 53.02. For the average African American seventh grader, it is estimated that true seventh grade mathematics achievement is 5.93 points lower (47.09). In addition, the researchers reject (at the .001 level) the null hypotheses that γ_{00} and γ_{01} are 0 and conclude that the average White student had non-zero true mathematics achievement in seventh grade (hardly surprising) and that there is a statistically significant difference in the average true seventh grade mathematics achievement of White students compared with their African American peers.

In the second part of the fitted model, it is estimated that the annual rate of true change in mathematics achievement for the average White student is 2.87 points

per year. For the average African American student, it is estimated to be nearly half a point lower (at 2.39). In rejecting (at the .001 level) the null hypothesis on γ_{10} , it is concluded that the average White student experienced a statistically significant increase in true mathematics achievement over time. Because the researchers also reject (at the .05 level) the null hypothesis on γ_{11} , they conclude that differences between African American and White students in their annual rates of true change are also statistically significant. The estimated mathematics achievement for the average White student increased 11.48 points from 7th grade to 11th grade, while the increase for African American students was two points lower (9.56). African American students begin seventh grade with lower average mathematics achievement than their White counterparts, and the achievement gap increases over time.

Another way of interpreting the estimated fixed effects is to plot fitted trajectories for prototypical individuals. For this particular model, only two prototypes are possible: an African American student (*AFAM*=1) and a White student (*AFAM*=0). Substituting these predictor values into equation (3) yields the estimated seventh grade mathematics achievement and annual growth rates for each:

When *AFAM* = 0:

$$\begin{aligned} \hat{\pi}_{0i} &= 53.02 - 5.93(0) = 53.02 \\ \hat{\pi}_{1i} &= 2.87 - .48(0) = 2.87 \end{aligned}$$

When *AFAM*= 1:

$$\begin{aligned} \hat{\pi}_{0i} &= 53.02 - 5.93 = 47.09 \\ \hat{\pi}_{1i} &= 2.87 - .48(1) = 2.39 \end{aligned} \tag{4}$$

These estimates are then substituted into the level-1 model in equation (1) to obtain the fitted individual change trajectories:

When *AFAM* = 0:

$$\hat{Y}_{ij} = 53.02 + 2.87(GRADE_{ij} - 7)$$

When *AFAM* = 1:

$$\hat{Y}_{ij} = 47.09 + 2.39(GRADE_{ij} - 7) \tag{5}$$

These fitted trajectories are plotted in the right-hand panel of Figure 1, and reinforce the numeric conclusions articulated above. In comparison to White students, the average African American student has lower mathematics achievement in seventh grade and a slower rate of increase in mathematics achievement.

The estimated variance components assess the amount of outcome variability left after including the

predictor *AFAM*. The level-1 residual variance, ϵ_{ij} , summarizes the population variability in average student's outcome values around their own true change trajectory. Its estimate here is 37.17. Rejection of the associated null hypothesis test (at the .001 level) suggests the existence of additional within-person outcome variability that may be predictable in subsequent analyses by time-varying predictors other than time.

The level-2 variance components, σ_0^2 and σ_1^2 , summarize the variability in true seventh grade achievement and rate of true change remaining after controlling for *AFAM*. Tests associated with these variance components evaluate whether there is any remaining outcome variation that could potentially be explained by further predictors at level-2. For these data, the researchers reject both of these null hypotheses (at the .001 level), and conclude that additional level-2 predictors may help explain some of this residual variation. Finally, the level-2 covariance component, σ_{01} is considered. The researchers reject the null hypothesis on the covariance and conclude that the intercepts and slopes of the individual true change trajectories are indeed correlated in the population. Controlling for student race, on average, African American and White students who have higher true mathematics achievement in seventh grade also have greater rates of increase in true mathematics achievement between 7th and 11th grade.

The mathematics achievement example presented in this entry has many features that simplify analysis and interpretation. However, the multilevel model for change is a very flexible, powerful method for analyzing longitudinal data and may be used to address quite complex longitudinal research questions. Five of these possibilities may be considered here. First, although only one predictor has been included in the analysis, it is straightforward to examine the impact of additional substantive level-2 predictors. For example, in addition to the race variable studied here, it could also be asked whether girls and boys have different mathematics achievement trajectories or whether there is an impact of various instructional methods on the development of mathematics achievement. Second, while all students in the example were assessed on exactly five occasions (a balanced design), the model may also be fitted to longitudinal datasets containing individuals with varying numbers of measurement occasions (an unbalanced design). Third, here measures of mathematics achievement that were taken in the fall of every year were analyzed, but occasions of measurement need not be equally spaced and different participants can have different data collection schedules. Fourth, individual change can be represented not only as a linear function presented here, but also curvilinear and discon-

tinuous functions representing substantively interesting hypotheses of change in educational outcomes over time. Finally, in addition to time-invariant predictors of change, such as race and gender, the effects of predictors whose values change over time can also be estimated, such as type and level of mathematics course in which a student is enrolled each year. Readers wishing to learn more about using longitudinal data to analyze change over time should consult books devoted to the topic, including Diggle, Heagerty, Liang, and Zeger (2002); Fitzmaurice, Laird, and Ware (2004); Hedeker and Gibbons (2006); Raudenbush and Bryk (2002); Singer and Willett (2003); Snijders and Bosker (1999); Verbeke and Molenberghs (2000); Walls and Schafer (2006); and Weiss (2005).

SEE ALSO *Cross-Sectional Research Designs; Research Methods: An Overview.*

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M

MACCOBY, ELEANOR E(MMONS) 1917–

Eleanor Maccoby's work on gender development, on the impact of divorce on children and families and parent-child interactions, and on child rearing practices has greatly informed the field of human development. In 1970, with Miriam Zellner, Maccoby described the underlying psychological concepts fueling various Project Follow Through programs (a government funded educational reform similar to Head Start). Their work, which focused on facilitating at-risk students' academic and social development, continues to be at the forefront of research in educational psychology and school reform. Similarly, Maccoby's research on the biological underpinnings of gender identity (1974, with Carol Jacklin) continues to help inform educators about the within-group differences of male and female groups, as well as the rather limited between-group differences of children's behavior and socialization practices. In addition, Maccoby's gender segregation research highlights the adult controlled contextual aspects of educational environments that reinforce and further promote children's (particularly girls') preferences for same sex playmates and peer groups through adolescence.

Born in 1917, Eleanor Maccoby began her college career at Reed College in 1934 and later transferred and received her BS in psychology from the University of Washington in 1939. After working for the Department of Agriculture's Division of Program Surveys as a study director, Maccoby completed her MS in 1949 from the University of Michigan, as well as her PhD in experi-

mental psychology in 1950. While at Michigan she taught survey research methods and served as study director in the Survey Research Center (APA). Maccoby completed her dissertation in B.F. Skinner's lab; however, over time her theoretical interests shifted from behaviorism to learning theory, cognitive development, and interaction. Her early work with Robert Sears and Harry Levin at Harvard on parent-child interactions continues to be influential. At Harvard (1950–1958), Maccoby was an instructor and lecturer in the Department of Social Relations (APA). She joined the faculty of the Department of Psychology at Stanford University in 1958 and was awarded emerita status in 1987. Since that time Maccoby has continued her research and commentary on topics ranging from the lifespan development of gender differences and socialization processes to adaptive outcomes of divorce and the impact of media exposure on children and families, as well as out of the home childcare.

Maccoby's publications number well over 100, including her most cited co-authored book with Carol Jacklin, *Psychology of the Sex Differences* (1974). The work of *Sex Differences* was instrumental in summarizing extant literature on gender differences, encompassing more than 1,300 previous works. Also important is her work on the Stanford Longitudinal Study (1984, with Jacklin), which used a cross-sequential design to provide a comprehensive description of the development of same-sex play groups and group processes. Throughout Maccoby's career her research has focused on in-depth longitudinal analyses of human development, and it has offered great insight into the role that teachers can play in students' lives, as well as the impact parenting style on children's development.

Maccoby is the recipient of numerous distinguished and lifetime career awards and positions, including the American Psychological Association (APA), Division 7 Gordon Stanley Hall Award in 1982, the American Educational Research Association's Distinguished Contributions in Educational Research Award in 1984; the Society for Research in Child Development (SRCD's) Award for Distinguished Scientific Contributions to Child Development in 1987; the APA's Distinguished Scientific Contribution Award in 1988; and the American Psychological Foundation's Gold Medal Award for Lifetime Achievement in the Science of Psychology in 1996 (APA, 2007). In addition, she was the first female chair of the Department of Psychology at Stanford. As of 2007 she was a member of the National Academy of Sciences and had served as president of SRCD and the Consortium of Social Science Association (APA).

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Tierra M. Freeman

MAEHR, MARTIN L. 1932–

Martin L. Maehr was born in 1932 in Guthrie, Oklahoma. Maehr grew up in Perry, Oklahoma, where his father was a principal, and later a professor of educational psychology and administrator at Concordia College in Nebraska. Maehr married his wife Jane in 1959. He received his bachelor of arts and master of divinity

degrees from Concordia Seminary in St. Louis. He then went on to doctoral study in psychology and education at the University of Nebraska. Maehr's dissertation was titled, "The Effect of Food Deprivation on Binocular Conflict," and his advisor was Warren R. Baller.

Maehr first studied for the ministry, with the expectation of teaching at a liberal arts college. He planned to enter a graduate program in classics, studying Greek and Latin, but a college administrator who was a friend of his family advised him to study educational psychology, because the university was investing resources into that area and not into classics. Maehr later met Dr. Robert E. Stake, a psychometrician. Stake encouraged Maehr's interests in psychology, which led to his dissertation research and later to experimental research on social motivation and achievement in school settings. Maehr has stated that his dissertation work, combined with several courses in counseling and social psychology, ultimately led to his career studying motivation.

Maehr's first academic position as an assistant professor was at Concordia Senior College in Ft. Wayne, Indiana. After several years of teaching, Maehr received a postdoctoral research fellowship from the National Institute of Mental Health that allowed him to conduct research in social psychology at Syracuse University. This was a turning point in Maehr's career, and in 1967 he moved to the University of Illinois Urbana-Champaign, where he served as director and professor at the Institute for Child Behavior and Development, as professor of educational psychology, and as associate dean for graduate and international programs. In 1992 Maehr moved to the University of Michigan, where he became director of the combined program in education and psychology, and a professor of education and psychology.

Maehr has published widely in the field of achievement motivation. His early work in motivation examined a variety of topics, including self-concept, Atkinson's theory of achievement motivation, and the "Pygmalion" effect. In 1976 Maehr published an influential article in *Review of Educational Research* titled "Continuing motivation: An analysis of a seldom considered educational outcome." In that article Maehr argued that motivation to continue engaging in academic tasks is an important, yet undervalued outcome, that should be fostered in classrooms.

During his time at the University of Illinois, Maehr worked alongside a number of other motivation researchers, including John Nichols, Carol Ames, and Carol Dweck. The conversations and collaborations between and among these scholars ultimately led to the development of goal orientation theory, and Maehr was one of the major contributors to this extremely influential framework for the study of motivation. His work involved measurement development, the application of

goal theory to classroom and school reform, and the relation of goal orientation theory to both school leadership and school culture. Along with the late Carol Midgley and other collaborators at the University of Michigan, Maehr helped to develop the *Patterns of Adaptive Learning Survey* (PALS), which is one of the most widely used measures of achievement goals in the world. He also published several climate and leadership inventories with Larry Braskamp. Maehr also collaborated with other motivation researchers, including Avi Kaplan, Tim Urdan, Dennis McInerney, Leslie Fyans, and Eric M. Anderman.

At the University of Michigan, Maehr collaborated extensively with Midgley and the late Paul R. Pintrich. Maehr and Midgley worked together on several large-scale projects. One of the most notable involved work on motivation-based school reform in elementary and middle schools; Maehr and Midgley and their students worked with teachers, administrators, and parents in order to change the policies and practices of schools to become more aligned with the pursuit of mastery goals. That work resulted in the publication of a book, *Transforming School Cultures*, in 1996. Maehr worked with Pintrich on many projects, including the editing of several editions of the well-regarded *Advances in Motivation and Achievement* series as well as other volumes on academic motivation.

Maehr published extensively. In addition to the *Advances in Motivation* series, he wrote and edited numerous other books, and published over 100 peer-reviewed articles and book chapters. His research was funded by the National Institutes of Health, the U.S. Department of Education, National Science Foundation, and the Spencer Foundation. He is a fellow of the American Psychological Association and the American Psychological Society.

Maehr retired from his position at the University of Michigan in 2005. However, he remained extremely active as Emeritus Professor of Education and Psychology at Michigan, and as the co-principal investigator on a large-scale NSF-funded project examining the assessment of motivation, and a study funded by the Spencer Foundation examining Middle Eastern students in public schools in the United States.

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Eric M. Anderman

MASTERY LEARNING

Few programs have been implemented as broadly or evaluated as thoroughly over the last four decades in education as those associated with mastery learning. Programs based on mastery learning principles operate today in nations throughout the world and at every level of education. When compared to traditionally taught classes, students in mastery learning classes consistently have been shown to learn better, reach higher levels of achievement, and develop greater confidence in their ability to learn and in themselves as learners (Guskey, 1997, 2001).

THE DEVELOPMENT OF MASTERY LEARNING

Although the basic tenets of mastery learning can be traced to such early educators as Comenius, Pestalozzi, and Herbart (Bloom, 1974), most modern applications stem from the writings of Benjamin S. Bloom of the University of Chicago. In the mid-1960s Bloom began a series of investigations on the variation that existed in student learning outcomes. He recognized that while

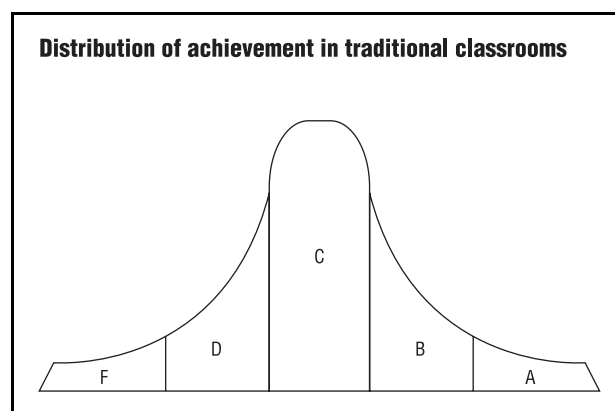


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

students vary widely in their learning rates, virtually all learn well when provided with the necessary time and appropriate learning conditions. If teachers could provide the time and more appropriate conditions, Bloom reasoned that nearly all students could reach a high level of learning.

To determine how this might be practically achieved, Bloom first considered how teaching and learning take place in typical group-based classrooms. He observed that most teachers begin by dividing the concepts and skills that they want students to learn into smaller learning units. Following instruction on the unit, teachers administer an assessment to determine how well students have learned those concepts and skills. Based on the assessment results, students are sorted, ranked, and assigned grades. The assessment signifies to students the end of the unit and the end of the time they need to spend working on the unit material. It also represents their one and only chance to demonstrate what they have learned.

When teaching and learning proceed in this manner, Bloom found that only a small number of students learns well and the pattern of student achievement was similar to the normal curve distribution shown in Figure 1.

Seeking a strategy that would produce better results, Bloom drew upon two sources of information. He first considered the ideal teaching and learning situation in which an excellent tutor is paired with each student. In other words, Bloom tried to determine what crucial elements in one-to-one tutoring could be transferred to group-based instructional settings. Second, he reviewed descriptions of the learning strategies of academically successful students in group-based learning environments that distinguish them from their less successful classmates.

Bloom saw value in organizing the concepts and skills to be learned into units and assessing students' learning at the end of each unit as useful instructional techniques. But the classroom assessments most teachers used seemed to do little more than show for whom their initial instruction was and was not appropriate. Bloom believed that a far better approach would be for teachers to use their classroom assessments as learning tools, and then to follow those assessments with a feedback and corrective procedure. In other words, instead of using assessments only as evaluation devices that mark the end of each unit, Bloom recommended using them as part of the instructional process to identify individual learning difficulties (feedback) and to prescribe remediation procedures (correctives).

This is precisely what takes place when an excellent tutor works with an individual student. If the student makes a mistake, the tutor first points out the error (feedback) and then follows up with further explanation and clarification (correctives) to ensure the student's

understanding. Similarly, academically successful students typically follow up the mistakes they make on quizzes and assessments. They ask the teacher about the items they missed, look up the answer in the textbook or other resources, or rework the problem or task so that they do not repeat those errors.

With this in mind, Bloom outlined an instructional strategy to make use of this feedback and corrective procedure, labeling it "Learning for Mastery" (Bloom, 1968), and later shortening it to simply "Mastery Learning" (Bloom, 1971a). With this strategy, teachers first organize the concepts and skills they want students to learn into learning units that typically involve about a week or two of instructional time. Following initial instruction on the unit, teachers administer a brief quiz or assessment based on the unit's learning goals. Instead of signifying the end of the unit, however, this assessment's purpose is to give students information, or "feedback," on their learning. To emphasize this new purpose Bloom suggested calling it a *formative assessment*, meaning "to inform or provide information" (see Scriven, 1967). A formative assessment identifies for students precisely what they have learned well to that point, and what they need to learn better (Bloom, Hastings, & Madaus, 1971).

Paired with each formative assessment are specific "corrective" activities for students to use in correcting their learning difficulties. Most teachers match these "correctives" to each item or set of prompts within the assessment so that students need work on only those concepts or skills not yet mastered. In other words, the correctives are "individualized." They may point out additional sources of information on a particular concept, such as page numbers in the textbook or workbook where the concept is discussed. They may identify alternative learning resources such as different textbooks, learning kits, alternative materials, CDs, videos, or Web-based instructional lessons. Or they may simply suggest sources of additional practice, such as study guides, computer exercises, independent or guided practice activities, or collaborative group activities.

With the feedback and corrective information gained from the formative assessment, each student has a detailed prescription of what more needs to be done to master the concepts or skills from the unit. This "just-in-time" correction prevents minor learning difficulties from accumulating and becoming major learning problems. It also gives teachers a practical means to vary and differentiate their instruction in order to better meet students' individual learning needs. As a result, many more students learn well, master the important learning goals in each unit, and gain the necessary prerequisites for success in subsequent units.

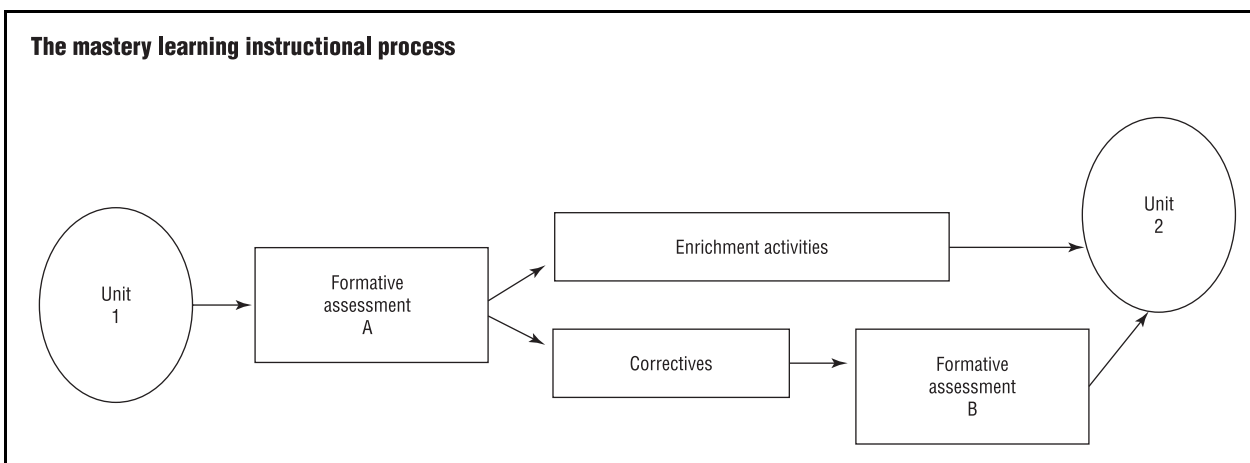


Figure 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

When students complete their corrective activities after a class period or two, Bloom recommended they take a second formative assessment. This second, “parallel” assessment covers the same concepts and skills as the first, but is composed of slightly different problems or questions, and serves two important purposes. First, it verifies whether or not the correctives were successful in helping students overcome their individual learning difficulties. Second, it offers students a second chance at success and, hence, has powerful motivational value.

Some students, of course, will perform well on the first assessment, demonstrating that they have mastered the unit concepts and skills. The teacher’s initial instruction was highly appropriate for these students and they have no need of corrective work. To ensure their continued learning progress, Bloom recommended that teachers provide these students with special “enrichment” or “extension” activities to broaden their learning experiences. Enrichment activities typically are self-selected by students and might involve special projects or reports, academic games, or a variety of complex, problem-solving tasks. Figure 2 illustrates this instructional sequence.

Bloom believed that through this process of formative classroom assessment, combined with the systematic correction of individual learning difficulties, all students could be provided with a more appropriate quality of instruction than is possible under more traditional approaches to teaching. As a result, nearly all might be expected to learn well and truly master the unit concepts or learning goals (Bloom, 1976; 1977). This, in turn, would drastically reduce the variation in students’ achievement levels, eliminate achievement gaps, and yield a distribution of achievement more like that shown in Figure 3.

Bloom emphasized, however, that reducing variation in students’ achievement does not imply making all

students the same. Even under these more favorable learning conditions, some students undoubtedly will learn more than others, especially those involved in enrichment activities. But by recognizing relevant, individual differences among students and then altering instruction to better meet their diverse learning needs, Bloom believed the variation among students in how well they learn specific concepts or master a set of articulated learning goals could eventually reach a “vanishing point” (Bloom, 1971b). In other words, *all* students would be helped to learn well the knowledge and skills prescribed in the curriculum.

MISINTERPRETATIONS OF MASTERY LEARNING

In some instances “mastery learning” has been confused with the concept of “mastery goals” used in motivation research (Ames, 1992; Dweck, 1986). Although theoretically related, these concepts are quite distinct. “Mastery learning” relates to a theory about learning and an accompanying set of instructional strategies, as described above. “Mastery goals,” on the other hand, concern a central distinction drawn by achievement goal theorists between striving to acquire skill and develop understanding (mastery goals), and striving to demonstrate superiority relative to others (performance or ability goals) (Butler, 2000). Mastery goals are typically associated with defining competence relative to task demands, attributing outcomes to effort, preferring challenging tasks, perceiving difficulty as an indication of the need for further learning, and responding to difficulty by seeking help and additional information. In contrast, performance or ability goals lead to defining competence relative to others, attributing outcomes to ability, interpreting difficulty as indicative of low ability, and refraining from

exposing inadequate ability by seeking help (Butler, 2007). Hence, while the criterion-referenced orientation of mastery learning clearly focuses on mastery goals, the concepts are quite different.

Another misinterpretation stems from some early attempts to apply mastery learning that were based on narrow and inaccurate understandings of Bloom's theory. These efforts focused only on low-level cognitive skills, attempted to break learning down into small segments, and insisted that students "master" each segment before being permitted to move on. Teachers were regarded in these programs as little more than managers of materials and record-keepers of student progress. Unfortunately, similar misinterpretations of mastery learning continue (e.g., Prawat, 1992; Satterly, 1981).

Nowhere in Bloom's writing, however, can this kind of narrowness and rigidity be found. In fact, Bloom emphasized quite the opposite. He considered thoughtful and reflective teachers vital to the successful implementation of mastery learning and continually stressed flexibility in its application. In his earliest description of the process Bloom wrote:

There are many alternative strategies for mastery learning. Each strategy must find some way of dealing with individual differences in learners through some means of relating the instruction to the needs and characteristics of the learners. . . . The nongraded school (Goodlad & Anderson, 1959) is one attempt to provide an organizational structure that permits and encourages mastery learning. (Bloom, 1968, pp. 7-8)

Bloom further emphasized his belief that instruction in mastery learning classrooms should focus on higher level learning goals, not simply basic skills. He noted:

I find great emphasis on problem solving, applications of principles, analytical skills, and creativity. Such higher mental processes are emphasized because this type of learning enables the individual to relate his or her learning to the many problems he or she encounters in day to day living. These abilities are stressed because they are retained and utilized long after the individual has forgotten the detailed specifics of the subject matter taught in the schools. These abilities are regarded as one set of essential characteristics needed to continue learning and to cope with a rapidly changing world. (Bloom, 1978, p. 578)

Modern research studies have shown mastery learning to be particularly effective when applied to instruction focusing on higher level learning goals such as problem solving, drawing inferences, deductive reasoning, and creative expression (Arredondo & Block, 1990; Blakemore, 1992; Clark, Guskey, & Benninga, 1983;

Kozlovsky, 1990; Mevarech, 1980, 1981, 1985; Mevarech, & Werner, 1985; Soled, 1987). When well implemented, the process helps teachers improve student learning in a broad range of learning goals from basic skills to highly complex cognitive processes.

RESEARCH RESULTS AND IMPLICATIONS

Despite the modest nature of the changes required to implement mastery learning, extensive research evidence gathered in Asia (Kim et al., 1969, 1970; Wu, 1994), Australia (Chan, 1981), Europe (Dyke, 1988; Langeheine, 1992; Mevarech, 1985, 1986; Postlethwaite & Haggarty, 1998; Reezigt & Weide, 1990, 1992; Yildiran, 2006), South America (Cabezon, 1984), and the United States (Anderson, 1994; Block, Eftim, & Burns, 1989; Guskey & Pigott, 1988; Walberg, 1984, 1988), shows the careful and systematic application of mastery learning principles can lead to significant improvements in student learning. Some researchers even suggest that the superiority of Japanese students in international comparisons of achievement in mathematics operations and problem solving may be due largely to the widespread use in Japan of instructional practices similar to mastery learning (Nakajima, 2006; Waddington, 1995).

Long-term investigations have yielded similarly impressive results. A study by Whiting, Van Burgh, and Render (1995), for example, representing 18 years of data gathered from more than 7,000 high school students showed mastery learning to have remarkably positive influence on students' test scores and grade point averages as well as their attitudes toward school and learning. Another field experiment conducted in elementary and middle school classrooms showed that the implementation of mastery learning led to significantly positive increases in students' academic achievement and their self-confidence (Anderson, Barrett, Huston, Lay, Myr, Sexton, & Watson, 1992). Even more impressive, a comprehensive, meta-analysis review of the research on mastery learning by Kulik, Kulik, & Bangert-Drowns (1990a) concluded:

We recently reviewed meta analyses in nearly 40 different areas of educational research (J. Kulik & Kulik, 1989). Few educational treatments of any sort were consistently associated with achievement effects as large as those produced by mastery learning. In evaluation after evaluation, mastery programs have produced impressive gains. (p. 292)

Research evidence also shows that the positive effects of mastery learning are not limited to cognitive or achievement outcomes. The process also yields improvements in students' confidence in learning situations, school attendance rates, engagement in class activities, attitudes toward learning, and a variety of other affective

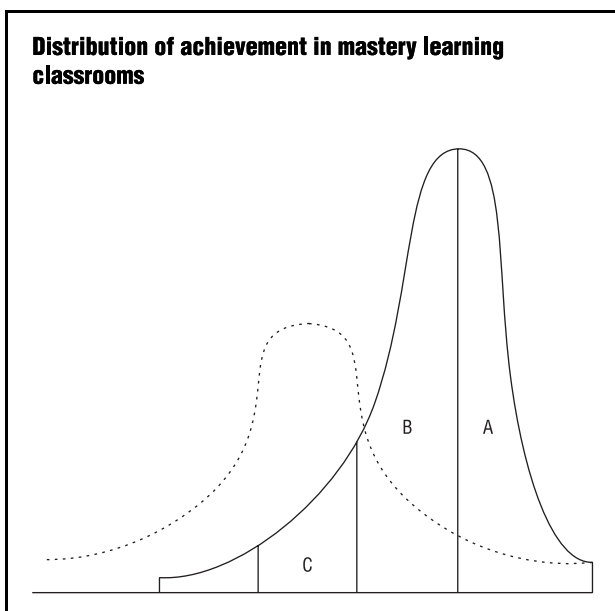


Figure 3 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

measures (Block & Burns, 1976; Block, Efthim, & Burns, 1989; Guskey & Pigott, 1988, Whiting & Render, 1987).

It should be noted that one review of the research on mastery learning, contrary to all others, indicated that the process had essentially no effect on student achievement (Slavin, 1987). This finding surprised not only scholars familiar with the vast research literature on mastery learning showing it to yield very positive results, but also large numbers of practitioners who had experienced its positive impact firsthand. A close inspection of this review shows, however, that it was conducted using techniques of questionable validity (Joyce, 1987; Hiebert, 1987), employed capricious selection criteria (Anderson & Burns, 1987; Kulik, Kulik, & Bangert-Drowns, 1990b), reported results in a biased manner (Bloom, 1987; Walberg, 1988), and drew conclusions not substantiated by the evidence presented (Guskey, 1987, 1988a). Most importantly, two much more extensive and methodologically sound reviews published since (Guskey & Pigott, 1988; Kulik, Kulik, & Bangert-Drowns, 1990a) have verified mastery learning's consistently positive impact on a broad range of student learning outcomes and, in one case (i.e., Kulik, Kulik, & Bangert-Drowns, 1990b), showed clearly the distorted nature of this earlier report.

Researchers in the 21st century generally recognize the value of the central elements of mastery learning and their importance in effective teaching at any level of education. Similar elements provide the foundation for

more recently developed instructional approaches including differentiated instruction (Tomilson, 2003) and understanding by design (Wiggins & McTighe, 2005). As a result, fewer studies focus on the mastery learning process, *per se*. Instead, researchers are looking for ways to enhance results further, adding additional elements to the mastery learning process that positively contribute to student learning in hopes of attaining even more impressive gains (Bloom, 1984a, 1984b, 1988; Walberg, 1990). Recent work on the integration of mastery learning with other innovative strategies appears especially promising (Arredondo & Block, 1990; Guskey, 1988b, 1990a, 1990b; 1997b; Motamedi & Sumrall, 2000).

Mastery learning will not solve all the complex problems facing educators. Nevertheless, careful attention to the elements of mastery learning allows educators at all levels to make great strides in their efforts to reduce the variation in student achievement, close achievement gaps, and help all children to learn excellently.

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Thomas R. Guskey

MATHEMATICS, LEARNING AND TEACHING

SEE *Learning and Teaching Mathematics*.

MCKEACHIE, WILBERT J(AMES) 1921–

The life of arguably one of the most influential educational psychologists began humbly in a one-room school house in White Lake, Michigan. With his father as the lone teacher, Wilbert (Bill) J. McKeachie (born August 24, 1921) began a journey of life-long learning that spanned nine decades. His life experiences include serving as a church minister, a mathematics teacher, a naval radar officer, president of multiple academic organizations, and a marriage to the same woman (Ginny) for 65 years.

After graduating from Michigan State Normal College (later Eastern Michigan University), he spent four months teaching mathematics and serving as a United Methodist minister in Trout Lake, a small town in Michigan's Upper Peninsula. His application for clergy deferment was denied, and in January 1943 he reported for naval training in San Francisco. From June 1943 until the end of World War II, he served as a radar officer on the USS *Guest*. Every destroyer in the *Guest's* fleet was hit, and eight of nine were sunk. Only the *Guest* survived.

Upon his return from war, McKeachie entered the doctoral program in psychology at the University of Michigan. He studied the then-emerging field of personality and social psychology, exploring issues of group formation and conformity, under Michigan's department chair Donald G. Marquis. When McKeachie received his degree, Marquis convinced him to forgo opportunities to join the faculty at other universities and instead stay at Michigan and coordinate the introductory psychology program. McKeachie joined the faculty at Michigan in 1948 and officially retired in 1992, although he continued his work as an emeritus professor into the early 2000s.

His honors and awards (over 30 citations) reflect the many spheres on which his career had an influence. Most

notable among them are the Thorndike Award for Outstanding Research from APA Division 15, APA's Centennial Award for Outstanding Contribution, American Psychological Foundation Gold Medal Award, and APA's Presidential Citation.

In addition to these awards, McKeachie led several academic organizations. He served as president of the American Psychological Association, the American Psychological Foundation, the American Association for Higher Education, and was founding president of the Educational, Instructional, and School Psychology Division of the International Association of Applied Psychology. McKeachie served on the editorial boards of 20 journals and on governing boards of 17 organizations in higher education, many times serving in multiple capacities. (For example, he served in 22 different leadership positions for the American Psychological Association alone.)

Picking the most significant research contributions of someone with more than 390 publications is difficult. Still, three can be highlighted here. His signature written work is arguably his internationally recognized book *Teaching Tips*, as of 2008 in its twelfth edition. This book started as mimeographed copies of pedagogical strategies that he distributed to his teaching assistants in 1951. The book appeared in several languages and was widely respected by university professors. With its wide-ranging content from test-writing to leading discussions to establishing good relations with university support staff it is the quintessential survival guide for new faculty.

Second, the modern-day freshman-experience course has roots in McKeachie's work. These courses, along with the spate of related books, can arguably be traced to McKeachie's course entitled "Learning to Learn," which he first offered at Michigan in 1971. Like most of his work, the course was ahead of its time. It was his attempt to bring what were, at the time, pioneering concepts of motivation and cognition to help college students become better learners. The result was a national trend of most universities offering such courses.

Third, McKeachie was instrumental in securing funding for the National Center for Research to Improve Post-Secondary Teaching and Learning, which was housed at Michigan for five years. The most fruitful product from the center's existence was the Motivated Strategies for Learning Questionnaire (MSLQ), a self-report instrument designed to assist college students in assessing their learning strategies and motivation. Its subscales include what became fundamental concepts in the field of educational psychology such as self-efficacy, critical thinking, and goal orientation. The MSLQ has been used in hundreds of universities, dozens of countries, and translated into several languages.

Lest McKeachie be known as a one-sided academic with no interests or skills outside his career, it is worth noting that he was an amateur music composer, producing a range of works that include his high school fight song in 1939, a civil rights song in the 1960s, and several pieces that were sung by his own First Baptist Church of Ann Arbor. He also had a talent for pitching fastpitch softball. He pitched games in seven decades (from the 1930s to the 1990s), accumulating more than 900 victories. These and other accomplishments, too numerous to mention, demonstrate how his original love of learning that began in White Lake, Michigan, spread across his whole life.

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Scott VanderStoep

MEMORY

Alan Baddeley's 1999 book describes the case of Clive Wearing, a talented musician who in 1985 fell ill with a viral infection that resulted in encephalitis which caused

extensive brain damage. Wearing could no longer remember what happened more than a few minutes before. He continued to believe that he had just regained consciousness and kept a diary in which he constantly recorded that belief. Wearing could, however, still play music. Thus, some kind of memory remained intact. His case demonstrates the importance of memory.

In 1968 Atkinson and Shiffrin developed a model consisting of three different kinds of memory: sensory, short term, and long term (Atkinson & Shiffrin, 1968). Sensory memory is very brief, lasting about 1/3 of a second (Sperling, 1960). Short-term memory is temporary memory storage. It has limited capacity and duration. Long-term memory is a more enduring memory.

SHORT TERM MEMORY AND WORKING MEMORY

Miller described the capacity of short-term memory (STM) storage as 7 ± 2 bits of information (Miller, 1956). Contents in short-term memory last about 20 to 30 seconds unless an individual rehearses or elaborates on the material. There are two kinds of rehearsal: maintenance rehearsal and elaborative rehearsal. Maintenance rehearsal involves the repetition of the contents of STM; elaborative rehearsal involves a deeper form of rehearsal by which people connect the to-be-remembered information to what they already know. One way to reduce the demands on working memory involves chunking information, or grouping bits of information. For example, when trying to remember the phone number 555-1212, it is easier to remember two chunks ("555" and "1212") rather than the seven individual numbers. Information is lost from short-term memory through decay and interference. Decay occurs when information is not used, and it simply fades from memory. Interference occurs when something else gets in the way of recall.

The probability of recalling information presented in a list is influenced by the position of the information in the list, a phenomenon known as the *serial position effect*. Recency effects indicate that items from the end of a list will be recalled, and primacy effects indicate that words at the beginning of a list will be recalled. Recognizing the limits of short-term memory, teachers can keep their instructions brief and provide opportunities for rehearsal.

A MODEL OF WORKING MEMORY

Working memory is a term used to describe a limited, though active, memory system. It differs from short-term memory in that it includes manipulation functions as well as storage. Baddeley proposed that working memory has a number of subsystems that are coordinated by a *central executive* (Baddeley, 1990). The first of these subsystems is the *phonological loop system*, which processes

speech or auditory information. It consists of a passive phonological store and an articulatory rehearsal process.

The Phonological Loop System. The phonological loop processes verbal information. Evidence for it includes the phonological similarity effect, the unattended speech effect and the word length effect. People make more errors if the words they are asked to recall are similar in sound to one another (Baddeley, 1993). When individuals are asked to perform a verbal task (e.g., reading) with speech in the background, performance is impaired, a phenomenon known as the *unattended speech effect*. Verbal information that is presented auditorially is processed automatically. A third source of evidence in support of the phonological loop is found in the *word length effect*. There is a link between memory span and the length of words to be recalled.

The Visuospatial Sketchpad. A second subsystem in Baddeley's model is the *visuospatial sketchpad*, which is used for processing visual or spatial material or both. The results of a 1968 study by Brooks showed that when an individual engages in a visuospatial task such as pointing while performing a visual imagery task, the same processing capacity is being used. If the form of the task (verbal or visual) and that of the response (verbal or visual) are the same, performance is impaired.

The Executive System. The central executive system of working memory controls the phonological loop and the visuospatial sketchpad. It is an attentional control system with limited capacity (Baddeley, 1993). Daneman and Carpenter's 1980 study explored the relationship between working memory and reading comprehension by asking individuals to read passages that contained inconsistencies due to the presence of words with more than one meaning. Individuals with low working memory spans were able to come to the correct conclusion only 25% of the time. Individuals with high working memory spans were able to keep the initial information in working memory until they encountered the information that clarifies the passage. Additional research suggests that the functioning of the central executive system is the key difference between good and poor comprehenders (Oakhill, 1982, 1984; Oakhill, Yuill, & Parkin, 1986).

MEMORY DIFFICULTIES OF CHILDREN WITH SPECIAL NEEDS

When instructions are complicated or lengthy, there is a risk that students will not remember them. If students fail to follow instructions, it may be that the instructions exceeded their working memory's capacity for processing information. Interruptions are frequent in elementary school classes and it seems reasonable to assume that

the constant interruption can produce interference effects. Working memory is involved in such tasks as reading comprehension, writing, problem solving, and mathematics (Swanson & Siegel, 2001).

Individuals with a large working memory span utilize cognitive resources more efficiently while reading, and as a result have more resources for storage while comprehending the text (Swanson & Siegel, 2001). Students must also retrieve information from long-term memory to include in their writing. Maintaining ideas and choosing among them while actually producing text can make heavy demands on memory capacity. Some learners have difficulty writing because of limited working memory capacity.

Students with learning disabilities frequently have deficits in working memory (Swanson & Siegel, 2001). In particular, they have difficulty with reading comprehension because of deficits in the phonological loop. Such difficulties are problematic on tasks that require a learner to retain information in mind for a short period while also carrying out further activities. This skill is very important in reading tasks in which information that is coming in must be stored temporarily while other information is being processed (Swanson & Alexander, 1997). Difficulties with working memory can also interfere with writing, because efforts to record ideas may interfere with maintenance rehearsal in working memory.

Students and teachers can use a variety of strategies to reduce the demands on working memory. Children often count on their fingers, thus giving themselves a visible record of their cognitive activity rather than relying on memory. Other strategies for supporting working memory include presenting information in multiple modalities, allowing students to record their ideas before writing, or using speech-to-text software to reduce the burden on working memory. Using an external representation can reduce the demands on working memory.

LONG TERM MEMORY

Researchers have described several types of long-term memory. The Atkinson and Shiffrin model was based on the duration of memory. Processing was divided among sensory, short-term, and long-term memory. This model was very useful, but it does not provide a complete description of how memory works.

There are several ways to distinguish between various kinds of long-term memories. One important distinction is between episodic and semantic memory (Tulving, 1972). Episodic memory is memory of events and typically includes sensory information (things seen, heard, or smelled, and so on). Such memories often have heightened emotional content (happy, sad, fearful). These memories are embedded in a specific context—a specific

time and place. In contrast, semantic memory is memory of verbal information or declarative knowledge—that is, knowledge about facts. For example, knowing one's address is an example of declarative knowledge. It is separate from sensory information and not tied to particular experiences. Combining episodic and semantic memories makes information more memorable and retrievable.

Semantic memory is memory for meaning and is thought to be organized like a network. In 1969 Collins and Quillian proposed the earliest network model of semantic memory. In this model, semantic networks are made up of a network of related propositions, the smallest units of meaning that can be verified as true or false. A proposition involves linking two concepts by a relationship. Connections between ideas also vary in strength and frequency of use. These factors are more important than the actual categorical structures.

A second distinction in types of memory is between declarative and procedural memory. Declarative memory is like semantic memory. For example, a person might have declarative memories about the structure of a bicycle. In contrast, procedural memory is memory about how to do something. In the example given above, Clive Wearing had retained procedural memory of how to play music.

IMAGES

Responding to a question about an image takes about the same amount of time as responding to a picture (Kosslyn, 1976). In one study, participants were asked to form a mental image of a cat. They were then asked questions such as, "Does the cat have a head?" and "Does the cat have claws?" Responses to the latter question took longer, as participants appeared to scan the image.

Image information is thought to be stored in piecemeal fashion in long-term memory. Images are created by activating the overall or global shape of the image; elaborations are then added to create a complete image (Kosslyn, 1980, 1983). More detailed images take longer to retrieve. Images are thought to be stored in a non-image format that specifies a *recipe* for constructing the image. As with the processing of language, processing images takes time.

SCHEMAS AND SCRIPTS

Semantic memory is organized in complex networks. Complex understanding of a domain will result in a dense network of interconnected propositions about that domain. *Schemas* refer to organized sets of propositions about a topic (Bartlett, 1932). Learners' available schemas influence how they interact with the environment.

The learner's schemas may be altered as a result of interacting with the environment.

A schema that describes the typical sequence of events in a situation is called a *script*, or *event schema*. For example, when people go to a restaurant, they usually expect actions to unfold in a particular way. Another type of script is a story grammar that can help students to understand and remember stories (Gagné, Yekovich, & Yekovich, 1993).

LEVELS OF PROCESSING

In 1972 Craik and Lockhart proposed an alternative theory of memory. It suggested that memory differences are not so much a function of duration as of depth of processing (Craik & Lockhart, 1972). They showed that students who attended to meaning performed significantly better than those who attended to surface features of the words. Craik and Lockhart argued that the differences in performance reflected differences in depth of processing.

Craik and Lockhart's concept of levels of processing helped shift the emphasis in the study of memory from storage to processing. The Atkinson and Shiffrin model defined memory systems in terms of the storage/duration of memories and described very short stores (sensory and short-term memory) and very long-term stores (long-term memory). The levels of processing theory focuses on the likelihood of retrieval as a function of how effortful and meaningful the initial encoding was.

ENCODING: ORGANIZATION, PRACTICE, AND ELABORATION

Encoding is the taking in of information. The probability that information will be retrieved or remembered depends on the quality of encoding. Key processes in good encoding are organization, practice, and elaboration. It is easier to learn organized material than it is to learn disorganized material.

Practice helps develop good memory. Material that is used more often is remembered more easily. However, there are different ways of practicing. Distributed practice is much more effective than massed practice. Distributed practice is done over a period of time, with varying intervals between rehearsals of the information. Remembering involves using the cues available to assist remembering but also involves generating cues that help remembering. Distributed practice allows students to practice both of these skills. Massed practice, in contrast, involves engaging in extensive practice at one time, such as studying all night before an exam. This can be somewhat effective for an immediate task but is unlikely to lead to long-term recall of information.

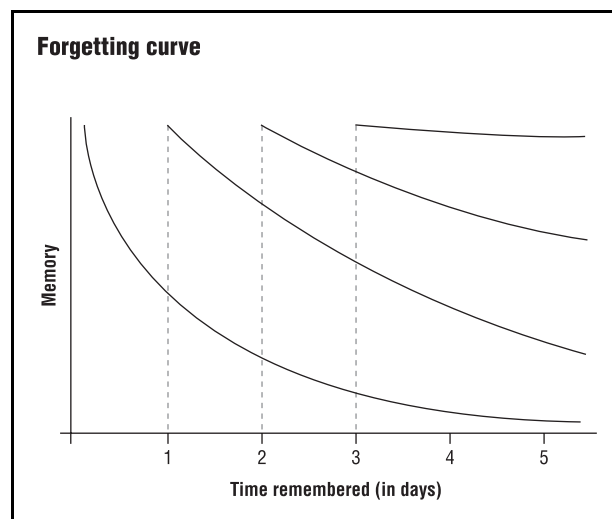


ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Elaboration also helps in encoding and retrieval. It involves connecting new information with prior knowledge or to images or other enhancements of the information to be learned. Images in particular are powerful aids to memory and are frequently used to elaborate on information.

IMAGERY AND VISUAL LEARNING STRATEGIES

Dual-coding theory (Paivio, 1986) explains why images are helpful in remembering. According to this theory, images and words are represented differently, as *imagens* and *logogens*. When the two forms of representations are linked, the memory for the information is stronger. Baddeley's findings on the separate working memory systems for visual and verbal information also support the importance of presenting and learning information in both visual and verbal forms (Baddeley, 1999). Visual strategies such as concept maps and graphic organizers integrate verbal, visual, and spatial information to enhance encoding and retrieval.

RETRIEVAL AND FORGETTING

Remembering can occur through either recognition memory or recall. Recognition memory responds to cues. Responding to multiple-choice tests can require recognition memory because the cues provided by the options from which one may choose will provide some assistance to memory. When information is recalled, one must generate information without cues. Responding to an essay question, for example, requires that one generate and organize the content.

Retrieval occurs within a semantic network because activation is spread from one node to another. Related ideas are triggered. The specific linkages will vary from one person to another. Because of the structure of a network, retrieval can involve reconstructing the links between propositions and ideas.

Forgetting occurs when there is interference or decay. When material is encoded in an organized manner, more cues are encoded, thus making retrieval easier. Also, information that is used more frequently is easier to recall. Material that is not encoded in an organized way and not used often is more likely to be forgotten. This is so because in a propositional network model of memory, retrieval occurs through a process of spreading activation. When one node in a network is triggered, related nodes are also triggered as activation spreads along the links to them. When these links are used often, less activation is needed to generate the connecting node. If the nodes are highly interconnected with many links, forgetting is less likely, but retrieval may take longer. In a curious irony, the more people know, the longer it may take them to verify that they know it.

Forgetting occurs when information is not used. If students have not practiced solving geometry problems for a year, they are likely to have forgotten the steps in doing so. Forgetting also occurs because of interference.

BRAIN PROCESSES AND MEMORY

A number of structures in the medial temporal lobes of the brain are important for memory. They include the amygdala, the hippocampus, and the rhinal cortex that underlies the amygdala and hippocampus. The hippocampus plays a key role in the storage of new memories (Gazzaniga & Heatherton, 2003). The hippocampus and surrounding rhinal cortex are the most important areas for the consolidation of memory (Eichenbaum, 2002; Gazzaniga & Heatherton, 2003). The frontal lobes are also considered important for memory; although people who experience damage to the frontal lobes do not suffer dramatic memory loss, they may have difficulty remembering the order of events. Brain-imaging studies show that when people try to remember a list of words, the frontal lobes light up (Buckner, Kelly, & Petersen, 1999). The frontal lobes are more active when a task requires deeper encoding.

SEE ALSO *Cognitive Strategies; Information Processing Theory.*

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Angela M. O'Donnell

MENTAL RETARDATION

With the advent of the Binet test in the early 20th century, professionals were provided with a way of quantifying intelligence and defining the condition subsequently known as mental retardation. Later, the American Association on Mental Retardation (AAMR) assumed a leading role in defining mental retardation for professional audiences. The AAMR definition was updated frequently in response to changes in the way that mental retardation was conceptualized by those in the field. As of the early 2000s AAMR definition states: "Mental retardation is a disability characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills. This disability originates before age 18" (American Association on Mental Retardation, 2002). Examiners use standardized tests to assess intellectual and adaptive behavior functioning. As a part of the standardization process for these measures, normative groups are used to determine age based deviation scores that have a mean of 100 and, usually, a standard deviation of 15 points. Significant limitations are present when these scores are more than two standard deviations below the mean (i.e., a score of 70-75 allowing for the standard error of measurement for the specific assessment instrument used).

The AAMR definitions have typically been incorporated into current versions of other diagnostic systems. For example, the language of the 1992 AAMR definition is clearly evident in the *Diagnostic and Statistical Manual of Mental Disorders IV TR* (APA, 2000). In contrast, state educational agencies vary considerably in which definition of mental retardation is used to establish eligibility guidelines. A survey of state agencies conducted by Denning, Chamberlain, and Polloway (2000) revealed that the 1983 AAMR definition of mental retardation was being used in 86 percent of the states in either verbatim or an adapted version and that only 7.9 percent of the states had incorporated the 1992 AAMR definition in an adapted or verbatim format. Moreover, 5.9 percent of the states used alternative definitions. The reasons for these differences in definition were not readily apparent from the published report.

In the early 2000s, the term *mental retardation* is rapidly falling into disfavor among professionals, families, and self-advocates. There is considerable pressure to change the term to something that is perceived as less stigmatizing, such as intellectual disability. Intellectual disability is the term that is currently used in many other English speaking countries, and, perhaps for that reason, this term was chosen by the American Association on Mental Retardation as a replacement in its organization name. The American Association on Intellectual and

Developmental Disabilities is in concert with other prominent organizations such as the International Association for the Scientific Study of Intellectual Disabilities and the President's Committee for People with Intellectual Disabilities. Although there is increasing momentum for widespread change in terminology, the term mental retardation remains imbedded in public policy. For example, a diagnosis of mental retardation is typically required to establish eligibility for state and federal disability programs such as the Individuals with Disabilities Education Improvement Act of 2004, Social Security Disability Insurance, and the Medicaid Home and Community Based Waiver. Schalock, Luckasson, and Shogren have argued that "intellectual disability covers the same population of individuals who were diagnosed previously with mental retardation in number, kind, level, type and duration of the disability, and the need of people with this disability for individualized services and supports" (2007, p. 120). Although it is relatively easy for a professional association to adopt a change in terminology, as of 2007 it is expected to be some time before other associations and governmental entities would follow suit no matter how much the change is needed.

ASSESSMENT

Contemporary definitions of mental retardation require assessment of general intellectual functioning and adaptive behavior to determine a diagnosis. General intellectual functioning is measured by an individually administered, standardized intelligence test. Measures appropriate for school age children include the Wechsler Preschool and Primary Scale of Intelligence (3rd ed.), the Differential Ability Scales-II, the Wechsler Intelligence Scale for Children (4th ed.), Kaufman Assessment Battery for Children-II, and Stanford-Binet (5th ed.). Test selection is based on the chronological age of the child and the child's general level of functioning as well as the test's ability to clearly differentiate among children who perform at the lower end of a particular test. Given the likelihood that a child with mental retardation may also have sensory impairment or physical disability or be nonverbal, assessments have to be highly individualized and require the use of specialized measures designed for these populations. For example, intelligence tests appropriate for nonverbal or hearing impaired students are the Test of Nonverbal Intelligence-3 and the Leiter International Performance Scale (Rev.). In general, intellectual assessments for children with mental retardation require an examiner with considerable skill and experience in the assessment of children with special needs (Sattler & Hoge, 2006).

Adaptive behavior is typically assessed by informant report given the need for information about typical behavior that would go beyond that observed in a formal testing situation. Informants can include parents, teachers, or some

other adult with considerable knowledge of the child's daily functioning. Measures of adaptive behavior assess personal and social competence in meeting common life demands as determined by the child's chronological age as well as the child's cultural background. Examples of areas assessed by these measures include: communication and language skills, social and interpersonal skills, gross and fine motor skills, and degree of independence in daily living skills. There are several well standardized measures available as of 2007, including the Adaptive Behavior Assessment System-II, Scales of Independent Behavior (Rev.) and the Vineland Adaptive Behavior Scales-II. These instruments vary in their coverage, but all assess skills and abilities consistent with the conceptual, social, and practical dimensions of adaptive behavior in the 2002 AAMR definition as well as the specific adaptive skill areas delineated in the DSM-IV TR (2000) (i.e. communication, self-care, home living, social skills, community use, self-direction, health and safety, functional academics, leisure skills, and work skills for adults only).

CHARACTERISTICS OF MENTAL RETARDATION

Children with mental retardation are typically identified because they do not keep pace with developmental expectations in cognitive, language, social, and motor functioning. Typically, significant developmental delays in early childhood are predictive of poor academic functioning in childhood, as compared with same-age peers. Considerable study has been directed toward identifying the cognitive difficulties associated with mental retardation. Most of this work was conducted using experimental designs based on the deficit model of mental retardation. That is, comparisons were made between children with mental retardation and their same chronological age peers. Using this framework, nearly every cognitive process studied revealed dramatic differences between the two groups. The areas of study included attention, working memory, perceptual organizational skills, verbal problem solving, visual-spatial problem solving, vocabulary, language and abstract reasoning, among others. Subsequent studies have adopted a developmental perspective, in which the functioning of children with mental retardation is compared with typically developing children of comparable developmental level. Although some differences remain, it is clear that children with mental retardation generally follow the same developmental pathways as their typically developing peers but at a slower rate and do not ultimately attain as high a level.

Similarly, slower progress in attaining independence in meeting common life demands, or adaptive behavior, characterize children with mental retardation. It is a matter of some debate as to whether the observed deficits

in adaptive behavior are a function of deficits in intellectual functioning. In fact, empirical studies indicate a high degree of correlation between measures of intelligence and adaptive behavior suggesting that they are not entirely independent entities. Moreover, some authors suggest that there are unique aspects of adaptive functioning that are not tapped by existing measures. These attributes include social intelligence, social competence, vulnerability, gullibility, and credulity. Greenspan (1999) argues that deficits in these areas contribute to the victimization of children with mental retardation as well as social and economic exploitation.

INDIVIDUAL DIFFERENCES AMONG CHILDREN WITH MENTAL RETARDATION

Throughout the 20th century, people realized that there are demonstrable and clinically relevant differences among people with mental retardation. Traditionally this differentiation was based on level of functioning. The terms mild, moderate, severe, and profound are in the early 2000s used in DSM IV TR to designate levels of mental retardation that correspond to standard deviation units below the mean. Mild mental retardation is defined as between two and three standard deviations below the mean, moderate mental retardation is between three and four and so on. These categories have endured because there are clear differences among the levels in both cognitive performance and adaptive functioning. A similar subgroup classification system, using different terminology (i.e., educable, trainable, severe/profound), is still employed by some state education departments (Denning et al., 2000).

In 1992 the American Association on Mental Retardation published a revision of its classification manual that represented a paradigm shift for the field. In this system, reliance on a deficit oriented approach (i.e., mild, moderate, severe, and profound) was supplanted by a supports-based approach to describing the individual needs of persons with mental retardation. By so doing the severity level descriptions were abandoned and a diagnosis of mental retardation was based solely on IQ and adaptive functioning scores below 70 to 75. The new classification system required description of the degree of support needed to maximize a person's performance across a variety of functioning areas. Support was defined in terms of intensity and duration and categorized as intermittent, limited, extensive, and pervasive. Support needs were designated for each area of functioning recognizing that an individual may require more intensive supports in some areas as contrasted with others. Accordingly, a person might require extensive supports in academic activities and intermittent support in self-care

activities. Ultimately this information could inform intervention planning and enhance the person's overall functioning level. The AAMR (later AAIDD) published a Supports Intensity Scale for use with adults, with a children's version of the Supports Intensity Scale expected to follow.

A emphasis within the field as of 2007 is to focus on etiology in describing subgroups of children with mental retardation. For example, research aimed at defining the behavioral characteristics, or phenotypes, of various genetic disorders is moving ahead at an accelerated rate. Although a great deal of research has been focused on Fragile x, Angelman, Prader-Willi, Smith Magenis, and Williams syndromes, much was also published on Down syndrome. Studies of specific genetic disorders have yielded information regarding cognition, language and communication, visual-spatial skills, social development, and maladaptive behavior that has implications for educational professionals (Fidler, Hodapp, & Dykens, 2002).

INTERVENTIONS AND INSTRUCTIONAL PROCEDURES IN THE EARLY 2000S

Beginning with the Education for All Handicapped Children Act in 1975, the Individualized Education Plan has been the blueprint for educational services provided to children with mental retardation. This act established that all children, regardless of ability, were guaranteed a free and appropriate public education in the United States. The early 21st century version of this landmark legislation is known as the Individuals with Disabilities Education Improvement Act of 2004. A guiding principle of this legislation is that services should be provided in the least restrictive environment. That is, children with disabilities should receive educational services with their typically developing peers to the greatest degree possible. The goal for students with disabilities is inclusion within the general education setting. Inclusion means more than physical presence in the classroom or other education setting. Various practices are used to facilitate inclusion such as cooperative learning and peer tutoring experiences as well as instructional tools or strategies that enhance the salience of the academic content. Generally speaking, children with needs for extensive or pervasive supports spend the majority of their day in self-contained educational settings while children with less intense support needs may spend the majority of their day in a general education class with special education teacher services.

Early 2000s legislation such as the No Child Left Behind Act has reinforced the view that children with disabilities, including mental retardation, should graduate from public schools with basic or fundamental knowledge in mathematics, literacy, science and technology,

practical skills sufficient to be self-supporting upon graduation, and problem-solving skills that foster lifelong learning. The success with which students with mental retardation achieve these skills varies considerably. For those who experience the greatest challenge with the general curriculum, efforts have yielded a functional curriculum that provides critical skills needed to participate in daily routines. These skills include independent living skills, communication, social skills, academic skills, and transition and community living skills. Support within the general education curriculum for children with mild mental retardation can be achieved in several different ways such as the use of accommodations that provide equal access to learning, curriculum modifications based on the child's current level of academic mastery, and adaptations of instructional methods to facilitate completion of assigned tasks.

Instructional procedures vary according to the needs of individual children. In general, children with mental retardation require explicit instruction if they are to succeed in school. Research has focused on a variety of methods to maximize instructional outcome and to promote generalization to real world settings. Examples of these methods include encouraging choice-making and self determination to enhance motivation to learn, teaching self-monitoring skills to encourage independence in completing academic tasks, and embedding instruction within activities to promote stimulus generalization and student motivation while distributing instructional trials over longer periods of time.

ISSUES RELATED TO ASSESSMENT AND INSTRUCTION

Children with mental retardation are likely also to have other deficits, such as cerebral palsy, seizure disorders, and sensory impairment (such as hearing and/or visual problems). In general, children with severe or profound mental retardation are at greater risk for these associated conditions as compared with children with mild or moderate mental retardation. Children with mental retardation are also at increased risk for health conditions that may affect their attendance at school as well as their participation in school activities. Finally, children with mental retardation are also at greater risk for speech problems. These difficulties can include difficulty with articulation as well as voice problems such as abnormal pitch or voice intensity.

Psychiatric diagnoses are more common among children with mental retardation as compared with their typically functioning peers. Epidemiological studies suggest that the risk may be as much as four times greater. For example, a study of 10,000 children aged 5 to 15 years in Great Britain revealed that 39 percent of children with mental retardation met DSM-IV and ICD-10

criteria for at least one psychiatric disorder as compared with 8.1 percent of children without mental retardation (Emerson, 2003). The reasons for this increased risk are not well known. Generally it is believed that the increased prevalence of sensory disorders, epilepsy, and brain damage associated with many specific etiologies play a role as does atypical developmental experience. It could well be that many children do not meet the criteria for a diagnosis of mental disorder but do manifest sub-threshold levels of particular symptoms that warrant intervention. The terms *behavior problems* or *behavior disorders* are often used to describe such cases.

The emphasis on studying behavioral phenotypes associated with particular etiologies has revealed co-occurring behavior problems and psychiatric disorders. These associations include attention-deficit hyperactivity disorder in fetal alcohol syndrome, anxiety in Williams syndrome, oppositional and defiant behavior in Smith-Magenis and Down syndromes, and self-injury in Lesch-Nyhan, Prader-Willi, Smith-Magenis, and Fragile x syndromes. Moreover, epidemiological studies indicate that as many as 75 percent of children with autism also have mental retardation. These children can be particularly challenging in the school setting when they exhibit property destruction, physical aggression, self-injury, and tantrums.

SEE ALSO *Special Education*.

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META-ANALYSIS

The term meta-analysis, first coined by Gene Glass in 1976, refers to a statistical technique used to synthesize data from separate comparable studies in order to obtain a quantitative summary of research addressing a common question. In 1904 Karl Pearson published what is believed to be the first meta-analysis, examining the effectiveness of a vaccine against typhoid. In 1932 Ronald Fisher, in his classic text *Statistical Methods for Research Workers*, presented a technique for combining the *p* values that came from statistically independent tests of the same hypothesis. However, meta-analysis began to gain widespread use beginning in the 1960s with the tremendous growth in social scientific research and increasing interest in its social policy implications (Chalmers, Hedges, & Cooper, 2002). During the 1970s and 1980s, many of the techniques first invented by Pearson and Fisher were rediscovered and more sophisticated techniques were developed with the work of Gene Glass, Barry McGaw, and Mary Lee Smith (1981), John Hunter, Frank Schmidt, and Greg Jackson (1982), Robert Rosenthal (1984), and Larry Hedges and Ingram Olkin (1985).

Prior to the widespread use of meta-analysis, researchers relied on a narrative approach to summarize and integrate research on a specific topic. However, traditional narrative reviews have been criticized because, although they can provide a meticulous list of multiple tests of a hypothesis, they often fail to fully and accurately integrate findings and are prone to allowing the biases of the reviewer to enter into conclusions. Just as in the traditional narrative review of research, the aim of a meta-analysis is to summarize the results of past studies, suggest potential reasons for inconsistencies in past research findings, and direct future investigations. However, although meta-analysis has the same goals as the traditional narrative review, many limitations of the narrative review can be addressed by using statistical procedures to combine the results of previous studies (Cooper & Rosenthal, 1980). In the early 2000s, meta-analysis is an accepted and respected technique across many disciplines from psychology and education to medicine and public policy.

META ANALYTIC PROCEDURES

Prior to conducting a meta-analysis, the researcher must first define the problem to be addressed by the meta-analysis, collect research relevant to the problem, and evaluate the quality of the data (Cooper, 1998). After these steps have been completed, then a meta-analysis can be conducted and the results interpreted.

Often the purpose of a meta-analysis is to answer three questions. First, does variable X have an effect on variable Y? Second, how much of an effect does variable X have on Y? Finally, are there moderating variables that can explain why the effect of X on Y varies from one study to the next? To answer the first two questions, meta-analysts will (a) calculate an effect size for the outcomes of hypothesis tests in every study and (b) average these effect sizes across hypothesis tests to estimate general magnitudes of effect and calculate confidence intervals as a test of the null hypothesis. In order to examine the question of moderating variables, meta-analysts will also (c) conduct homogeneity analyses in order to assess whether variations in outcomes exist and what features of comparisons might account for that variation, if it exists. The procedures for conducting a meta-analysis are described in detail in Cooper (1998), Cooper and Hedges (1994), Hedges and Olkin (1985), and Lipsey and Wilson (2001).

Estimating Effect Sizes. Cohen (1988) defined an effect size as “the degree to which the phenomenon is present in the population, or the degree to which the null hypothesis is false” (pp. 9–10). There are many different metrics to describe an effect size. Generally, each metric is associated with particular research designs. Although numerous estimates of effect size are available, three dominate the literature. The first, called the *d*-index by Cohen (1988), is a scale-free measure of the separation between two group means that is used when one variable in the relation is dichotomous and the other is continuous. Calculating the *d*-index for any study involves dividing the difference between the two group means by either their average standard deviation or the standard deviation of the control group. Another effect size metric is the *r*-index, or the Pearson product-moment correlation coefficient. Typically it is used to measure the degree of linear relation between two continuous variables. The third effect size metric is the odds ratio. The odds ratio is applicable when both variables are dichotomous and findings are presented as frequencies or proportions. The index is often used in studies of educational interventions when the outcome of interest is drop-out or retention rates.

Averaging Effect Sizes. The primary findings of meta-analyses are the average effect sizes and measures of dispersion that accompany them. State-of-the-art meta-

analytic procedures call for the weighting of effect sizes when they are averaged across studies. In the weighted procedure, each independent effect size is first multiplied by the inverse of its variance and the sum of these products is then divided by the sum of the inverses. The weighting procedure is generally preferred because it gives greater weight to effect sizes based on larger samples and larger samples give more precise population estimates. Confidence intervals are then calculated to test the null hypothesis that the difference between two means, or the size of a correlation or odds ratio, is zero.

Homogeneity Analyses. In addition to the confidence interval as a measure of dispersion, meta-analysts usually carry out homogeneity analyses. Homogeneity analyses allow the meta-analyst to explore whether effect sizes vary from one study to the next. A homogeneity analysis compares the amount of variance in an observed set of effect sizes with the amount of variance that would be expected by sampling error alone and provides calculation of how probable it is that the variance exhibited by the effect sizes would be observed if only sampling error were making them different. If there is greater variation in effects than would be expected by chance, then the meta-analyst can begin the process of examining moderators of comparison outcomes.

Moderator Analyses. Homogeneity analyses also allow the meta-analyst to test hypotheses about why the outcomes of studies differ. First, the meta-analyst calculates average effect sizes for different subgroups of studies, comparing the average effect sizes for different methods, types of programs, outcome measures, or participants. Then, homogeneity analyses are used to statistically test whether these factors are reliably associated with different magnitudes of effect. As previously suggested, homogeneity analyses assess whether sampling error alone accounts for variation or whether the features of studies, samples, treatment designs, or outcome measures also explain variations in the strength and/or direction of effect sizes across various groupings. This test is analogous to conducting an analysis of variance, in that a significant homogeneity statistic indicates that at least one group mean differs from the others.

Alternatively, meta-regression can be used to examine whether particular characteristics of studies are related to the sizes of the treatment effect. However, unlike the strategy previously discussed, meta-regression allows the meta-analyst to explore the relationship between continuous, as well as categorical, characteristics and effect size, and allows the effects of multiple factors to be investigated simultaneously (Thompson & Higgins, 2002).

COMPLEX DECISIONS IN META ANALYSIS

When conducting primary research, investigators encounter decision points at which they have multiple choices about how to proceed. Meta-analysts must make decisions concerning how to handle multiple effect sizes coming from the same sample since this violates the assumption of most meta-analytic procedures that effect sizes are independent data points. Meta-analysts employ multiple approaches to handling non-independent tests. Some treat each effect size as independent so that no within-study information is lost, regardless of the number that come from the same study. However, this strategy violates the assumption that the estimates are independent and results of studies will not be weighted equally in any overall conclusion about results. Rather, studies will contribute to the overall effect in relation to the number of statistical tests contained in it.

Others use the study as the unit of analysis. In this strategy, a mean or median result is calculated to represent the study. This strategy ensures that the assumption of independence is not violated and that each study contributes equally to the overall effect. However, some within study information may be lost in this approach. As of 2007 the preferred approach is to use a shifting unit of analysis (Cooper, 1998). Here, each study is allowed to contribute as many effects as there are categories in the given analysis, but effects within any category are averaged. This shifting unit of analysis approach retains as much data as possible from each study while holding to a minimum any violations of the assumption that data points are independent.

Meta-analysts also have to decide whether a fixed-effects or random-effects model of error underlies the generation of study outcomes (Hedges & Vevea, 1998). In a fixed-effects model of error, all studies are assumed to be drawn from a common population. As such, variance in effect sizes is assumed to reflect only sampling error, that is, error solely due to participant differences. In a random-effects model of error, studies are expected to vary also as a function of features that can be viewed as random influences. Thus, in a random-effect analysis, study-level variance is assumed to be present as an additional source of random influence. If it is the case that the meta-analyst suspects a large number of these additional sources of random error, then a random-effects model is most appropriate in order to take these sources of variance into account. If the meta-analyst suspects that the data are most likely little affected by other sources of random variance, then a fixed-effects model can be applied. However, it is often difficult to decide whether there may be sources of random error affecting results. Consequently, the most conservative approach is to con-

duct all analyses twice, once employing fixed-effect assumptions and once using random-effect assumptions. Differences in results based on which set of assumptions is used can be incorporated into the interpretation and discussion of findings.

ALTERNATIVE APPROACHES TO META ANALYSIS

While the inverse-variance method deriving from Hedges and Olkin (1985) described above has the most widespread use, alternative approaches to meta-analysis exist. In particular, approaches deriving from both Rosenthal (1984) and Hunter, Schmidt, and Jackson (1982) are commonly used.

Like the inverse-variance method, the Rosenthal technique converts study findings into standard index of effect and combines them to produce weighted means. However, unlike the Hedges and Olkin approach to estimate the overall significance of the effect, Rosenthal suggests combining the probabilities of each effect size. Further, heterogeneity is examined informally using diffuse and focused comparisons.

In the Hunter, Schmidt, and Jackson (1982; Hunter & Schmidt, 2004) approach, study findings are also converted into standard index of effect and combined to produce weighted means. However, untransformed effect size estimates weighted by the sample size of the study are used to compute the weighted mean effect size. Further, heterogeneity in effect sizes across studies is examined by comparing the observed variation in obtained effect sizes with the variation expected due to sampling error, that is, the expected variance in effect sizes given that all observed effects are estimating the same underlying population value. However, a formal statistical test of the difference between these two values is typically not carried out. Rather, the meta-analyst adopts a critical value for the ratio of observed-to-expected variance to use as a means for rejecting the null hypothesis. In this approach, the meta-analyst might also adjust effect sizes to account for methodological artifacts such as sampling error, range restrictions, or unreliability of measurements. This method has been applied most often in the areas of industrial and organizational psychology.

ADVANTAGES OF META ANALYSIS

There are a number of advantages of meta-analysis over traditional narrative techniques for synthesizing research (see Rosenthal & DiMatteo, 2001, for a full review). First, the structured methodology of meta-analysis requires careful review and analysis of all contributing research. As such, meta-analysis overcomes much of the bias associated with the reliance on single studies or subsets of studies that inevitably occurs in narrative

reviews of a literature. Second, meta-analysis allows even small and non-significant effects to contribute to the overall conclusions and avoids wasting data because a sample size was too small and significance was not achieved.

Third, meta-analysis allows the synthesist to ask questions about variables that moderate effects. Specifically, even if no individual study has compared results of different methods, types of programs, outcome measures, or participants, by comparing results across studies the synthesist can get a first hint about whether these variables would be important to look at in future research and/or as guides to policy. Without the aid of statistics, the synthesist simply examines the differences in outcomes across studies, groups them informally by study features, and decides whether the feature is a significant predictor of variation in outcomes. At best, this method is imprecise. At worst, it leads to incorrect inferences. In contrast, meta-analysis provides a formal means for testing whether different features of studies explain variation in their outcomes.

LIMITATIONS OF META ANALYSIS

Despite many advantages, meta-analysis has been criticized for a number of legitimate limitations and concerns. First, while many meta-analysts go to great lengths to locate as much relevant research as possible, missing data as a result of the literature search procedures on the part of the synthesist or data censoring on the part of primary researchers, editors, or publishers is often inevitable. When data are systematically missing, not only is the size of the sample gathered for the research synthesis reduced, but the representativeness of the sample and the validity of the results are compromised, regardless of the quality of the meta-analysis in all other respects (Rothstein, Sutton, Borenstein, 2005). A number of techniques have been developed in order to assess the possible presence of data censoring and the implications of this threat to the validity of the conclusions drawn from the meta-analysis (see Rothstein, Sutton, Borenstein, 2005, for full review).

Second, meta-analysis is sometimes criticized for combining research of varying quality using various methods and samples. Because a meta-analysis is only as good as the primary research it is cumulating, it is important that the meta-analyst believes that each finding is testing the same relationship and that the primary researchers made valid assumptions when they computed the results of their statistical tests. Of course, research quality can also be used as a moderator variable in the meta-analysis.

Third, while educational psychology research often examines the combination and interaction of many variables in multifactorial models, including regression analyses,

meta-analysis is focused on individual effects. Consequently, there is some loss of information in meta-analysis because it remains difficult to include studies in which complex models were used to analyze data.

Finally, synthesis-based evidence should not be interpreted as supporting statements about causality. When different study characteristics are found associated with the effects of a treatment, the synthesist should recommend that future researchers examine these factors within a single experiment.

DIRECTING RESEARCH AND INFORMING EDUCATIONAL POLICY

With the ever growing volume of primary research on various education related topics, meta-analysis has become an essential tool among school policy makers and practitioners for coping with the overwhelming number of results. In the early 2000s, meta-analysis is often used to guide policy and practice in the classroom. Topics have ranged from the effectiveness of homework, access to special education, or the relationship between class size and achievement to the effect of providing rewards on intrinsic motivation or the relationship between race and achievement motivation. Further, often a synthesis of the current research leaves as many questions unanswered as it answers. However, it provides a comprehensive guide to direct future research. Clearly, the synthesist faces a number of complex issues in conducting a meta-analysis. However, if social science research is to contribute to rational decision making, then rigorous, systematic syntheses of research are a most critical component in researchers' methodological toolbox. Meta-analysis facilitates the attainment of these necessary standards.

SEE ALSO *Research Methods: An Overview.*

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METACOGNITION

Learning depends, in part, on the effective use of basic cognitive processes such as memory and attention, the activation of relevant background knowledge, and the deployment of cognitive strategies to achieve particular goals. To ensure that the basic processes are used effectively, that the activated knowledge is indeed relevant, and that appropriate strategies are being deployed, learners also need to have awareness and control of their cognitive processes. This higher-level cognition was given the label metacognition by American developmental psychologist John Flavell (1976).

The term metacognition literally means cognition about cognition, or more informally, thinking about thinking. Flavell defined metacognition as knowledge about cognition and control of cognition. The knowledge component encompasses what one knows about cognition, including knowledge about oneself as a learner, about aspects of the task at hand, and about strategies needed to carry out the task effectively. The control component encompasses the strategies one uses to make cognitive progress, such as planning how to approach a task, evaluating progress as the task is being completed, and changing tactics if difficulties arise.

HISTORICAL ROOTS OF INQUIRY IN METACOGNITION

Research on metacognition had its origins in the 1970s work of Flavell (1976, 1979) and another prominent developmental psychologist, Ann Brown (1943-1999). This work focused on children's metamemory, that is, their knowledge and control of their memory processes. In a landmark study, Kreutzer, Leonard, and Flavell, interviewed children in kindergarten and grades 1, 3, and 5 to determine their knowledge of how their memories work. Open-ended questions were asked about a variety of hypothetical situations tapping knowledge of person, task, and strategy variables influencing memory. For example, children were asked how they could be sure to remember to take their skates to school with them the next day and how they would remember a phone number, and whether it would be easier or harder to remember a list of words they had already studied. Responses revealed that even the youngest children had some knowledge of the workings of their memory, but that older children had greater insights.

Brown's early interest in metacognition was reflected in the title of a 1978 chapter, "Knowing when, where, and how to remember: A problem of metacognition." Her 1970s research on how well children were able to assess their readiness to be tested on recall of simple materials, such as pictures of common objects, evolved naturally into research on the role of metacognition in studying academic materials and comprehending prose. Her 1980 chapter in a book on theoretical models of reading introduced metacognition to the community of reading researchers and helped to fuel the most active line of domain-specific inquiry in metacognition.

Although Flavell and Brown are credited with introducing the term metacognition, they were not the first to study phenomena that was to be called metacognitive. From the beginning of the twentieth century reading researchers were documenting the importance of monitoring and regulating one's comprehension processes. Memory researchers were studying feelings of knowing and memory monitoring from at least the 1960s. Information processing models from the 1970s included executive control systems that regulate basic cognitive processes.

In addition, Soviet psychologist Lev Vygotsky (1896-1934) and Swiss psychologist Jean Piaget (1896-1980) included processes regarded as metacognitive in their theories of children's thinking. Vygotsky theorized that children develop the capacity for self-regulation through interaction with more knowledgeable others. These individuals initially assume responsibility for monitoring progress, setting goals, planning activities, allocating attention, and so on. Gradually, responsibility for these executive processes is given over to the child, who

becomes increasingly capable of regulating his or her own cognitive activities. This transition from other-regulation to self-regulation is in the early 2000s regarded as a hallmark of metacognitive development. Piaget theorized that peers challenge one another's thoughts and thus advance their cognitive development. Inducing children to reflect on their own thinking is in fact inducing metacognition.

Vygotsky's theory provides the foundation for contemporary classroom interventions that begin with explicit instruction on the part of the teacher, followed by modeling and guided practice of cognitive and metacognitive strategies, with a gradual release of responsibility to the student.

Piaget's theory has been built upon by contemporary researchers, including Palincsar and Brown, to reveal that peer discussion and collaboration help students to monitor their own understanding and build new strategic capabilities.

IMPORTANCE OF METACOGNITION IN THEORIES OF LEARNING AND INSTRUCTION

The implicit focus on metacognitive processes in early theories of information processing and cognitive development gave way to an explicit focus in contemporary theories of learning and instruction. Within a decade of the seminal work of Flavell and Brown, hundreds of laboratory studies had accumulated showing that metacognitive knowledge and control were associated with more successful cognitive performance, and applied research confirmed the practical importance of metacognition in the classroom. When students have knowledge and control of their own cognitive processes, learning is enhanced; this assertion holds regardless of the domain of learning, whether reading, writing, science, mathematics, or any other activity that involves thinking.

Evidence that metacognition is firmly entrenched in theorizing about how students learn comes from two influential national committees charged with reviewing and synthesizing the research on learning in the 1990s. Early in the decade a taskforce of the American Psychological Association, under the leadership of Nadine Lambert and Barbara McCombs, developed a set of learner-centered psychological principles intended as guidelines for school redesign and reform. Informing the principles was a model of learning that integrated the following factors: cognitive, metacognitive, motivational, affective, developmental, social, and individual differences. Metacognition was featured in one of the 14 learner-centered principles: "Thinking about thinking: Higher order strategies for selecting and monitoring mental operations facilitate creative and critical thinking." In justifying this principle the authors noted that instructional approaches

that foster metacognition can enhance not only student learning but also student responsibility for learning.

Later in the 1990s a committee of the National Research Council, led by John Bransford, Ann Brown, and Rodney Cocking, similarly concluded that metacognition is a key factor in learning that should be deliberately cultivated. They emphasized the particularly important role that metacognition plays in promoting transfer of learning. That is, students can more readily apply knowledge acquired in one context to another context if they have more awareness of themselves as learners, if they monitor their strategies and resources, and if they assess their readiness for tests and other performances.

Although metacognition is a term that may still need to be defined to the general public, it is well represented in most college-level textbooks in cognitive, developmental, and educational psychology. Further information about the role of metacognition to learning and instruction can be found in numerous articles, chapters, and edited books, including those by DeSoete and Veenman; Hacker, Dunlosky and Graesser; Hartman; Israel and colleagues; Miller; Paris; Schneider and Lockl; Schraw and Impara; and Sternberg.

DEVELOPMENTAL AND INDIVIDUAL DIFFERENCES IN METACOGNITION

The early research on metacognition was conducted by developmental psychologists whose particular interest was in age-related changes. Flavell, Brown, and their colleagues documented substantial growth in knowledge and control of memory. Researchers demonstrated similar developmental trends in other cognitive enterprises, including communication, comprehension, problem solving, and attention. A consistent pattern in the domain of reading documented in the early years by Baker and Brown but still found in the early 2000s is that younger readers have little awareness that they must attempt to make sense of text; they focus on reading as a decoding process, rather than as a meaning-getting process.

Metacognitive growth is gradual throughout childhood, adolescence, and even into adulthood.

One cannot simply assert that an individual has or does not have metacognition. Metacognition is not a unitary construct, either across domains or within domains, nor is the deployment of a metacognitive strategy all or none. There are degrees in the effectiveness with which strategies can be applied. Children show primitive abilities to plan and check their activities on simple tasks during the preschool years, but even advanced students in higher education show metacognitive limitations on more difficult tasks.

A parallel line of inquiry that grew up alongside the developmental work focused on individual differences in metacognition, typically involving comparisons of better and poorer students, or students with and without a learning disability. Again, the pattern has been quite consistent, with better students demonstrating more knowledge and control of the processes involved in a given domain, whether it is studying, reading, writing, mathematics, or scientific problem solving. Ability-related differences in knowledge about cognition, like developmental differences, have been documented in countless studies, across age groups ranging from early childhood through later adulthood.

The compelling body of descriptive evidence that younger and less-skilled students have limited metacognitive knowledge and control led psychologists to ask whether metacognition could be deliberately fostered and if so, whether it would enhance children's success in school. Experimental research conducted as early as the 1980s provided an affirmative answer. Although the evidence became clear that increasing students' metacognitive awareness and control can improve learning, Baker points out that the relation between metacognition and learning is not unidirectional. Rather, reciprocal causation is most likely; that is, improvements in metacognition contribute to improvements in learning, which in turn contribute to further improvements in metacognition.

ASSESSMENT OF METACOGNITION

A variety of approaches have been used to measure metacognition, and considerable controversy exists as to the best ways to assess it. The tools that one selects must be suited to the developmental levels of the students and the purposes of the assessments. Multiple measures are recommended because they can provide converging evidence; if the same findings are obtained with different tools, the researcher or educator can be more confident in his or her conclusions.

The most frequently used approach to assess both metacognitive knowledge and metacognitive control is to ask students directly what they know or what they do while engaging in particular cognitive activities. Verbal reports are typically elicited through structured interviews, such as that originally used by Flavell, or by questionnaires that include multiple response options to a series of items. Most questionnaires are domain specific (e.g., they focus only on reading or only on math), but some are intended to be more domain general. A domain-specific inventory might tap a student's understanding of variables that affect reading outcomes and of strategies that are effective for comprehending text. An example of a well-validated inventory is Mokhtari and Reichard's Metacognitive Awareness of Reading Strategies Inventory. A domain-general inventory might assess an individual's knowledge

about cognition (including declarative, procedural, and conditional knowledge) and regulation of cognition (including planning, monitoring, debugging, and evaluating learning). An example of a well-validated inventory is Schraw and Dennison's Metacognitive Awareness Inventory. Another valuable self-report option for assessing metacognitive control is to ask students to think aloud about what they are doing and thinking as they solve a problem or read a text.

Technological advances have led to more sophisticated and sensitive ways of assessing metacognitive control. Students can be asked to engage in a task while process measures are being collected online. For example, to assess metacognitive control during reading, a passage may be presented to the reader on a computer screen. Patterns of movement through the text are collected automatically, revealing whether the reader paused at a particular point, whether he or she looked back at previous text, or whether he or she jumped ahead. In many cases, the texts participants read contain errors that were deliberately introduced to make the text difficult to understand. Patterns of movement through the texts reveal processes of comprehension monitoring, or the lack thereof. These process measures are often supplemented by asking readers to reflect on what they were thinking or to answer follow-up comprehension questions. Online processing tasks can also be used to track cognitive monitoring while performing other activities such as mathematical problem solving, writing, computer programming, and vocabulary learning. An advantage of these approaches is that they reveal what students actually do instead of what they say they do. Research using online measures reveals the same developmental and ability-related differences documented through verbal reports.

Still another general approach to assessing metacognition is used primarily by researchers studying basic cognitive processes. In judgments of learning tasks, students are presented with to-be-learned material, such as a list of words or a passage, and they are given a test over the material. They are then asked to judge how well they learned the material or how well they answered the comprehension questions. Judgments of learning are then examined in relation to actual performance. A related approach assesses feelings of knowing or knowledge monitoring; it involves presenting students with material and asking them how well they think they would perform on a test. For example, they might be presented with a list of vocabulary words and asked how many they would be able to define or a set of math problems and asked how many they can solve. They are then asked to complete the task, and their performance is compared to their predictions. Even students at the college level generally are not very good at monitoring their learning, but research has shown that a host of factors influences their success, such

as item difficulty and familiarity of the to-be-learned materials, and that they can be taught to monitor more effectively.

Researchers are the most frequent users of metacognitive assessments, but classroom teachers and school psychologists have also become interested in evaluating their students' metacognitive knowledge and control. According to Baker and Cerro, it is important to be mindful of the limitations of the tools that are used and the conclusions that can be drawn. For example, a limitation of questionnaires is that there is not necessarily a correspondence between what people say they do and what they actually do. Comparisons of questionnaire responses with performance measures on a given task often yield rather low correlations. In addition, people often respond according to what they think they should say, rather than what they actually believe or do. Despite their limitations, verbal reports can be valid and reliable sources of information about cognitive processes when carefully elicited and interpreted, as can more direct processing measures.

INSTRUCTIONAL IMPLICATIONS

Classroom-based intervention studies began to be implemented in the 1980s shortly after laboratory studies provided solid evidence that metacognitive knowledge and control could be fostered through direct instruction. These interventions typically are domain specific, undertaken not with the goal of increasing metacognition for its own sake, but rather with the goal of increasing learning. Teacher-led interventions using metacognitively oriented reading instruction have resulted in gains in students' metacognition as well as comprehension. One program developed by Michael Pressley and colleagues, known as Transactional Strategies Instruction, is effective with children as early as second grade. Similarly, teacher-led interventions have been devised and successfully implemented to help students plan, monitor, and evaluate their own thinking during mathematical problem solving. Peer collaboration and discussion play a vital role in the classroom as students make explicit their cognitive processes, assumptions, and strategies. Evidence that metacognitive intervention is effective is in the early 2000s so strong that disciplinary organizations and national panels recommend that metacognition be included in teacher preparation and in classroom curricula.

SEE ALSO *Brown, Ann Leslie; Cognitive Strategies; Piaget, Jean; Pressley, G. Michael; Reciprocal Teaching; Self-Regulated Learning; Theories of Learning; Theory of Mind; Vygotsky, Lev Semenovich.*

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Linda Baker

MI THEORY

SEE *Multiple Intelligences*.

MICROGENETIC RESEARCH

How do children learn? Developmental or educational psychologists would seem to be the experts to turn to in seeking answers to this question. Yet, for a long time, developmental psychologists devoted themselves to understanding how children's knowledge and understanding changes, but they did not directly examine the process by means of which these changes occur. Instead, the typical method was to study what children of one age understand and compare that to what children a few years older understand. Researchers then made inferences about what developed between the two ages. But clearly these inferences were indirect. No one had observed the change occurring within the individual child.

THE 1982 RESEARCH BY KUHN AND PHELPS

The microgenetic method has changed this. Its goal is direct observation of the change process as it occurs in individual children.

Its defining characteristic is that an individual encounters the same or similar problem over frequent occasions, allowing the researcher to observe how the individual's approaches to the problem change over time. Although the method has precursors in the work of Werner (1948), the first modern study featuring the microgenetic method was published by Kuhn and Phelps in 1982. They observed fourth grade students engaged in a scientific inquiry task. Students observed that one combination of liquid chemicals (e.g., A, B, and C) turned the mixture cloudy and another combination (e.g., B, C, and D) did not. The student's task was to experiment with the set of liquids to determine which of the individual liquids played a role in producing the chemical change and which did not.

Students of this age found the task difficult and typically did not succeed in drawing valid conclusions during their first attempt. But the critical feature of the method is that the student encounters the task not just once but a number of times, typically over a period of weeks or months. What Kuhn and Phelps observed is that over this course of time most students' performance improved in two ways. First, the conclusions got better. A student was more likely to correctly identify the components of the mixture that played a causal role in producing the outcome, as well as identify those components that played no causal role. But second, and equally important, the strategies by means of which a student generated those conclusions also underwent change. Specifically, the student displayed a number of different strategies to apply to the problem, and what changed over time was the frequency with which they were applied. More advanced and effective strategies—the ones that yielded valid conclusions—began to be used more frequently, while the less advanced, ineffective strategies that led to invalid conclusions became less frequent.

Exactly how did this change take place? Kuhn and Phelps found that some, but only a minority, of children showed an abrupt shift from predominant use of weak strategies to predominant use of strong strategies. These individuals discovered the best way to approach the problem quite suddenly, their approach took a sharp turn, and they rarely used the poorer strategies again. These children, however, were in the minority. For the majority of children, change took place much more gradually as better strategies increased in frequency and poorer ones decreased. Moreover, this change was not a smooth, continuous one. A better strategy might appear once but then not be used again until several sessions later. Or once this better strategy became predominant, a weak strategy that had not been used for some time might reappear. Change, in other words, was overall in a positive direction, but the progress was not even or constant.

An implication is that change entails two components: consolidation and mastery of the stronger strategies, leading

to more frequent usage and inhibition of the weaker strategies. Both are necessary for success. Much of the evidence from microgenetic studies suggests that the inhibition component may be the more challenging of the two. This conclusion is significant because it reverses previous conceptions of development.

A SIMILAR PROCESS ACROSS DIVERSE DOMAINS AND AGE GROUPS

Other studies since the one by Kuhn and Phelps have confirmed these basic findings over a wide range of cognitive tasks, including many that figure prominently in classroom instruction, and age groups. (For reviews of research see Siegler & Crowley, 1991; Kuhn, 1995; Miller & Coyle, 1999; Siegler, 2006). Chen and Siegler (2000), for example, observed changes in frequency of usage among 2-year-olds in the multiple strategies they exhibited to reach a desirable out-of-reach toy—reaching with their hands, asking for an adult's help or using an available tool. Siegler and Chen (1998) observed the strategies of 5-year-olds over time in making judgments about the operation of a balance scale. Alibali (1999) identified and followed over time ten different strategies that third and fourth graders used in solving mathematical equality problems ($3 + x = 9$). Thornton (1999) studied 5-year-olds playing the game of Twenty Questions.

Not only did she see strategy change over time; she also found that the type of strategy that was initially predominant was predictive of the degree of progress children showed. Children who initially asked only entirely specific questions (“Is it the red car?”) were less likely to progress than were those who initially included at least some less specific questions (e.g., “Is it the car?”) in their repertoires. These were the children most likely to progress to consistent usage of the most effective strategies (e.g., “Is it one of the cars?”) Other studies have similarly found initial variability to be a predictor of change.

The microgenetic method has produced many of the kinds of changes with practice in school-related tasks that educators hope to see, making it possible to better understand them (Kuhn, 2005). Dean and Kuhn (2007) used a microgenetic method to follow changes over time in fourth graders' scientific reasoning. Students had to discover which of multiple potential variables did and did not make a difference to an outcome, as they worked on multiple problems over a number of months.

Dean and Kuhn found not only that students' knowledge and the strategies used to generate that knowledge improved over time, but also that this improvement was better maintained, compared to a condition involving brief direct instruction of the effective strategy.

Finally, Kuhn, Goh, Iordanou, and Shaenfield (in press) observed change over time in sixth graders' argumentation strategies as they worked in pairs debating a social issue with a pair of peers who held an opposing view. Although they received no formal instruction, their argumentation skills showed improvement when assessed individually (without peer support) on a new topic.

LEARNING AND DEVELOPMENT

How and why does the microgenetic method work? Ideally, frequent exercise serves simply to speed up the change process, allowing the researcher to examine it, without altering its essential characteristics. A concern is that this acceleration might change characteristics of the process, if so limiting what can be learned about such changes as they occur in an entirely natural environment. Studies that have compared change patterns under microgenetic conditions with those observed over a much longer time period using longitudinal methods, however, find that the patterns observed under the two conditions are comparable (Siegler & Svetina, 2002). What differs is the length of time over which they take place.

But this does not mean that there is no difference between the comparatively rapid cognitive changes that have typically been called learning and the slower changes that have been referred to as development. The distinction between development and learning is a long-standing one that has been important to developmental psychologists, and there is no indication that it should be discarded.

While the microgenetic method has contributed to making the dividing line between learning and development less firm than it was once thought to be, it does not follow that there remain no useful distinctions at all. Learning what songs are on this week's Top 10 List and learning that conflicting ideas can both be right are different kinds of learning in numerous important respects (among them generalizability, reversibility, and universality of occurrence). What is important is recognizing the process of change as one that has multiple parameters. When the process is examined microgenetically, it becomes possible to begin to characterize it in terms of many such parameters. The distinction between development and learning is also indicated by the fact that microgenetic studies have typically shown change to occur more rapidly in older children or adults than in their younger counterparts (Kuhn & Pease, 2006; Kuhn, Garcia-Mila, Zohar, & Andersen, 1995). The older individuals apparently bring something to the learning process that the younger ones have not yet developed.

METASTRATEGIC MANAGEMENT

Another important question that has been asked about the strategy change that microgenetic studies reveal is the

degree to which it occurs under the individual's conscious monitoring and control. Because inhibition of less effective strategies is involved, the development of conscious awareness, monitoring, and management of one's own learning processes executive or metastrategic functions have been suggested as playing an important role. Some microgenetic researchers, such as Siegler (2000, 2006; Siegler & Jenkins, 1989), emphasize the need for associations with the more frequent, less effective strategies to be weakened, as well as associations with more effective strategies strengthened. Others, such as Kuhn and colleagues (Kuhn, 2001; Kuhn & Dean, 2004) emphasize relinquishment of less effective strategies as a more formidable obstacle than strengthening new ones. These researchers propose that knowledge at a meta-level is as important as that at the performance level and plays a major role in what happens there. If so, the changes that occur at the strategic level in microgenetic studies should be accompanied by changes at the metastrategic level and studies by Kuhn and colleagues provide evidence that this is the case (Dean & Kuhn, 2007; Kuhn & Pearsall, 1998; Kuhn, Garcia-Mila, Zohar, & Andersen, 1995).

In the study by Kuhn and Pearsall, for example, during repeated engagement over several months with a scientific investigation task students were asked at several points to explain to a new student how to do the task. This measure of metastrategic understanding showed advances over time, as did measures of strategic performance. Kuhn and Pease (2006) showed that metastrategic monitoring and management of performance also increase over longer periods of time, as a part of normal cognitive development. They studied the performance of 12-year-olds and young adults in learning a simple set of causal relations, and they attributed the adults' superior performance to enhanced meta-level monitoring and management.

MICROGENETIC RESEARCH IN THE CLASSROOM

Although classroom teachers are unlikely to use it to conduct formal research studies, the microgenetic method clearly has a place in the classroom. Teachers are using the microgenetic method in an informal, naturalistic way when they assign their students the same or a similar task repeatedly over a period of time, for example, to carry out two-digit multiplication or to select a book to read and to write a book report on it. Teachers expect to see changes over time in the strategies a student brings to bear on the task and in the product that results. The findings from more formal microgenetic research offer teachers a framework for conceptualizing and monitoring such changes. They suggest that teachers have many strategies they might usefully consider in observing a student's progress over time. These include not only the product of the student's efforts the work the student submits for a grade but also what strategies the student has applied to generate this

product, how the individual has changed over time, whether the student needs more help in inhibiting ineffective strategies or in consolidating the use of effective ones, and, perhaps most significant of all, what progress the student is making in coming to monitor and manage his or her own learning.

SEE ALSO *Piaget, Jean; Strategy Development.*

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Deanna Kubn

MIDDLE SCHOOL, TRANSITION TO

SEE *School Transitions: Middle School*.

MIDGLEY, CAROL 1933–2001

Carol Midgley was born in 1933 and grew up on Long Island, New York. For her undergraduate education, she attended the University of Vermont, where she met her future husband, Rees. The couple moved to Ann Arbor, Michigan, in 1961, where they raised their three children. Carol Midgley devoted much time to volunteer work, particularly in education. She was an activist whose mission was to improve public schools. Her efforts led to the implementation of open classrooms and “small houses” in local elementary and middle schools; she later worked with other members of her community to create Community High School, a school designed to focus on the academic and socio-emotional need of early adolescents.

Midgley returned to graduate school in the 1980s and received her Ph.D. in educational psychology from the University of Michigan in 1987. Her research focused on academic motivation during adolescence, with a particular emphasis on early adolescence. At Michigan, Midgley engaged in collaborative work with her mentor, Jacquelynne Eccles. They worked on a study designed to examine why women often opted out of studying mathematics, even when their performance was good. Midgley then worked on a large-scale study with Eccles, Allan Wigfield, and other colleagues, examining the transition from elementary school into middle school (MSALT: The Michigan Study of Adolescent Transitions). That study was originally designed to examine changes in expectancies and values in early adolescents as they transitioned from elementary school into middle school. It was the first study of school transitions that examined both within-year and between-year changes in motivation. Results of the study indicated that students’ expectancies and values do change as students move into

middle school, and these changes are often in a negative direction. The focus on changes in expectancies and values of early adolescents across the transition countered the commonly held assumption that the observed drop in motivation was due to puberty.

Midgley and Eccles used stage-environment fit theory to explain these negative shifts in motivation. They argued that the environment in middle school was antithetical to the developmental needs of early adolescents, and that this mismatch between school environments and adolescents’ needs contributed to the downward shift in motivation. As an example, they noted that early adolescents need cognitively challenging and interesting work, whereas the curricula that are presented in many middle schools are often repetitious and boring.

When later asked about Midgley’s work on collaborative projects, Eccles noted that Midgley’s involvement in all of these projects was critical: “We couldn’t have done it without her.”

In 1989 Midgley accepted a position as a research scientist in the Combined Program in Education and Psychology at the University of Michigan. There, Midgley began a long collaboration with Martin Maehr and also began mentoring her own graduate students. At this time, Midgley became particularly interested in goal orientation theory. Her career shifted at this point as she dedicated much of her future work to her original interest in school reform.

Midgley and her colleagues first worked in elementary schools, helping teachers to focus instruction on mastery goals (i.e., effort, improvement, and self-comparisons). Midgley then received funding from the U. S. Department of Education to work with educators on school reform, using a goal theory approach. Along with Maehr and their graduate students, Midgley immersed herself in collaborative work with several elementary and middle schools in Michigan. The goal of these studies was for educators to examine the types of achievement goals that they foster in their students (i.e., mastery or performance goals), and then to work with those educators to change instructional practices, so that the focus of instruction would be on mastery rather than performance. This work was both arduous and inspiring; it resulted in many publications and a book co-authored with Maehr. The work demonstrated that goal theory could be used to effectively guide school reform, and that educators could change their practices to focus on mastery.

Midgley later received funding from the William T. Grant Foundation to study the development of achievement goals during adolescence. This longitudinal work examined changes in goals and goal structures, as well as the relations of these changes to adolescent well being. Midgley also received funding, with her colleague Julianne Turner, from the Spencer Foundation; that study examined students’ avoidance beliefs

and behaviors in mathematics classrooms before and after the transition into middle school. The study used both quantitative and qualitative methods to examine the effects of instructional practices on avoidance behaviors. Result of the study indicated that students displayed fewer avoidance behaviors (i.e., self-handicapping, avoidance of help-seeking) when students perceived a mastery goal structure in math classrooms.

Under Midgley's direction, she and her students developed the Patterns of Adaptive Learning Survey (PALS). The PALS is an instrument that measures personal goal orientations and classroom goal structures. The instrument is widely recognized in the field. It has been translated into several languages and used with many thousands of students across the world.

Midgley died in 2001. Her legacy lives on, as her work on adolescent motivation continues to influence both research and policy in the United States and abroad. She is arguably one of the most cited researchers in the field of academic motivation. She mentored a large group of graduate students who continue to pursue her goals of improving education for adolescents.

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The Students of Dr. Carol Midgley

MISDIAGNOSES OF DISABILITIES

Focus on misdiagnoses of special education disabilities has centered predominately on the overrepresentation of Black males in mental retardation classrooms. While it is unknown how many misdiagnoses occur each year, they have been systematically and historically documented across all ethnic minority populations (e.g., Hispanic, Native American, and Asian American) and special education categories (Reschley, 1981). Indeed, ethnic disproportionalities have been reported in specific learning disability (Barona, Santos de Barona, & Faykus, 1993; Payette & Clarizio, 1994) and in emotionally disturbed (Harris-Murri, King, & Rostenberg, 2006; Yeh, Forness, Ho, McCabe, & Hough, 2004), whereas in gifted and talented classrooms, ethnic minorities and females are under-represented and have a lower retention rate than their white, male counterparts (Moore, Ford, & Milner, 2005).

Based on these findings, researchers in psychology and education have emphasized the importance of cultural sensitivity and awareness in professionals who refer, test, and diagnose disabled children, especially minorities. In particular, the ways in which standardized tests are used and interpreted have been criticized given the weight an IQ score has on every special education diagnosis (e.g., Reschley, 1981). Because of an IQ phenomenon known as the Flynn effect, however, each one of the over 2 million children who are evaluated every year on IQ tests as part of their special education evaluation is at risk for misdiagnosis, regardless of ethnicity and gender.

USE OF IQ IN DETERMINING DIAGNOSES AND SERVICES

IQ tests are used in all special education diagnosis decisions, but they play a fundamental role in mental retardation (MR) and specific learning disability (SLD) diagnoses. Under federal guidelines, a child who displays "significantly subaverage general intellectual functioning, with deficits in adaptive behavior, and manifested during the developmental period (prior to age 18), that adversely affects a child's educational performance" will receive MR services (*Assistance to States for the Education of Children with Disabilities*, 2006, p. 46756). While each state has the flexibility to develop its own criteria (as long as it does not conflict with the criteria set forth by IDEA), "significantly subaverage general intellectual functioning" is usually determined by an IQ score of 70 points or below, as recommended by the American Psychiatric Association (APA, 1994) and the American Association of Intellectual and Developmental Disabilities (formerly known as the American Association of Mental Retardation; AAMR 1992). Often, obtaining an

IQ score below the cut-off of 70 points is enough to meet the criteria for mental retardation or MR.

Under the same guidelines, SLD is defined as “a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations” (*Assistance to States for the Education of Children with Disabilities*, 2006, p. 46757). There is much variability, however, between states on the ways in which SLD is diagnosed. A commonly used method is to determine if a student’s IQ is significantly higher than his or her achievement test score, although this methodology is highly criticized among researchers and practitioners (e.g., Reschley & Hosp, 2004) and is no longer required in the Code of Federal Regulations. Regardless, a child must display at least average intellectual functioning (usually defined as an IQ of 85 points or higher) in order to qualify for SLD services. Thus, many educational diagnoses require scoring above or below a specific IQ score cut-off to qualify.

SLD is an umbrella term for a diverse array of cognitive disabilities that can range from brain injury to dyslexia. Therefore, services can range from providing students with extra time on tests to hiring resource room specialists. While the latter services can be costly, they are implemented less frequently than the former services, which are substantially less expensive. Therefore, while SLD is the most common special education diagnosis, accounting for almost half (48.5%) of the five million children in special education in 2002 (U.S. Department of Education, 2004), the costs of providing SLD services can vary widely.

MR, by contrast, is far less frequently diagnosed, accounting for less than 10% of the special education population (U.S. Department of Education, 2004). It is, however, a more consistent and costly set of services, compared to SLD. Common services offered to MR students include modified regular assignments and more extensive educational interventions, such as receiving one-to-one instructions in a self-contained classroom, instruction from specialists, and trained aides (Singer, Butler, Palfrey, & Walker, 1986).

THE FLYNN EFFECT

The Flynn effect refers to the steady rise in IQ scores seen between 1945 and the early 2000s. It is named after James Flynn (1984, 1987), the political scientist credited with its most extensive documentation. Flynn and others (e.g., Te Nijenhuis & Van der Flier, 2007; Rodgers & Wanstrom, 2007) have observed this systematic IQ rise in 29 nations, spanning 5 continents, including both developed and developing nations. The estimated magni-

tude of these gains range between 5 to 25 points within a single generation, depending on the country and type of IQ test used. In the United States, this rise is estimated to be approximately 3 points a decade on the Wechsler Intelligence Scale for Children (WISC) and the Stanford-Binet measures.

The reason for the wide range in gains between (as well as within) countries can be attributed to the IQ test that is used. Gains are higher on measures that rely heavily on tests of fluid abilities, or on-the-spot reasoning and abstract abilities, than they are on tests of crystallized abilities, or accumulated knowledge. Tests of crystallized intelligence, such as the vocabulary and arithmetic subtests on the WISC, show very small gains (only 2 to 3 points) between 1947 and 2002. Whereas subtests tests that measure abstract reasoning, visual cognition, on-the-spot reasoning, and working memory show gains up of 25 points during the same time period (Flynn, 2007).

The Flynn effect is measured in terms of IQ gains that result from people doing significantly better on an old IQ test that was created as far back as 25 years before their time (and has not been changed in that interval) when compared to their performance on a more current test whose content has been updated. In other words, as IQ test norms get older, people perform better on them, raising the mean IQ by several points within a matter of years. Specifically, within 20 years, the average IQ in the U.S. population rose from 100 to 106. To compensate for this upward creep, IQ tests are re-normed, at which point the test is made harder. Re-normed tests reset the mean back to 100, which in turn, hides the previous gains from the old norm. Therefore, the same person will score higher on an outdated, old IQ test compared to a brand new IQ test, even if both tests are administered on the same day.

THE FLYNN EFFECT AND MR/SLD DIAGNOSES

Given the fluctuations in IQ created by the Flynn effect when old IQ tests are re-normed, coupled with the heavy use of IQ cut-off scores, the diagnoses of MR and SLD are problematic. While scores rise and thus as more students surpass the 70 IQ cut-off, fewer students are classified MR. Similarly, more students are classified SLD as more students surpass the 85 IQ cut-off. Thus, the discrepancy between IQ and achievement widens. Both of these trends occur regardless of the students’ actual cognitive ability. When scores fall with the onset of new IQ norms, these diagnostic trends will reverse; suddenly, MR diagnoses will increase, while SLD diagnoses will decrease. Again, these changes will occur not because the child’s cognitive ability has changed but because the child was tested on a new IQ norm.

While Flynn's seminal analyses excluded individuals with cognitive disabilities, several studies have directly explored the Flynn effect among children in special education. Many researchers have reported that children receiving special education services lose, on average, some 5 to 9 IQ points when tested on a newly normed IQ test (e.g., Wechsler, 1991). More alarmingly, Kanaya, Scullin, and Ceci (2003), using a nationally diverse sample, found that over 30% of the students in their sample who tested above the MR cut-off score of 70 points on the WISC-R (Wechsler 1974) tested below the cut-off when retested on the newer normed WISC-III (Wechsler, 1991). This, in turn, resulted in a threefold increase in MR diagnoses, simply due to the test norms used and the year tested even though the students' actual cognitive ability did not decline.

In addition, among children initially diagnosed with SLD on the WISC-R, Gaskill and Brantley (1996) found that more than 40% of the students in their sample no longer met the criteria for SLD when retested on the newer, harder WISC-III. This finding was replicated by Truscott and Frank (2001) who found that the number of SLD diagnoses in a school district decreased with the introduction of the new norm as students no longer had a significant discrepancy between their IQ scores and achievement test scores.

Therefore, MR and SLD students were measured as having a significant drop in IQ when retested on a newer norm, and this drop often leads to a change in their diagnosis. More in-depth analyses also suggest there are individual differences in the Flynn effect. For example, Kanaya, Ceci, and Scullin (2005) discovered a larger Flynn effect among younger children tested on the original WISC norms (Wechsler, 1949), compared to older children on subsequent WISC-R norms. In addition, findings by Sanborn, Truscott, Phelps, and McDougal (2003) suggest that the Flynn effect is diminished in SLD children at lower IQ levels when compared to SLD children at higher IQ levels.

RESEARCH IMPLICATIONS FOR PROFESSIONALS

Due to the Flynn effect and the use of IQ cut-off scores in special education policies, children are diagnosed based on the year tested and test norms used rather than their actual cognitive ability. Therefore, children who are tested on old IQ norms and misdiagnosed due to their inflated scores will not qualify for or receive the resources of the appropriate education that is guaranteed to them by law. After the initial diagnosis, in order to accommodate changes that may occur in children's needs over time, federal guidelines require periodic re-evaluations for all children in special education. An IQ test is often

administered as part of this re-evaluation to determine if the current educational program is meeting the children's needs and if services should be modified or discontinued. At this time, children run the risk of receiving a diagnosis based on a norm that has continued to age since their initial diagnosis, thus obtaining a further inflated score. Therefore, the services provided and the financial costs of providing them to disabled children can vary widely throughout the course of those children's education.

Consequently, the services and resources provided to misdiagnosed children will change independent of their actual cognitive ability and educational needs. In other words, schools will misallocate their financial resources and the students may not receive the services they need. Such findings and implications call into question the use of IQ cut-off scores in special education diagnoses and suggest that researchers, teachers, administrators, and policy makers must recognize the role of the Flynn effect when determining the educational needs of children with disabilities.

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MODELING

Modeling describes the process of learning or acquiring new information, skills, or behavior through observation, rather than through direct experience or trial-and-error efforts. Learning is viewed as a function of observation, rather than direct experience (Holland & Kobasigawa, 1980). When viewed as a process of learning, there are three elements involved in modeling: the model, or the person observed, the observer, the individual who acquires new knowledge or skills as a result of observing

the model, and reinforcement, which, in part, determines which behaviors will be repeated. These three factors interact to affect behavior. Reinforcement entails the use of reinforcers (primary or secondary) to increase or decrease the likelihood of future behavior. Through observation of models, a student may learn to hit a baseball (motor skills), how best to interact with members of the opposite sex (social skills), or how to perform double-column addition (intellectual skills). Models can be real people the student observes directly (e.g. teachers, parents, coaches), or they can be symbolic characters in books, movies, and television. In either form, real or symbolic, it is difficult to imagine any society in which modeling has not played a crucial role in the transmission of knowledge, skills, and behaviors from one generation to the next.

MODELING EFFECTS ON LEARNING AND BEHAVIOR

Bandura and Walters (1963) concluded that the observation of models can result in one of three outcomes: (a) the modeling or observational learning effect, (b) the inhibitory or disinhibitory effect, and (c) the eliciting effect (which has also been referred to, by Holland and Kobasigawa, 1980, as the social facilitation or response facilitation effect). The modeling effect refers to the acquiring of new behavior as a result of observing a model, real or abstract. Learning how to hit a baseball can come from watching the coach directly or from watching a famous baseball player demonstrate the skill on a best-selling instructional video. The inhibitory or disinhibitory effect refers to the strengthening or weakening of behaviors as a result of observing a model. Many students will be inhibited about acting out in class simply by observing a classmate being punished for a particular behavior. Conversely, some students will be disinhibited, or will be more likely to act out, when they observe that same behavior not being punished. The eliciting effect occurs when a previously learned behavior happens more frequently as a result of observing a model being reinforced for the same behavior. Although it is similar in nature to the modeling effect and disinhibitory effect, Bandura (1971) suggests that the eliciting effect is unique for a couple of reasons. He notes:

Response facilitation effects can be distinguished from observational learning and disinhibition by the fact that no new responses are acquired, and disinhibitory processes are not involved because the behavior in question is socially sanctioned and, therefore, is unencumbered by restraints. (p. 656)

Advertisers rely on the eliciting effect to sell their products by trying to convince people that purchasing their special brand of product (e.g. jeans, perfume, car), will make them more attractive, sophisticated, or likeable in the eyes of others.

ROLE OF MODEL, OBSERVER, AND REINFORCEMENT

As has been discussed, modeling, or learning as a function of observation, involves the model, the observer, patterns of reinforcement, and how these factors interact to influence behavior or learning. Attributes typically associated with effective models include power, prestige, competence, and warmth or caring. Models that demonstrate one or more of these characteristics are likely to have a stronger influence on the observer (Bandura, 1986). On the part of the observer, in order for modeling to be effective, there are four processes that must take place: attention, retention, reproduction, and motivation. First, the observer must pay attention. People are more likely to pay attention to models in a position of power (e.g., President of the United States) or prestige (e.g., music or movie star), who demonstrate competence (e.g., recognized expert), or show warmth (e.g., a caring teacher) toward the observer. Second, the observer must be able to retain what has been observed by encoding it in long-term memory. Effective teachers incorporate modeling in lesson plans and activities that facilitate long-term learning of information and skills. Third, the observers must be able to reproduce what has been observed. Not only do they need to possess the physical capacity, but they must also believe that they are capable of reproducing the behavior or task. Lastly, the student must be motivated for modeling to be effective. When a student observes other students in the class being reinforced by the teacher for speaking up during a class discussion on World War II, this may motivate the student to overcome his or her shyness and contribute to future class discussions. At the same time, when a teacher ridicules wrong answers from students, other students are less likely to be motivated to speak up for fear of also being ridiculed if they give the wrong answer.

Much in the same way as it functions in operant conditioning, reinforcement (type and frequency) influences the response patterns of observed behavior in the process of modeling. Rather than having a direct influence, however, such as in operant conditioning, reinforcement in modeling has a more indirect role in the learning of new behavior. When individuals observe behavior being punished or rewarded in others, this may lead to the vicarious reinforcement of that behavior in the individual. According to Bandura and Walters (1963), reinforcement in modeling operates in one of four ways, three at the level of the observer, and one at the level of the model. At the level of observer, there is increased likelihood that an observed behavior will be imitated if: (a) the observer is directly reinforced by the model, such as when a teacher praises a student for correctly doing a math problem just demonstrated on the board; (b) the imitated behavior is reinforced by its own consequences, such as a mother's excitement to the

child who says "mommy" for the first time; or (c) the observer experiences vicarious reinforcement, such as the shy student who speaks up more in class after observing the teacher respond positively to other students who have done so. Reinforcement occurs at the level of the model when being imitated becomes reinforcing in itself, such as the father who feels proud because his son's batting performance improves as a result of instruction from the father. The father will be more likely, in this case, to continue with the instruction because the outcome is reinforcing the modeled behavior.

Modeling as a process of learning draws heavily from a variety of theoretical sources, including behaviorism (classical and operant conditioning), social learning and social cognitive theory, information processing theory, and sociocultural theory. In order to understand how characteristics of the model, the observer, and reinforcement interact to affect learning and behavior, it is necessary to understand how the various theories have uniquely contributed to our current understanding of modeling.

MODELING AND EARLY LEARNING THEORY

In early theories of human learning, namely behaviorism (i.e., classical and operant conditioning), theorists such as Ivan Pavlov (1849–1936), John B. Watson (1878–1958), and B.F. Skinner (1904–1990) used animal experiments to search out and verify explanations for human behavior. In classical conditioning, Pavlov discovered that dogs could be conditioned to respond in a certain way through the pairing of different stimuli in the environment. From this perspective, learning was viewed as a stimulus-response (S-R) relationship. A stimulus (in the environment) could be manipulated to elicit a particular response (in the individual). In classical conditioning, the focus is on how involuntary responses, such as salivating, are elicited as a result of changes in environmental conditions. As such, classical conditioning only describes one way that learning can occur in animals and humans, rather than having practical applications for classroom management. It was not until the later work of Skinner, in which he introduced the notion of reinforcement, that learning theory began to have practical implications for the classroom and student learning.

Lefrançois (2000) writes, "Simply put, Skinner's model of operant conditioning describes learning as an increase in the probability of occurrence of an operant (emitted response) as a function of reinforcement" (p. 123). With operant conditioning, Skinner expanded the behaviorist model of learning from (S-R) to include reinforcement, in which learning was viewed as (S)timulus-(R)esponse-(R)einforcement-(R)esponse, in which the increased or decreased likelihood of a behavior was contingent upon the type and frequency of reinforcement used. Types of reinforcement include positive reinforcement, negative reinforcement, and

MODELING IN THE CLASSROOM

To model a Venn diagram for early elementary students, the teacher, Ms. Lopez, first accesses the students' background knowledge. She then models completing a Venn diagram using think alouds.

Ms. Lopez: "Girls and boys, yesterday we talked about how apples and oranges are similar and how they are different. Today I'm going to show you how we can organize that information in a Venn diagram. Raise your hand if you've seen a Venn diagram. [Show a blank Venn diagram.] We can use a Venn diagram to organize information about two items that we are comparing and contrasting. Information that applies to both is written in the area in the middle where the two circles overlap."

On the Elmo, Ms. Lopez draws a Venn diagram: "First, I make sure that my paper has the long sides at the top and bottom. I'll draw a big circle on the right side of the paper. That's where I'll write everything about only apples, so I'll write 'Apples' above that circle. My second circle will be on the left side of the paper, but watch carefully. The second circle is going to overlap the first one and the overlap is big enough for me to write things there. I'll label the left circle 'Oranges' because that's where I'm going to write everything about only oranges. Over the center part, where the two circles overlap, I'll write 'Both.'"

"The first thing I have to do is remember what I know about apples and oranges. I know that apples are red, so I'll write 'red' in the circle labeled 'apples.' Since I wrote about the color of apples, I need to write about the color of oranges across from that in the Venn diagram. I'll

write 'orange' in the circle labeled 'Oranges' directly across from 'red' in the 'Apples' side. We want to keep our comparisons across from each other so we can see them easily when we look at the Venn diagram."

Ms. Lopez finishes writing and looks at the class. "Let me think about what else I know about apples and oranges. I can compare their skin. Apples have skin you can eat, so I'll write 'have skin you can eat' in the 'Apple' side of the Venn diagram. We have to peel oranges and don't eat their skin, so I'll write 'can't eat the skin/peel' in the 'Orange' side."

"I know they're both fruit, so I'll write 'fruit' in the overlapping part under 'Both' because that fact is about both apples and oranges."

Ms. Lopez continues her think aloud, saying, "Let me see. We get juice from both fruits, so I can include that in the section about both," as she continues to fill in the Venn diagram.

"What else do I know about apples and oranges? I know. Oranges have segments and apples are solid fruit, so I'll write 'segments' in the 'Orange' section and 'no segments' in the 'Apple' section."

Ms. Lopez continues entering facts about apples and oranges until the diagram is complete frequently reminding the students that they need to be careful to write in the information that compares things directly across from each other in their sides of the Venn diagram so the information is organized.

Heidi H. Denler

punishment I and II. Frequency of reinforcement refers to schedules of reinforcement, such as continuous or intermittent. Some researchers (e.g., Masia & Chase, 1997) have linked operant conditioning with observational learning by pointing out that reinforcement plays a crucial role in determining the likelihood that an observed behavior will be imitated. Further, Bandura (1977) noted that imitation itself is a class of operants that is strongly influenced by patterns of reinforcement.

MODELING AND SOCIAL LEARNING THEORY

Bandura played a crucial role in bridging the gap between behavioral theory, with its focus on direct experience, and

social learning theory, in which many believed that much of human learning occurred through the process of socialization. Rather than having to be "conditioned" (classical conditioning) or "shaped" (operant conditioning), Bandura and other early social learning theorists posited that the adults in any society transferred the skills and knowledge of that society from one generation to the next through a socialization process. Miller (1983) notes that it was at this point that learning theory moved strictly from the realm of the laboratory and into the real world as a way to explain human learning.

Miller (1983) also notes that two major shifts occurred in the history of social learning theory. First was the early work by Bandura and others demonstrating

Modeling

that imitation was linked with operant conditioning through reinforcement, or, that observed behavior was more likely to be imitated when it was reinforced in some way. This presented a major shift in learning theory because, for the first time, behavior was not viewed as only being a function of direct experience. The second major shift occurred with the work of Bandura and Walters in the 1960s and 1970s in which they argued that observational learning could occur without demonstrating a particular behavior. With behaviorism's focus on observed and measurable behavior, the assumption was that learning only occurred to the extent that it could be measured. Bandura (1965) referred to the latter as "no-trial learning." With these shifts came an increasing focus on how models and observers influenced the learning process, especially in Bandura's 1986 model of reciprocal determinism.

MODELING AND COGNITIVE PROCESSES

As discussed earlier, models can affect behavior in one of three ways, including the modeling effect, the inhibitory or disinhibitory effect, and the eliciting effect. With Bandura's reciprocal determinism model of learning, greater attention was paid to how the individual (observer) played a role in the learning process, especially in how cognitive and motivational processes influenced individual perceptions of observed events. Bandura (1986) notes that the greater the cognitive ability and prior knowledge on the part of the individual, the greater the perceptive ability of what is being observed. According to social cognitive theory, self-efficacy and self-regulation are important processes related to modeling in achievement contexts (i.e. school outcomes). Similarly, information processing theorists have clarified how such processes as encoding, retrieval, long- and short-term memory, and metacognition can also influence observational learning (Schunk & Zimmerman, 1996). In both cases the focus is placed on how observers perceive and process the information they are observing, and to a larger degree how capable they will be in reproducing the observed skill or behavior. Bandura (1986) refers to modeling as an "information-processing activity in which information about the structure of behavior and about environmental events is transformed into symbolic representations that serve as guides for action" (p. 51). Bandura suggests that modeling, on the part of the observer, is governed by four processes: attention, retention, production, motivation (see previous discussion on these processes for further detail).

MODELING SOCIOCULTURAL THEORY

In many ways, Lev Vygotsky's sociocultural theory of intellectual development combines many of the impor-

tant aspects of modeling in a way that illustrates the importance of observation in the process of learning. Vygotsky hypothesized that larger cultural and social systems played an essential role in the acquisition of language skills, intellectual development, and ultimately in becoming literate in the traditions and knowledge of a greater society (John-Steiner & Mahn, 1996). Without actually using the term modeling, Vygotsky described a process of intellectual development that started at the level of observation and eventually moved to the level of internalization. Many students are familiar with terms such as apprentice and the zone of proximal development, where through observation and reinforcement (i.e., scaffolding), students develop ever more sophisticated views of the world. While not using the exact terms, Vygotsky suggested that the tools of any society, which could be viewed as symbolic models, and teachers, who are examples of real-life models, are essential in helping children internalize and integrate skills and knowledge that are first perceived at the level of observation.

MODELING AS A MODE FOR LEARNING

Modeling is one of the most efficient modes of learning of any new skill or knowledge (Bandura, 1986). It is difficult to imagine any society that has not relied on models in one form or another to transmit the most important and basic cultural values, customs and beliefs from one generation to the next. If all of human learning had occurred at the level of direct experience or trial-and-error efforts, human progress would have occurred at a much slower rate. From childhood through adulthood, modeling plays a key role in the acquisition and development of cognitive and metacognitive skills, fine motor skills, interpersonal skills, and later professional skills. Each of these is gained primarily through the process of observation.

Motor skill acquisition and development occur as children observe parents, siblings, and peers interact with their worlds. From the simplest act of learning how to pick up and use a fork to the complex and multifaceted process of driving a car, all of these skills are acquired through the observation of models. Which skills are learned and repeated by the observer will ultimately depend upon the types of reinforcement received, as well as how capable or motivated the observer is to repeat those behaviors.

Learning simple cognitive skills, such as basic arithmetic or reading skills, as well as more complex cognitive skills, such as critical thinking or problem solving, are facilitated when models verbalize their own thought processes as they engage in these activities. Thoughts are thus made observable, and potentially modeled, through overt verbal representation of the model's actions. Modeling

both thoughts and actions has several helpful features that contribute to its effectiveness in producing lasting improvements in cognitive skills. Nonverbal modeling gains and holds attention, which is often difficult to sustain by talk alone. It also provides an informative semantic context within which to imbed verbalized rules. Behavioral referents confer meaning on cognitive abstractions. Moreover, verbalized rules and strategies can be reiterated in variant forms as often as needed to impart a cognitive skill without taxing observers' interest by using different exemplars. In addition, the more and varied application can deepen understanding of generative rules.

According to the social cognitive model of learning, the acquisition of metacognitive and self-regulatory skills and competence first develops through social interaction, otherwise known as observational learning (Schunk & Zimmerman, 1996). Schunk and Zimmerman suggest that in developing what they call self-regulatory competence, students need to be given opportunities to practice the various strategies associated with self-regulated learning in order to fully develop and master this set of skills. Mastering these skills is made easier when models provide "guidance, feedback, and social reinforcement during practice."

MODELING AND COGNITIVE APPRENTICESHIP

Cognitive apprenticeship (Collins, Brown, & Newman, 1989; Collins, Brown, & Holum, 1991) incorporates key aspects of modeling, self-regulation and mastery learning. In cognitive apprenticeship, in which "thinking is made visible," teachers can utilize or combine various methods (i.e., modeling, coaching, scaffolding, articulation, reflection, and exploration) to help students build on their prior knowledge in a way that allows them to become self-regulated learners. Collins and his colleagues (1991) contend that through modeling, coaching, and scaffolding, which they refer to as the "core" of cognitive apprenticeship, students develop and acquire an integrated set of skills through the processes of "observation and guided practice."

Cognitive apprenticeship differs from traditional apprenticeship in three important ways. First, in traditional apprenticeships, the process of learning usually involves easily observable tasks. The carpenter learns his trade by following the example of the more experienced craftsman. There is little difficulty learning the "thinking" behind the successful completion of a particular task or process. In cognitive apprenticeships, the model, perhaps a teacher, has the difficult challenge of "making thinking visible," while usually engaging in an abstract task or process. Further, in cognitive apprenticeships, both the model's and the observer's thinking need to be

made explicit. For the model, this is to ensure that the observer understands the how, why, and when of solving a particular problem. For the observer, this is to ensure that he or she receives proper feedback and support (i.e., scaffolding) during the learning process. Second, in traditional apprenticeships, the process of learning usually occurs in authentic settings while engaging in actual tasks. The learning is situated in a context and presents both the model and the observer the opportunity to engage in and understand not only the final product, but also how the final product is achieved. In a cognitive apprenticeship model, such as learning in the classroom, the process of learning occurs at the abstract level. Learning at the abstract level may lead to difficulty with transfer, or the ability to generalize newly acquired skills and knowledge in future activities.

To enhance learning in a cognitive apprenticeship model, Collins, Brown, and Holum (1991) offer a few suggestions for teachers. First, they suggest that teachers offer students a variety of tasks that range from "systematic to diverse." By presenting a diversity of tasks, teachers challenge students to generalize what they have observed. Second, they encourage teachers to help students reflect on their experiences in ways that help students "articulate the elements that are common across tasks" (p. 41). Lastly, they suggest helping students to understand the relevance of what they learn in order to motivate them to utilize newly acquired skills and knowledge in future endeavors. Clearly, the cognitive apprenticeship model requires that both the model and observer be active members of the learning process.

Models and modeling play an essential role in observational learning. At its core, modeling refers to imitation as a function of observation; however, it is much more than simple mimicry (Bandura, 1986). As a process of learning, modeling draws from various theoretical perspectives, including behaviorism (classical and operant conditioning), social learning and social cognitive theory, sociocultural theory, and information processing theory to explain how the model, the observer, and patterns of reinforcement interact to affect learning and behavior. Contrary to earlier views of learning, modeling assumes that individuals can learn vicariously through the experiences of others. In addition, learning is assumed to occur even in the absence of a direct demonstration of a particular learned skill or behavior. It may simply be a matter of choice on the part of the individual not to perform the newly acquired skill. Models can be either real or abstract, and have been shown to influence behavior in one of three ways: (a) the observational learning or modeling effect, (b) the inhibitory or disinhibitory effect, and (c) the eliciting effect. In order for modeling to be effective, the observer must be able to attend to, retain,

reproduce, and be motivated to perform the observed behavior.

Contemporary views of modeling have linked this process of learning with the acquisition of fine and basic motor skills, interpersonal skills, cognitive development, and metacognition and self-regulation. Most contemporary views link aspects of the model, the observer, and reinforcement in a way as to explain new and effective ways of learning. One example of this would be cognitive apprenticeship (Collins et al., 1991), in which teachers, as effective models, make their thinking explicit to help student growth and development. As Schunk and Zimmerman (1996) have noted, when models also provide assistance and guided practice, student learning is enhanced.

SEE ALSO *Bandura, Albert; Cognitive Apprenticeship; Social Cognitive Theory.*

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MORAL DEVELOPMENT

Morality refers to a doctrine or system of beliefs, values, or principles that govern human conduct in two ways: by prescribing positive behaviors that benefit others and by proscribing negative actions that harm others. The former set of behaviors, often called prosocial behaviors, include sharing, helping, and comforting. In terms of moral judgment, these actions are viewed as good and ought to be carried out. The latter type of actions, often referred to as inhibitory or negative morality, include violations of others' rights and welfare, such as hitting, harming, and otherwise injuring others physically or psychologically, actions viewed as bad which one ought not to do.

While defining morality might be a fairly straightforward matter, speculations about its origins and development have proved far more contentious. So, too, has the role of schools and classroom teachers in promoting its growth. This entry offers a summary of the major differing views on the origins of morality and its development. It focuses on two forms of moral development judgment and identity that have generated decades of empirical research and have affected moral/character education in the United States. In the context of describing the normative developmental changes that occur from early childhood through late adolescence, the entry explores the roles of gender, ethnicity, and culture on moral development. The role schools and teachers in fostering moral development is considered next, with a set of recommendations for educators.

MORAL DEVELOPMENT: SUMMARY OF PSYCHOLOGICAL PERSPECTIVES

In the field of psychology, morality and its development has been variously defined by different types of psychologists. Psychoanalysts, such as Sigmund Freud (1856–1939), believe that morality is rooted in the avoidance of guilt and shame and that its development is a product of the super-ego. In a similar vein, some developmental and social psychologists, such as Martin Hoffman and Jonathan Haidt, respectively, point to emotions as the basis of morality. According to Hoffman, as well as evolutionary psychologists, the origins of these moral emotions or senses date back many millennia to what has been

called the ancestral environment or environment of evolutionary adaptation. While modern speculation about the biological and evolutionary basis of morality dates back to Charles Darwin's *The Descent of Man*, it has experienced a resurgence in the 21st century as findings from neuroscience have emerged.

Behavioral psychologists, most famously B. F. Skinner (1904–1990), offer a starkly contrasting view of the origins and development of morality regarding the mind of the newborn as a so-called blank slate, devoid of any inherent moral emotions or inclinations whatsoever. Direct experiences and the consequences they beget are the sole sources of all learning, moral and otherwise. In short, moral values are essentially synonymous with cultural mores. Morality has no biological or evolutionary basis, nor is it motivated by emotions, conscience, or judgment; it is simply those behaviors reinforced as good or bad, driven by the rewards they beget or the punishments they offset.

Despite the historic importance and one-time ascendancy of the foregoing views, the work of cognitively oriented developmental psychologists has dominated the field of moral psychology since the 1960s. Rooted in seminal work on moral judgment by Jean Piaget (1896–1980), Lawrence Kohlberg (1969) created a three-level, six-stage cognitive-structural model of the growth in moral reasoning and judgment. Like emotion-based theories, cognitive-structuralism posits that biology is important to moral development (though in terms of maturation of cognitive capacities, not the possession of inherent emotions). Like behavioral views, cognitive-structuralism posits that the environment plays a critical role in moral learning (though through thoughtful discussions of moral dilemmas, not mindless associations between behaviors and reinforcers). Given the enormous influence of Kohlberg's work on the field of moral psychology and education, his theory is described in more detail below. Before doing so, a brief discussion follows below of the important view of moral development that developed since about the 1980s.

While Kohlberg's theory and research continued to influence the field, the last quarter of the 20th century witnessed the gradual rise of empirical and theoretical work on the development of moral self-understanding and identity. The interest in moral identity and its role in moral behavior was brought into focus with Augusto Blasi's 1980 review of empirical research on moral cognition and moral action. After describing the relatively modest relations between moral judgment and moral behavior, Blasi posited that the observed gap might be explained by moral identity or the extent to which moral values and goals are regarded as core or essential aspects of the self. Individuals with strong or well developed

sense of the self-as-moral would be more likely to act in accordance with their moral judgments. The critical mechanism is a sense of personal responsibility to act and the concomitant need to maintain "self-consistency" (Blasi, 1983). Blasi's groundbreaking work on moral identity spawned much theoretical and empirical research, which is explored below.

MORAL JUDGMENT DEVELOPMENT: KOHLBERG'S COGNITIVE STRUCTURAL MODEL

Based on his longitudinal study of 75 males as well as numerous cross-cultural studies in disparate countries (e.g., Canada, Mexico, Taiwan, Turkey), Kohlberg posited that moral judgment develops along a three-level, six-stage continuum. Each of the three levels is composed of two stages, which describe the structure of thinking individuals use as they reason through a moral dilemma. The Moral Judgment of Interview (MJI) consists of five moral dilemmas (i.e., paragraph-length hypothetical vignettes in which the protagonist faces a decision that pits two moral values against each other). In the classic Heinz and the Drug dilemma, for example, issues of life and property rights are put at odds, and one must decide whether the Heinz should steal a drug that might save the life of his wife. However, it is not the determined course of action itself (steal/do not steal) that is used to score one's level and stage moral judgment. Rather, it is reasoning that one employs to render the decision that is of greatest interests to cognitive-structural theorists such as Kohlberg.

The first or preconventional level of development is characterized by largely egocentric reasoning, where good or right actions are defined in terms of their consequences to the self. At stage one, the first and most primitive form of reasoning, there is an unquestioning deference to superior power (e.g., "might makes right") and the physical consequences of action (regardless of meaning or value) dictate whether it is good or bad. At stage two, right action consists of that which instrumentally satisfies one's own needs and the needs of others. While elements of fairness and reciprocity are present, they are construed in a physical, pragmatic manner (e.g., "you scratch my back and I'll scratch yours") and not in terms of justice. Empirical research suggests that these two stages of reasoning are typical of children aged 4 through 10.

The second or conventional level of development morality is seen as conforming to and even maintaining the expectations, rules, and norms of the one's family, group, or society.

Kohlberg referred to stage three as "good-boy-good-girl orientation" because of its emphasis on pleasing others by conforming to stereotypical images of various

social roles (e.g., being a “good son” by helping your mother with chores or a “good husband” by sacrificing your own safety for that of your wife). At stage four a higher level of abstraction is achieved and employed in moral reasoning. Rather than conforming to familial roles and expectations, the emphasis is now on maintaining law and order. Right behavior consists of doing one’s duty, showing respect for authority and maintaining the given social systems (e.g., legal, religious). Empirical research suggests that these two stages of reasoning are typical during late childhood (Stage Three) and adolescence (Stage Four).

Finally, the fifth or postconventional level of development is characterized by a significant shift from given norms and conventions toward autonomous moral principles and values. At stage five, a “social-contract orientation” is achieved, and right action is defined in terms of general rights and standards. While still possessing legalistic overtones, reasoning at this stage involves a clear awareness of the relativism of personal values and opinions. Accordingly, an emphasis is placed upon procedural rules for reaching consensus and the possibility of changing the law (not simply conforming to it) to maximize social utility. At stage six, moral development reaches its pinnacle, and reasoning is characterized by consideration of universal moral principles. Prominent among these principles is respect for life and the notion of that all humans regardless of class, color, and creed possess an inherent dignity and worth that cannot be bought or bartered. Empirical research suggests that relatively few people achieve stage five reasoning and fewer still stage six. Indeed, stage six was all but removed from the model in the later 1980s because so few people demonstrated such thinking, and it is not included in the definitive scoring manual for the MJI (Anne Colby & Kohlberg, 1987).

CRITICISMS AND CORRECTIVES TO KOHLBERG AND COGNITIVE STRUCTURALISM

As with any theory, Kohlberg’s model of moral development is not without shortcomings and vocal critiques. Three of these are discussed below.

Gender Bias. Perhaps the most famous criticism of Kohlberg’s theory was launched from within his own research group at Harvard University. In the late 1970s Carol Gilligan began to raise concerns about gender bias in the theory, suggesting that justice-based philosophical orientation of the model emphasized traditional masculine values and traits (e.g., individual rights, rationality, and impartiality) and thus marginalized traditional feminine values and traits (e.g., interpersonal care, intuition,

and social relations). Her book, *In a Different Voice*, which offered an alternative stage model of care-based moral development, was widely read, if not fully embraced. This and other prominent books on caring inspired numerous empirical investigations into the question of gender differences in moral orientation and judgment. These investigations lend some credence to Gilligan’s critique but taken together show that gender differences are not as great as she claims (e.g., Walker, 2006). Where, for example, Gilligan posits a dichotomy—males are justice oriented and females are care oriented—the research indicated that males and females possess both justice- and care-based orientations (with females being only slightly more care oriented). With regard to moral reasoning itself, the vast majority (86%) of the 80 MJI studies reviewed by Walker revealed no such differences. Nonetheless, Gilligan’s critique was an important one that pushed the field of moral psychology beyond its philosophical moorings in formal ethics and liberal social science.

Cultural Differences. A second and equally heated debate that Kohlberg’s theory generated concerns his claims of universality; that is, that people the world over from tribal nomads to inner-city urbanites undergo the same six-stage developmental progression in their capacity to reason morally. In the most comprehensive review of this claim, involving 45 cross-cultural studies using the MJI, John Snarey reported general support for it but with a few major caveats. Chief among these is a bias favoring complex urban societies and middle-class populations (i.e., both score slightly higher). Similarly, cross-cultural studies employing the Defining Issues Test (i.e., a widely used pen and paper adaptation of the MJI) have shown educational attainment to be the single best predictor of moral reasoning scores. Age, gender, and ethnicity explain relatively little variance (if any at all) once education is accounted for.

It is important to keep in mind Kohlberg’s model and these empirical studies focus on only one component of moral functioning: the development of moral judgment. Even if people across the globe exhibit the same invariant cognitive-developmental progression in their capacity to reason through a set of standardized hypothetical dilemmas, there remains plenty of room for cultural variation in the content, prioritizing, commitment to and expression of moral values and judgments. The work of cultural psychologists such as Richard Schweder and Hazel Markus provides great insights into some of these differences. So, too, does the work social-cognitive domain theorists such as Elliot Turiel, Larry Nucci, and Judith Smetana. They point to distinctions between three domains of judgment: the personal, social conventional, and moral. In doing so, domain theorists distinguish cultural mores from moral principles and identify where they may

overlap and conflict. Furthermore, domain theorists believe that each domain has its own developmental trajectory. This conjecture is meant to serve as a corrective to Kohlberg's model, which is seen as conflating the personal and conventional with the moral.

The Thought/Action Problem. Perhaps that most enduring and damning shortcoming of Kohlberg's theory relates to his claim that moral judgment "can be a quite powerful and meaningful predictor of action" (Kohlberg & Candee, 1984, p. 397). As noted above, Blasi's 1980 review of the literature investigating the relations between moral reasoning and moral action suggested otherwise. This finding was not news to philosophers who had long since been writing about the thought/action problem. And, of course, most people need only look at their histories to find examples of behavioral engagement at odds with moral judgment. In educational settings, the epidemic of academic cheating offers a disconcerting illustration of the phenomenon: Most students cheat, even if they believe it is wrong or unjustifiable to do so. In short, while judgment may be a necessary component of moral action, it alone is not sufficient to compel it. Blasi's review made this clear and in doing so ushered in a new era of theorizing and research on moral motivation, one focusing on moral self, identity, personality, and character.

MORAL IDENTITY: BLASI'S SELF MODEL AND ITS LEGACY

It is important to note at the outset that despite the theory's limitations in predicting behavior, Blasi does not seek to rid moral psychology of its interest in moral judgment. He recognizes its importance, regarding it as necessary but insufficient in explaining the complexity of human moral motivation and functioning. In particular, the movement (or lack thereof) from thought to action needs further explanation, and Blasi's self model offers one. Rooted in the work of Eric Erikson (1902–1994) and Jane Loevinger (1918–2008), Blasi posits that the observed gap might be explained by moral identity, that is, the extent to which one regards moral values and goals as core or essential aspects of the self, "those aspects without which the individual would see himself or herself to be radically different" (Blasi, 1984, p. 131). Individuals with strong or well-developed sense of the self-as-moral are more likely to act in accord with their moral judgments. The critical mechanism is a sense of personal responsibility to act and the concomitant need to maintain self-consistency.

Blasi's self model also suggests that moral identity is not a unitary construct. Whereas some individuals may

see honesty and fairness as essential aspects of themselves, other individuals may highlight compassion and caring for others as most salient to their sense of self-as-moral. In *Varieties of Moral Personality*, philosopher Owen Flanagan (1991) echoes Blasi's conjecture, arguing that "ethical goodness is realized in a multiplicity of ways" (p. 332). Lawrence Walker and his colleagues conducted several studies of moral maturity and exemplarity, focusing on three types: just, brave, and caring (see Walker, 2004). Research on moral identity has extended into domains beyond, but related to, the moral domain. Jim Younnis and Miraday Yates's work on civic identity provides a good example.

Finally, Blasi contends that moral identity is developmental in nature, that how the "essential self" is perceived and defined changes over time. Moreover, the centrality of morality to the self varies between individuals; the self comprises many qualities and their hierarchical ordering varies from person to person. In their seminal work on the development of self-understanding through childhood and adolescence, Damon and Hart found that moral qualities such as honesty and loyalty did not become a part of study participants' self-definitions until they reached adolescence. In the twenty years since Damon and Hart's 1988 book *Self-understanding in Childhood and Adolescence* was published, very little progress was made in creating a model of moral identity development comparable to Kohlberg's model of moral judgment development. It is clear that just as very few people ever achieve stage six reasoning ability, very few experience a full integration of morality and self. In their landmark 1992 study *Some Do Care: Contemporary Lives of Moral Commitment*, Anne Colby and William Damon give insights into the lives of people with extraordinary commitment to moral causes and actions. For these exceptional individuals, morality has been so completely integrated into their sense of self that they report feeling as though they had no choice. Though in a different way, this sense of not choosing but rather acting automatically is at the heart of the connections between moral expertise and schema accessibility that Daniel Lapsley and Darcia Narvaez (2004) make in their social-cognitive approach to moral development.

MORAL EDUCATION: INTEGRATIVE ETHICAL EDUCATION AND OTHER APPROACHES

Most Americans embrace the idea that public school curricula include some form of moral or character education. Indeed, the moral and civic purposes of education have a long history in both Western and Eastern political thought. The content and form as well as demand for moral education has varied greatly over time, even within

the brief history of U.S. democracy (see Colby et al., 2003). This does not mean moral education is without its detractors or that there is no lively debate about the “what” and “how” of moral teaching and learning. Nonetheless, in the early 2000s there was increasing concessions and convergence among once divergent camps in the field. Traditional character educators, whose chief objective was the inculcation for moral virtues such as honesty and chastity, have now conceded that moral reasoning has a place in the curriculum. Meanwhile, cognitive-developmentalists such as Kohlberg have realized the motivational value of character traits.

This transformation and its history are beyond the scope of this entry, but interested readers should consult William Damon’s 2002 *Bringing in a New Era of Character Education* and Daniel Lapsley and Clark Power’s 2005 *Character Psychology and Character Education*. In addition, Larry Nucci’s 2002 *Education in the Moral Domain* and Nel Noddings’s 2002 *Educating Moral People: A Caring Alternative to Character Education* are excellent resources for classroom teachers as they strike a balance between theory and practice. Rheta DeVries and Betty Zan’s 1994 *Moral Children: Constructing a Constructivist Atmosphere in Early Education* remains a long-standing and oft-cited guide for educators.

From these books and numerous other resources, the following sampling of recommendations for classroom practices rooted in Darcia Narveaz’s 2006 “Integrative Ethical Education” (IEE). As the name suggests, IEE explicitly brings together traditional character education and cognitive-developmental approaches. It is also rooted in the four component model of moral functioning (Rest, 1986), which highlights the need to foster growth in students’ moral 1) sensitivity, 2) judgment, 3) motivation, and 4) action.

Moral Sensitivity. According to Rest, moral sensitivity is the first component of moral functioning. While psychoanalysts, emotion-based theorists, evolutionary psychologists, and domain theorists all contend that some degree of moral emotional awareness and sensitivity is bred in the bone, all would also agree that the social environment and education are important in turning on and tuning in moral emotions and sensitivity. Teachers seeking to foster students’ moral sensitivity should create learning environments and curricula that offer frequent exposure to moral emotions, virtues, concepts, and issues; they should help students take the perspective of others (e.g., classmates, historical figures, contemporary politicians), and they should call attention to examples of caring and justice as well as insensitivity and injustice, including bias, sexism, and racism. In doing so, teachers can help students identify moral emotions and issues and express and manage them.

Moral Judgment. Firmly rooted in Kohlberg’s cognitive-structuralist model, this component of functioning concerns the capacity to interpret complex moral dilemmas. Whether real or hypothetical, moral dilemmas require people to discern the competing interests and values at stake and to render a judgment that—depending on the nature of the dilemma—gives due weight to one’s own well-being, concern for others, respect for law and tradition, and principles of justice. To foster these capacities educators should engage students in dilemma discussions. Doing so effectively, however, is not easy.

Moral Motivation. This component has been relabeled numerous times in the literature (motivation, commitment, and focus) as it is probably the broadest of the four. After all, the motivation to act or not to do so is a multifaceted phenomenon contingent on both personal and environmental factors. As described above, one of the most important personal factors is moral identity. Students who see themselves as moral beings are more likely to act like moral beings. Teachers can foster students’ moral identity development by exposing them to moral exemplars (e.g., honest, brave, caring) and by creating opportunities for students’ to clarify and cultivate the meaning and importance of moral values and goals in their lives. Moral motivation and identity are also strengthened when educators create school and classroom cultures in which making the right choice and being a good citizen in the community are recognized and rewarded.

Moral Action. The final component of moral functioning is moral action. Even if students possess the necessary sensitivity, judgment, and motivation to act rightly, they may not possess the needed skills or know-how to do so. Resolving conflicts with others, challenging bias and racism when they occur, and taking the initiative to start or even lead good works are not easy tasks. Educators must teach these skills by creating authentic opportunities for students to practice and hone them. Community service projects and school-based organizations offer venues for such skill development. Teachers should both encourage and mentor students’ efforts to address social, moral, civic, and political issues that affect them and their communities.

Moral learning in classrooms does not only occur through formal curriculum or extra-curricular programming. The “hidden curriculum” of schooling, as Philip Jackson famously called it, consists of (often unexamined) norms and policies that collectively give form and meaning to a wide range of behaviors. School governance structures, disciplinary procedures, the allocation of rewards, norms of teacher-student interaction, all communicate morally laden values. Issues of fairness, due process, equal opportunity, respect for differences, and

equity in the distribution of scarce resources and rewards (such as teacher attention and grades) permeate the institution of public education. These factors should not be ignored. Teachers must be mindful of the rules, procedures, and norms they establish in their classroom, and they must be mindful of how they go about following them. When possible, students should be included in the process of establishing the governance structures and disciplinary procedures of their school and classroom communities; they should be given a voice in the process and on-going responsibility for ensuring that the place in which they live and learn is fair, just, and caring.

SEE ALSO *Adolescence; Cheating; Early Childhood Development; Gilligan, Carol; Kohlberg, Lawrence; Moral Education; Prosocial Behavior.*

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MORAL EDUCATION

Every society is concerned about fostering moral character in children and forming responsible citizens. Controversy often accompanies these interests because adults do not always agree about what moral character is or how to cultivate it. Does a person with moral character support societal traditions, much like a tribal leader does, or

challenge them, as did Jesus and Martin Luther King Jr.? What exactly do children need to learn in order to be engaged citizens? Further, do children develop moral character through exhortation or through lived experience? Questions like these are debated.

The debate over defining moral education is often pitched between two seemingly opposed perspectives: traditional character education, focused on the development of specific kinds of virtuous traits and habits (Narvaez, 2006) and rational moral education, which focuses on moral judgment and reasoning regarding justice and fairness. The integrative ethical education model (IEE) described below embraces both traditions. IEE defines moral education as the development of moral expertise, which requires both virtue, as intuitions and skills, and moral cognition, as reasoning, imagination, and understanding.

HISTORY OF MORAL EDUCATION

The practices of contemporary moral character education can be traced to ancient Greek philosophers such as Socrates, Plato, and Aristotle (Lapsley & Narvaez, 2006; Nucci & Narvaez, in press). The Socratic emphasis on virtue emphasized the mind, particularly philosophical thinking and reasoning. Socrates’s own pedagogy known as the Socratic method used successive questions to guide students from ignorance to understanding. Knowing what is good was considered the sufficient condition for individuals to be considered good and virtuous. The Socratic emphasis on right thinking and reasoning echoes throughout the philosophy of his student, Plato, in his *The Republic* in which Plato seeks to define justice.

Aristotle’s teachings and philosophy emphasized the practice of good actions, not only reason, as a means to living a life of virtue. With the tutelage of mentors and moral exemplars, Aristotle came to believe that the virtuous life is attainable through the practice of specific habits and virtues. Aristotle’s philosophy of virtue laid the foundation for contemporary paradigms of character education.

The moral philosophy of early Greek thinkers, coupled with Christian theology, morality, and practice, provided a social and educational foundation in European and American societies from the Middle Ages to modern times. The intersection of moral philosophy and religion was especially evident in colonial U.S. schools; indeed, in the eighteenth and nineteenth centuries, U.S. schools aimed to develop students with good character through reading Bible stories and exhortations, what is considered traditional character education.

In the twentieth century, the explicit Protestant Christian theology of education became less congruous with the religious identity of many new immigrant citizens. Teachers could no longer rely on the assumption of a single universal religious identity as the foundation of

moral formation. At the same time, theoretical and empirical challenges were levied against moral character education in general. Among many provocative findings, the early work of Hartshorne and May, in *Studies in the Nature of Character* (1928 1930), concluded pessimistically that little if any universality or transfer of character existed across situations and general incongruence was demonstrated between moral knowledge and moral action.

Empirical challenges to moral character education and a changing social landscape precipitated a general decline in the interest and application of traditional character education in schools in the mid-twentieth century. The study of moral character education in many ways shifted to the psychological arena as issues of personality or values. Values clarification became a way for educators to discuss values without advocating any one in particular.

In the widespread move against behaviorism in psychology, Lawrence Kohlberg brought the developmental work of Swiss psychologist, Jean Piaget (1896 1980), to the United States. Inspired by Piaget, Kohlberg (1984) spawned the cognitive development approach to moral education as a counterweight to traditional character education and its collection of virtues. Kohlberg was concerned about the conventional condemnation of people such as Martin Luther King Jr., who were viewed as common criminals breaking the law. Kohlberg saw that civil rights demonstrators had a higher moral purpose in breaking the law, but he wondered how to prove that was true.

Integrative ethical education—ethical skills

<p>Ethical sensitivity</p> <ul style="list-style-type: none"> Understand emotional expression Take the perspectives of others Connecting to others Responding to diversity Controlling social bias Interpret situations Communicate well 	<p>Ethical judgments</p> <ul style="list-style-type: none"> Understand ethical problems Using codes & identifying judgment criteria Reasoning critically Reasoning ethically Understand consequences Reflect on process and outcome Coping and resiliency
<p>Ethical focus</p> <ul style="list-style-type: none"> Respecting others Cultivate conscience Help others Being a community member Finding meaning in life Valuing traditions & institutions Developing ethical identity & integrity 	<p>Ethical action</p> <ul style="list-style-type: none"> Resolving conflicts and problems Assert respectfully Taking initiative as a leader Planning to implement decisions Cultivate courage Persevering Working hard

SOURCE: Narvaez (2006).

ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Kohlberg examined the moral development of a cohort of boys through childhood and adolescence. Looking for underlying patterns, he presented his subjects with moral dilemmas and perceived a three-level, six-stage progression in their thinking over time, moving from pre-conventional thinking to conventional to post-conventional (Preconventional level: 1. avoid punishment, 2. Prudence and Simple Exchange; Conventional level: 3. Interpersonal Harmony and Concordance, 4. law and order; Postconventional level: 5. social contract, and 6. universal moral principles). Kohlberg proposed that with age and experience, each person moves from simple to more complex notions of moral reasoning, some moving farther up the stages than others. Each stage is more adequate than the previous one to solve complex moral problems. Kohlberg's basic theory was validated around the world, although there is some controversy about the nature and universality of the higher stages.

In order to stimulate moral reasoning development beyond that promoted by everyday experience, Kohlberg and his students developed the dilemma discussion method. The classic example is the "Heinz Dilemma" in which Heinz, a man of modest means, cannot afford the costly cure for his dying wife. Unable to appeal to the druggist or secure the necessary funds, Heinz breaks into the pharmacy and takes the medicine to save his wife. After the dilemma is presented, students take a position on whether he should steal the drug, and then they participate in small and large group discussions about the reasons for one action or another.

In his later years, Kohlberg and colleagues (Power, Higgins & Kohlberg, 1989) focused on a true-to-life cognitive developmental method, the just community, modeled on some features of the Jewish kibbutz. Implemented in schools and prisons, emphasis was placed upon developing adolescents' ties to community expectations (concerns of Stages 3 and 4) through democratic decision making of community rules (concern of Stage 5). Although an extremely demanding method, the "just community school" approach leads to increased trust, obedience, and loyalty among students, as well as moral stage growth.

NEWER APPROACHES

Newer generations of empirically derived approaches to moral character development developed in the late 20th century. Three are briefly described.

Child Development Project. The Child Development Project (CDP) was founded in the late 1970s as a comprehensive, systems-based approach for fostering positive and pro-social development of elementary-aged children. The CDP focuses on the home and classroom community as the formative contexts for moral character develop-

ment. Similar to Kohlberg's just community model, the intentional democratic structure of the CDP classroom promotes a sense of belonging, cooperation among peers, and sharing of values. A core theoretical component of the CDP is that participatory membership in a caring community, engagement in trusting interpersonal relationships, and collaborative learning experiences provide the necessary curricular and pedagogical foundation for pro-social development.

Teachers and parents become models and guides for the students, provide scaffolding for complex activities and concepts, and support students in their collaboration with peers and development of pro-social skills. CDP curricular materials engage the cognitive, behavioral, and affective components of pro-social development through supportive relationships with an adult, positive interactions with peers, experiences of perspective taking, understanding of values, and discussion of moral issues (see the Web site maintained by the Developmental Studies Center).

Students who participated in CDP demonstrated increased pro-social behavior, increased sense of school community, improved self-concept, and other positive outcomes (e.g., Battistich, Solomon, Watson, & Schaps, 1997). Most notable among the many positive findings was that sense of community was positively related to several key variables of interest such as conflict resolution skills, academic engagement, and concern for others.

Building Assets. It is widely accepted that parents are the primary moral educators of their children. Moral education and formation is more robust, however, when the moral instruction of the parents and family structure are resonant throughout the community (e.g., school, business, media). The Search Institute is a non-profit organization that promotes community-based positive youth development by deepening relationships and asset building. A list of forty positive assets (e.g., family support, adult role models, caring, peaceful conflict resolution) represent the internal and external values and competencies needed for healthy development and fundamental moral education (see the Web site maintained by the Search Institute). Greater numbers of assets are related to fewer risk behaviors. Through Search Institute programs, young people work with peers and adults in the community to deepen relationships, affirm the positive development of youth, and create and uphold institutions that promote an environment and experience that support positive and moral growth. This model has been linked with positive cognitive, affective, and behavioral change such as increased moral action in diverse contexts and communities (Benson, Leffert, Scales, & Blyth, 1998).

Social and Emotional Learning. Moral education occurs across diverse contexts (e.g., home, school, work) and through a variety of methods (e.g., direct instruction, experiential learning, counter-examples). But what are the underlying requisite skills for successful engagement in these moral contexts and activities? Social and emotional learning (SEL) is a theoretical and empirical domain that accentuates emotional intelligence as a suite of necessary skills for successful development. The SEL framework affirms the primacy of parents as moral educators and the importance of asset building within the community for successful development but focuses on specific social and emotional skills for life success. The Collaborative for Academic, Social, and Emotional Learning (CASEL) was founded in the 1990s to further explore how academic achievement skills are related to skills necessary for succeeding in life, both the private sphere of family and the public one of work. When children are emotionally and socially competent (e.g., self aware, respectful of others, able to manage conflict) they are better prepared to make moral and ethical decisions, to engage the moral messages of the community and to build assets from them (Lemerise & Arsenio, 2000). Emotional competencies provide the necessary intrapersonal and interpersonal foundation for successful moral judgment and action. Additionally, when SEL skills are taught in schools, students demonstrate increased engagement with learning and academic achievement.

Integrative Approaches. In the 1990s and early 2000s, there was a renewed interest in reconciling the divergence between traditional character education and rational moral education. Tom Lickona has collected the best concrete ideas and put them together in user-friendly books for elementary teachers. For example, Lickona and Davidson (2006) developed a model for helping high school students to develop both performance character and moral character.

The Integrative Ethical Education model (IEE; Narvaez, 2006) provides a broad, research-based framework for moral character development. It outlines an intentional, holistic, comprehensive, empirically derived approach to moral character education. Rooted in what was intuited by ancient philosophers and confirmed by modern science regarding how to cultivate human flourishing, this approach suggests five steps for educators to follow.

Step 1: Establish a caring relationship with each student. One of the most important protective factors against poor outcomes for a child are caring relationships, first, with an adult in the family, second, with an adult outside the family (Masten & Coatsworth, 1998). Teachers can provide the one relationship that supports a child.

Step 2: Establish a climate supportive of achievement and ethical character. A positive climate meets the needs of the child and fosters a sense of belonging to the larger group (Baumeister & Leary, 1995). Prosocial behavior is nurtured in climates that foster flourishing and the “developmental assets” that support resiliency (Benson et al., 1998). A caring classroom (and school) climate with high expectations is related both to high achievement and to moral behavior (Zins et al., 2004). In a caring classroom, discipline is not punishment but is coached character development.

Step 3: Teach ethical skills across the curriculum and extra-curriculum using a novice-to-expert pedagogy. The four component model (Narvaez & Rest, 1995) provides a functional view of moral behavior. Skills for each of the four components (ethical sensitivity, judgment, focus, action) have been identified. Best practice instruction provides opportunities for students to develop more accurate and better organized representations and the procedural skills required to use them. Children must experience an expert-in-training pedagogy for each skill that they learn. Teachers can set up instruction to help students develop appropriate knowledge by designing lessons according to the following four levels of activities: (1) immersion in examples and opportunities; (2) attention to facts and skills; (3) practice procedures; (4) integration of knowledge and procedures.

Step 4: Foster student self-authorship and self-regulation. Individuals can be coached not only in skills and expertise but in domain-specific self-efficacy and self-regulation (Zimmerman, Bonner, & Kovach, 2002). The most successful students learn to monitor the effectiveness of the strategies they use to solve problems and, when necessary, alter their strategies for success. Students can learn the metacognitive skills that moral experts have, for example, self-monitoring of attention away from temptations, self-cheerleading when energy flags, and selecting or designing the environment to maximize goal completion.

Step 5: Restore the village through asset-building communities and coordinated developmental systems. Truly democratic ethical education empowers all involved—educators, community members, and students—as they form a learning community together, developing ethical skills and self-regulation for both individual and community actualization. The purpose of ethical behavior is to live a good life in the community. Together, community members work out basic questions

such as the following: How should we get along in our community? How do we build up our community? How do we help one another flourish? Each individual lives within an active ecological context in which, ideally, the entire community builds ethical skills together.

The debate over what constitutes moral character education and the proper formation of good citizens continues in the 2000s. Three main categories or genres have emerged as approaches: traditionalist, humanist, and integrationist. The traditionalist genre is characterized by its focus on the development of specific kinds of virtuous traits or habits. Contemporary traditionalist perspectives often focus on a subset of virtues (e.g., Character Counts!). The humanist genre is characterized by the work of the philosophers John Dewey (1859–1952) and Nel Noddings (b. 1929), which focused on the role of experiences and, in particular, the quality of relationships in education and moral character development. Their work is typified by classrooms as democratic, participatory, and caring environments wherein students engage in collaborative endeavors. Finally, integrationists, as the name implies, incorporate traditional character education and rational moral judgment within the context of caring relationships and a caring community. Rational moral education is differentiated from traditional character education by its focus on moral judgment and reasoning oriented toward justice and fairness. Whereas traditional character education is concerned with the explicit formation of specific kinds of character (specific habits), rational moral judgment is concerned with developing the intellectual tools for moral reasoning and judgment. Although these two schools of moral education have been cast as divergent and mutually exclusive, integrative models of moral character education incorporate traditional virtue ethics and moral reasoning exercises within a caring environment for a truly comprehensive model of moral character education (Narvaez, 2006).

SEE ALSO *Cheating; Moral Development; Service-Learning.*

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MULTICULTURAL EDUCATION

Multicultural education encompasses theories and practices that strive to promote equitable access and rigorous academic achievement for students from all diverse groups, so that they can work toward social change. As a process of educational reform in PK-12 schools, higher education, and increasingly in out-of-school contexts, multicultural education challenges oppression and bias of all forms, and acknowledges and affirms the multiple identities that students bring to their learning.

Scholars have provided a range of definitions of multicultural education since the late years of the civil rights movement. A common theme that researchers of multicultural education underscore is that to maintain its critical analysis of power, multicultural education must be constructed within its history and roots in the civil rights movement (Banks 2004; Grant, Elsbree & Fondrie, 2004; Gay, 2004; Nieto & Bode, 2008; Sleeter & Bernal, 2004). To construct an analysis of power within school

reform, several multicultural educators have defined multicultural education as a matrix of practices and concepts rather than a singular static notion. Three major definitions of multicultural educations are reviewed below.

BANKS'S FIVE DIMENSIONS OF MULTICULTURAL EDUCATION

James A. Banks (1979), a leading scholar in the field, argued in the early development of the field of multicultural education that "educators should carefully define concepts such as multiethnic and multicultural education and delineate the boundaries implied by these concepts" (p. 237). His later work continued to emphasize this point (2006). Banks has historically advanced a definition of multicultural education as a broad concept and extrapolated on five dimensions (1991, 2004, 2006). He formulated the five specific dimensions as *content integration*, *knowledge construction process*, *prejudice reduction*, *equity pedagogy*, and *empowering school culture and social structure* (2004).

Content integration deals with the infusion of various cultures, ethnicities, and other identities to be represented in the curriculum. The *knowledge construction process* involves students in critiquing the social positioning of groups through the ways that knowledge is presented, for example in scientific racism or the Eurocentric view of the "discovery" of America. *Prejudice reduction* describes lessons and activities that teachers implement to assert positive images of ethnic groups and to improve intergroup relations. *Equity pedagogy* concerns modifying teaching styles and approaches with the intent of facilitating academic achievement for all students. *Empowering school culture* describes the examination of the school culture and organization by all members of school staff with the intent to restructure institutional practices to create access for all groups (Banks, 2004). While highlighting the interrelatedness of the five dimensions Banks promotes deliberate attention to each.

NIETO'S SEVEN CHARACTERISTICS OF MULTICULTURAL EDUCATION

Another leading scholar, Sonia Nieto, offered a definition of multicultural education in 1992 that continues to influence discourse in the field (Nieto, 1992, Nieto & Bode, 2008). Nieto's definition of the characteristics of "multicultural education in a sociopolitical context" addresses the context of communities, and the process of education, in terms of elasticity rather than as a fixed and static form (2008, p. 7). She focuses on seven characteristics of multicultural education: "*antiracist*, *basic*, *important for all students*, *pervasive*, *education for social justice*, *a process* and *critical pedagogy*" (Nieto & Bode, 2008, p. 44).

Antiracist education makes antidiscrimination explicit in the curriculum and teaches students the skills to combat racism and other forms of oppression. *Basic education* advances the basic right of all students to engage in core academics and arts; it addresses the urgent need for students to develop social and intellectual skills to expand understanding in a diverse society. That multicultural education is *important for all students* challenges the commonly held misunderstanding that it is only for students of color, multilingual students, or special interest groups. Rather, all students deserve and need an education that is inclusive and rigorous. The *pervasive* nature of multicultural education emphasizes an approach that permeates the entire educational experience, including school climate, physical environment, curriculum, and relationships. In education for *social justice* teachers and students put their learning into action. Students learn that they have the power to make change as apprentices in a democratic society. Multicultural education as a *process* highlights the ongoing, organic development of individuals and educational institutions involving relationships among people. It also points to the intangibles of multicultural education that are less recognizable than specific curriculum content, such as expectations of student achievement, learning environments, students' learning preferences, and cultural variables that influence the educational experience. *Critical pedagogy* draws upon experiences of students through their cultural, linguistic, familial, academic, artistic and other forms of knowledge. It also takes students beyond their own experiences and enables them to understand perspectives with which they disagree, as well as to think critically about multiple viewpoints, leading to praxis, or reflection combined with action (Freire, 2000).

Nieto's emphasis on critical pedagogy draws on the work of Freire (2000), linking multicultural education with wider issues of power, including socioeconomic and political equality, in what May (1999) calls "critical multiculturalism."

FIVE APPROACHES TO MULTICULTURAL EDUCATION

Christine Sleeter and Carl Grant connect the role of sociopolitical power to define multicultural education. Sleeter and Grant's article in *Harvard Educational Review* (Sleeter & Grant, 1987) provided an extensive review of the literature on multicultural education and explained five approaches. This work became a cornerstone of the field, upon which Sleeter and Grant (2006) continue to build. A brief overview and analysis of the five approaches articulated by Sleeter and Grant is provided here.

The goal of the first approach, which Sleeter and Grant call *Teaching the Exceptional and the Culturally Different*, is to equip students with the academic skills,



Multicultural education acknowledges and affirms the multiple identities that students bring to their learning. WILL & DENI MCINTYRE/PHOTO RESEARCHERS, INC.

concepts, and values to function in American society's institutions and culture. The positive attribute of this approach is that it spurred the movement toward modifying instruction and curriculum, commonly called differentiated instruction. Critics, however, claim that it has a tendency to emphasize an assimilationist perspective that positions students as holding deficits.

The second approach, *Human Relations*, consists of developing positive relationships among diverse groups and individuals to fight stereotyping and promote unity. Reducing prejudice and hostility are admirable goals, but according to its critics this approach tends to simplify culture and identity and avoids analyzing the causes of discrimination and inequality. Without a critical perspective, the Human Relations approach runs the risk of falling into the trap of feel-good tactics that are too soft on academic achievement.

Single-Group Studies is the third approach in the Sleeter and Grant analysis. The goal is to engage in an in-depth, comprehensive study that moves specific groups from the margins by providing information about the

group's history, including experiences with oppression and resistance to that oppression. The hope is to reduce stratification and create greater access to power. While there are many positive components to this approach, viewing it as a beginning or entry level approach to multicultural education may be the most appropriate appraisal of it. Criticism of this approach cites the unintentional effect of keeping groups such as people of color, women, people with disabilities, and working class people segregated and out of the mainstream curriculum. Other potential pitfalls are the possibility of promoting cultural separatism and the tendency for this approach to be implemented as a mere add-on.

The fourth approach to multicultural education is self-reflexively dubbed *multicultural education*. Sleeter and Grant use this seemingly redundant title to clarify this approach since so many other practices, such as those described in the first three approaches, are sometimes referred to as multicultural education. They cite Gollnick (1980) to explain that the multicultural education approach promotes a range of goals: the value of cultural diversity, human rights, respect for differences, alternative

life choices, social justice, equal opportunity, and equitable distribution of power. There are several criticisms of this approach that are discussed later in this entry. The most severe criticism argues that multicultural education promotes “particularism” and weakens social unification and academic rigor (Ravitch, 1990). Some scholars within the field of multicultural education point to the need for more attention to social structural inequalities and for teaching students the skills to challenge the disparities resulting from inequitable power structures.

The fifth approach, which is the approach Sleeter and Grant advocate, is *Education that is Multicultural and Social Reconstructionist*, which describes a complete redesign of an educational program. The notion of reconstructionism draws from Brameld’s framework to offer a critique of modern culture (Sleeter & Grant, 2006). Such a redesign recommends addressing issues and concerns that affect students of diverse groups, encouraging students to take an active stance by challenging the status quo, and calling on students to collectively speak out and effect change by joining with other groups in examining common or related concerns (Sleeter & Grant, 1987, 2006).

CURRICULUM DESEGREGATION AND EQUITY PEDAGOGY

The three major definitions of multicultural education by Banks, Nieto, and Sleeter and Grant helped to launch the field and continue to sustain a discourse that is constantly evolving. Geneva Gay (2004) has referenced the “shifting contours of multicultural education” and some of the reasons for the developmental changes in its intention, implementation, and effectiveness (p. 193). She demonstrates how multicultural education has changed over time by discussing it as a relatively young field, stemming from the time of *Brown v. Board of Education* (1954), that has grown through developmental phases. Gay emphasizes how multicultural education’s translation into practice is an ongoing dimension of its development. She cites two avenues for implementing educational equality within multicultural education: *curriculum desegregation* and *equity pedagogy*.

Curriculum desegregation requires analysis from every discipline and should not be relegated to the task of social studies and language arts. Gay points to several scholars who assert typologies that explain progression from simplistic curriculum reform to more comprehensive and complex forms. Other examples include lesson plans for specific subject areas. Gay (2003) also describes developmental paradigms that bridge multicultural theory and practice, pointing out that individual and institutional competencies vary widely, and that becoming a multi-

cultural educator is a process. In this she echoes one of Nieto’s seven characteristics (Bode & Nieto, 2008).

Instructional approaches and the shift to *equity pedagogy* are closely linked to the implementation of multicultural education through refining curriculum content (Gay, 2004). Gay explains that multicultural education places value on “*how* to effectively teach diverse students as well as *what* to teach them.” Achieving educational equity is a multi-dimensional goal that is addressed in the proposal for culturally responsive teaching, which consists of many domains:

The major domains include multicultural content; pluralistic classroom climates and learning environments; teacher attitudes and expectations toward diversity; building community among diverse learners; caring across cultures; use of multiple teaching techniques that are congruent with the cultural backgrounds, values, experiences, and orientations of different ethnic groups; developing personal efficacy and an ethos of success among diverse students; and using culturally informed assessment procedures to determine learning needs, knowledge acquisition, and skill proficiencies. (Gay, 2004, p. 214)

Citing a number of educational researchers who have demonstrated the effectiveness of multicultural education and its role in advancing academic achievement and participation in a democratic society, Gay confirms that educational desegregation and equality are advanced by multicultural education as the field continues to evolve:

Evidence increasingly indicates that multicultural education makes schooling more relevant and effective for Latino American, Native American, Asian American, and Native Hawaiian students as well. . . . Students perform more successfully on all levels when there is greater congruence between their cultural backgrounds and such school experiences as task interest, effort, academic achievement, and feelings of personal efficacy or social accountability. (Gay, 2003, p. 35)

INTERSECTIONS AND COMMONALITIES

These researchers’ explications of multicultural education deal with anti-racism, anti-oppression, and head-on indictments of policies and practices of schools and governments that maintain status quo privilege, power, and unequal schooling conditions. The aim of creating a more just society, by educating students for high academic achievement in which they become critically reflective and socially engaged is articulated by Banks (2004), Nieto & Bode (2008), Sleeter and Grant (2006) and Gay (2003, 2004). These aims remain consistent for multicultural educators as they reflect on challenges of the field.

SELF REFLEXIVE CRITIQUES FROM WITHIN THE FIELD

Despite the historical assertions of scholarship and efforts to inform the field of education, especially teacher education, the socially transformative qualities of multicultural education have not been universally understood or embraced. The uneven understandings of multicultural education theory have led to some critiques within the field. Sleeter and Bernal (2004) note that as more and more people have taken up and used multicultural education, it has come to be understood in a wide variety of meanings: "Ironically, (given its historical roots), a good deal of what occurs within the arena of multicultural education today does not address the power relations critically, particularly racism" (p. 240). This point is a prevalent concern among multicultural educators. McLaren and Torres (1999) argue, "in general, discourses in the US that deal with multiculturalism deal very little with the concept of racism and focus instead on the politics and affirmation of difference" (p. 44). Nieto, Bode, Raible, and Kang (2008) concur: "the political and transformative theories of multicultural education have often been neglected when translated into practice. As a result, even though multicultural education has made an important contribution to schools and communities, few long-term institutional changes have taken root" (p. 178). Gloria Ladson-Billings (2004) demands an examination of the intertwining of racialized identities with the political and economic history, and current social order of the United States. She notes a "new citizenship" being taken up by some people of color "who want to remake their world into a more just and equitable one" (p. 117). She sees the challenge for educators "to reveal and incite the power of democratic ideals for marginalized students in U.S. schools" (p. 122).

The challenge of translating multicultural theory into practice and maintaining a critical, transformative focus is increased by the contemporary globalized social order that is exponentially changing the way in which many scholars and educators understand culture and identity. For example, a great deal of research and practice in multicultural education has been influenced by questions of how culture might be defined or understood. Historically, in U.S. society and in many school contexts, the very notions of culture and difference have been delineated into static objects, as a metaphorical flag to wave. In that historical conception, culture is viewed as thing to have, rather than a practice of living, learning, performing, negotiating, and translating multiple experiences for oneself and one's community. This static framework for viewing culture implies that human identity, and by extension, human knowledge and student achievement, is contained by set boundaries and will remain unchanged.

Such a viewpoint is often referred to as a "modernist" conception of culture and cultural identity, which is

challenged by postmodern concepts in multicultural education (Dolby, 2000, Nieto, Bode, Kang & Raible, 2008). The understanding of culture as fluid and performative as opposed to a static fixture relates to other contemporary inquiries into human identity, such as questions about whether race is an inherent biological fact or a social construct. In 1998 the American Anthropological Association published a "Statement on Race" that indicted the attempts throughout U.S. history to establish division among biological populations as arbitrary and subjective by asserting "present-day inequalities between so-called racial groups are not consequences of their biological inheritance but products of historical and contemporary social, economic, educational and political circumstances" (p. 713).

Postmodern scholars criticize the argument that race is a biological rather than a social mechanism as an "essentialist" notion of race. Yet it is critical to note that abolishing notions of race does not end racism. Each scholarly definition of multicultural education reviewed here regards multicultural education as an anti-racist enterprise that assertively seeks to reduce prejudice. Yet these scholars point out that racism remains a stark reality and needs to be addressed by multicultural education even while contemporary discourse of identities call the notion of race into question (Nieto, Bode, Kang, & Raible, 2008).

Nieto, Bode, Kang, & Raible (2008) ask how multicultural education might transcend typically essentialist notions of race and other identities to reach a more nuanced, critical understanding of multicultural perspectives. As scholars of multicultural education reconceptualize the social constructs of race and racism, they acknowledge that multiple identities work in confluence in the anti-oppression goals of multicultural education. These identities, in addition to race, include social class, ethnicity, religion, language, age, ability/disability, sexual orientation, religion, gender, and other differences. However, because listing these identities as separate labels conflicts with postmodern frameworks on identity that insist identities and cultures are not static but shift and evolve in context, multicultural curriculum and instruction must evolve in a similar manner.

HETEROGENEITY AND HOMOGENEITY

Critical understandings of multicultural education address arguments about whether multicultural education should focus on differences or commonalities across and between ethnic groups. However, when multicultural education is understood within the multiple dimensions advanced by Banks (2006), Gay (2004), Nieto (2008) and Sleeter and Grant (2006) it cannot be viewed as an either/or enterprise.

Critics regard multicultural education, with its excessive emphasis on race and ethnicity, as divisive. They accuse its proponents of teaching to special interest groups to “disunite America” (Schlesinger, 1998). Many critics argue that teaching to a specific group emphasizes self-esteem at the expense of academic rigor. However, multicultural education insists on employing a range of strategies that aim for rigorous academic achievement for all students. Some of these educational strategies may involve inclusion of the knowledge, experiences, perspectives, and accomplishments of previously marginalized groups. This would be one of many approaches to multicultural education. Moreover, multicultural education asserts American ideals by upholding the unalienable constitutional right for every student to be prepared for full participation in a democratic society. However, a critical perspective demands that educators view the broad sociopolitical context of individuals and institutions, rather than labeling students or compartmentalizing them into rigid boxes. Such rigidity runs the risk of participating in and reinforcing stereotypes. At the same time, as Gay (2004) pointed out, the project of culturally responsive teaching requires addressing students’ cultural backgrounds through curriculum and pedagogy. Sleeter (2001) provided in-depth analysis of the critiques of multicultural education, addressing both the conservative and radical left critiques of multicultural education. Noteworthy among her multiple findings was that most of the conservative critics ignore the research by scholars in the field of multicultural education (Sleeter, 2001, p. 85).

In summary, the scholars in the field have asserted that multicultural education is a matrix of several dimensions, qualities, and approaches that encompass theories and practices as a process of educational reform. Multicultural education promotes equitable access and rigorous academic achievement for all students so that they can work toward social change.

SEE ALSO *Culturally Relevant Pedagogy*.

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MULTIPLE INTELLIGENCES

The theory of multiple intelligences, or MI theory, developed by Howard Gardner in the early 1980s, posits that individuals possess eight or more relatively autonomous intelligences that they use to solve problems and create products relevant to the societies in which they live. The eight intelligences identified by MI theory are linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, naturalistic, interpersonal, and intrapersonal. In conceiving of intelligence as multiple rather than unitary, the theory of multiple intelligences offers a very different perspective on human capabilities and potential than traditional conceptions of intelligence as measured by IQ tests.

GENERAL INTELLIGENCE VERSUS MI THEORY

The traditional conception of intelligence often referred to as IQ first came about in France in the early 1900s when psychologist Alfred Binet developed a 30-item intelligence test for identifying French school children in need of special education. Binet's work was popularized in the United States by Stanford psychologist Lewis Terman who published a revision of Binet's test in 1916 that came to be known as the Stanford-Binet scale.

Around the same time that Binet was developing his scale, English psychologist Charles Spearman (1904)

published a paper on general intelligence in which he asserted that all forms of intellectual activity stem from a unitary or general ability for problem-solving. While Binet had developed his scale with the goal of predicting children's school performance and not as a measure of intelligence across all endeavors, the results of his and Terman's work were taken as support of Spearman's theory. Spearman's conception of general intelligence became the prevailing view of intelligence over the course of the 20th century, though it did have its critics. Both Thorndike (1927) and Thurstone (1938) were prominent researchers who argued that an individual's intellectual abilities could not be measured by a single construct. Nonetheless, the conception of intelligence as a unitary ability gained hegemony among both psychologists and lay-people.

A challenge to this view of intelligence came in 1983 when Gardner laid out his theory of multiple intelligences in a work titled *Frames of Mind*. Gardner's theory emerged from his consideration of several simple but powerful questions:

Are the brilliant chess player, violinist and athlete "intelligent" in their respective disciplines? If they are, then why do our tests of "intelligence" fail to identify them? In general, why does the traditional construct of intelligence fail to take into account such large areas of human endeavor? (Gardner, 2006, p. 6)

In these words, Gardner voices his concerns with the intelligence test designed by Binet and its underlying acceptance of intelligence as a single, unitary construct. In *Frames of Mind*, Gardner (1983) lays out his own conception of intelligence which differs from Binet's in several fundamental ways. First, proponents of Binet's conception of intelligence typically define intelligence as the trait or quality measured by an intelligence test. As psychologist E.G. Boring (1923) famously declared, "Intelligence is what the tests test" (p. 35). Gardner (2006), in contrast, defines intelligence as "an information-processing potential to solve problems or create products that are valued in at least one culture" (p. 235). Second, the traditional conception of intelligence conceives of a high IQ score as indicative of an individual's ability to be high achieving across a wide range of endeavors. In contrast, MI theory argues that individuals who demonstrate a particular aptitude in one intelligence will not necessarily demonstrate a similar aptitude in another intelligence. For example, an individual who demonstrates an impressive level of musical intelligence may be far less skilled when it comes to bodily-kinesthetic or spatial intelligence, or vice-versa. Finally, while most proponents of general intelligence regard intelligence as an innate trait which one can do little to change, multiple intelligences theory conceives of intelligence as a

combination of heritable potentials and of skills that can be acquired and enhanced by appropriate experiences. In other words, while one individual may be born with a strong potential for musical intelligence, another individual can strengthen his or her musical intelligence through study and practice.

A common misunderstanding regarding MI theory is that people possess some intelligences and not others. According to MI theory, with the exception of individuals suffering from severe brain damage, all individuals possess the full range of intelligences. Thus, an individual's profile of intelligence may include a relatively low aptitude for musical intelligence, but that individual is misunderstanding MI theory if he or she claims to have no musical intelligence. Another misunderstanding is that every individual is superior in at least one of the intelligences. Individuals do differ in their levels of strength and weakness for each of the intelligences; however, there is no guarantee that every individual will demonstrate superior aptitude in at least one intelligence (Gardner, 1983).

IDENTIFYING AN INTELLIGENCE

Multiple intelligences theory has proved controversial in the psychology world. Perhaps the main source of this controversy is the evidence upon which the theory is based. Many other theories of intelligence are based entirely upon empirical data collected from psychometric instruments or experimental studies. These studies typically involve presenting subjects with a number of test items that are believed to measure intellectual capabilities. MI theory came about differently. Rather than conducting a series of experiments, Gardner (1983) developed his theory of multiple intelligences by synthesizing research from fields as diverse as evolutionary biology, neuroscience, anthropology, psychometrics as well as psychological studies of prodigies and savants. By drawing upon findings from these many diverse sources, Gardner developed the following set of criteria for identifying an intelligence:

- It should be seen in relative isolation in prodigies, autistic savants, stroke victims or other exceptional populations.
- It should have a distinct developmental trajectory.
- It should have some basis in evolutionary biology.
- It should be susceptible to capture in symbol systems.
- It should be supported by evidence from psychometric tests of intelligence.

It should be distinguishable from other intelligences through experimental psychological tasks.

It should demonstrate a core, information-processing system. (Gardner, 1998).

Through application of these criteria, Gardner identified eight distinct intelligences. Linguistic intelligence allows individuals to create and understand products involving language such as poems, political speeches, and newspaper articles. Logical-mathematical intelligence allows individuals to develop equations and proofs, make calculations, and solve abstract problems. Scientists, analytic philosophers, and computer programmers typically possess profiles of intelligence high in logical-mathematical intelligence. Spatial intelligence enables individuals to use maps and other forms of graphic information in order to navigate around or through complex terrains. Musical intelligence allows individuals to create and interpret different types of sound patterns and combinations. Bodily-kinesthetic intelligence involves using one's own body to create products or solve problems. Dancers, artists, and surgeons all require a profile of intelligence high in bodily-kinesthetic intelligence. Interpersonal intelligence captures an individual's ability to observe and understand other people's moods, desires, skills, motivations, and intentions while intrapersonal intelligence reflects an individual's ability to recognize and assess these characteristics within himself.

Gardner's original theory of multiple intelligences identified the seven intelligences described here. However, in the mid-1990s, Gardner found that naturalistic intelligence met the above criteria for identification as an intelligence as well. According to Gardner, naturalistic intelligence enables individuals to recognize and distinguish among products of the natural world such as animals, plants, rock configurations, and weather formations. Individuals with high levels of naturalistic intelligence might be drawn to careers in botany, meteorology, and veterinary science.

Yet another misconception about MI theory is that intelligences are constantly being identified and added. This misconception comes about in part because of the literally hundreds of psychologists, educators, and writers who have begun writing about various intelligences since Gardner's original publication of *Frames of Mind* in 1983. In truth, however, naturalistic intelligence is the only intelligence that Gardner has identified and added to the original set of intelligences originally described in *Frames of Mind*. Between the early 1980s and the early 2000s, researchers have suggested a number of additional intelligences, including moral intelligence, humor intelligence, cooking intelligence, and even sexual intelligence. However, as of 2007, none of these suggested intelligences has met the criteria cited above for identification as a unique intelligence.

One partial exception is the proposal of existential intelligence (Gardner, 1999). Existential intelligence has been described as the intelligence of big questions—a capacity to consider issues of life, death, love, war, and being. One might expect philosophers, poets, and theologians to demonstrate a particular aptitude for existential intelligence. Gardner (2006) has referred to existential intelligence as a half-intelligence because research to date has found existential intelligence to meet several of the criteria for identification as a unique intelligence but not all of them. Thus, it is not yet clear whether existential intelligence warrants identification as its own unique intelligence or whether the capacity to reflect upon big questions is better conceived of as a component of one or more of the existing eight intelligences. As of 2007, Gardner has held off on classifying existential intelligence as a full-fledged ninth intelligence.

Of course, it is entirely possible that early decades of the 21st century, research in fields such as genetics or neuroscience will demonstrate that existential intelligence or other intelligences do meet the criteria for inclusion as an intelligence. It is also possible—perhaps even likely—that research in these fields will reveal that hitherto identified intelligences such as logical-mathematical intelligence consist of several sub- or component intelligences. As brain imaging techniques improve and researchers' understanding of the human genome increases, there is little doubt that MI theory will adapt and change. That said, the precise number and boundary of the intelligences is less important than the overarching principle of MI theory: namely, that intelligence is better understood as multiple and specific rather than unitary and general (Chen & Gardner, 2005; Gardner, 2006b).

APPLICATIONS OF MI THEORY

Multiple intelligences theory has had a substantial impact upon the world of education; however, Gardner did not develop MI theory with an intended educational agenda or audience. Rather, Gardner developed his theory of multiple intelligences with the goal of drawing upon dramatic advances in the fields of neuroscience, biology, and psychology to offer an alternative way of thinking about human cognition. Nonetheless, numerous educators embraced the idea of multiple intelligences almost from its inception. Hundreds of schools, teachers, and researchers at all different levels and in many different countries and settings have applied MI theory to the practice of education various ways. Examples include schools that use MI theory to provide teachers with a common vocabulary for discussing the learning of individual students. Other schools teach students about the concept of intrapersonal intelligence in order to encourage them to reflect upon their own strengths and weaknesses. Still other

schools seek to deepen student engagement by designing curricula that draw upon different intelligences in students' investigation of a particular topic.

One of the first schools to draw extensively upon the principles of MI theory was the Key Learning Community in Indianapolis, Indiana. The Key Learning Community was founded by a team of teachers in 1987 with the mission of giving “equal emphasis for every student to each of the eight areas of intelligence: linguistic, musical, logical-mathematical, naturalistic, spatial, bodily-kinesthetic, interpersonal and intrapersonal” (Key Learning Community, 2007). The Key Learning Community regards MI theory as the cornerstone of its educational program, and, according to the Key Learning Community principal, the school's schedule “allows students to study all eight intelligences during the regular school day” (Key Learning Community, 2007). Interest in the work of the Key Learning Community has been widespread. The school hosts a formal visitors' program and annual summer institute which draw educators from across the United States and world interested in seeing the “world's first multiple intelligence school” in action.

If the Key Learning Community represents one of the earliest applications of MI theory, then Danfoss Universe represents one of the most ambitious. Danfoss Universe is a 10-acre science experience park that opened in Sonderberg, Denmark, in 2005. The park is divided into three parts: the outdoor park, a museum, and the Explorama. The Explorama is a museum-sized building with more than 50 different activities designed to teach visitors about their various intelligences (Danfoss Universe, 2007). For example, an intrapersonal exhibit called Mindball challenges contestants to lower their own stress levels deliberately; if they can do so, an electrode headband converts this reduction in stress into a force that can propel a ping pong ball into the orbit of the opponent. An exhibit on musical intelligence enables participants to create their own melodies on a theremin, one of the earliest electronic musical instruments. Finally, an exhibit on linguistic intelligence gives participants the opportunity to practice a few Japanese words and then examine a visual representation of their vocalization superimposed over that of a native Japanese speaker. Through trial and error, participants can improve their tone and pronunciation. With these and many other exhibits, Danfoss Universe encourages visitors to the Explorama to reflect upon their own profiles of intelligence. Moreover, in a subsequent addition, visitors have a chance to predict their performances on the various activities. At the end of their visit, they can compare their predictions with the actual outcome—another, quite veridical measure of intrapersonal intelligence.

RESEARCH ON MI THEORY

Since the late 1970s, numerous researchers have investigated the influence of MI theory. Here, two such studies are particularly notable, though in very different ways. Project Spectrum was a 10-year study conducted from 1984 to 1993 that sought to identify intellectual strengths in young children and then investigate the impact of an MI-based intervention program on first grade students at risk for school failure. As part of this study, both teachers and researchers observed at-risk first graders over the course of the school year as they participated in learning center activities designed to assess the absolute and relative strengths of the eight intelligences. From this study, Chen and Gardner (2005) report that “At-risk students, although they often perform poorly in traditional academic areas, are not necessarily low performers in all areas of learning” (p. 90). Chen and Gardner (2005) further report that identifying and nurturing these at-risk children’s strengths led to statistically significant increases in these children’s self-direction, self-confidence, positive classroom behavior, positive affect, self-monitoring, and active engagement. In short, then, it seems that using MI theory to identify children’s profiles of intelligence and relative strengths can play a role in deepening these children’s engagement and academic achievement.

A second study, the Project on Schools Using Multiple Intelligences Theory (SUMIT), was a three-year national study conducted from 1997 to 2000 that involved site visits, data analysis, and interviews with teachers at 41 schools that employed MI theory in some capacity. From this study, Kornhaber, Fierros and Veneema (2004) report that, after drawing upon MI theory, 78% of the schools in their study reported improved standardized test scores; 78% reported improved academic performance by students with learning difficulties; and 81% reported improvements in student discipline. More than half of these schools attributed these improvements to the implementation of curriculum and practices inspired by MI theory. Both Project Spectrum and Project SUMIT, then, seem to offer clear evidence of the promise that multiple intelligences theory holds for educators, schools, student performance, and school culture.

Part of the landscape in psychology and education since the early 1980s, MI theory has demonstrated considerable staying power. Its fate within psychology is likely to depend less on further tinkering with psychometric instruments and more on the convergence of evidence from neuroscience and genetics. These ongoing lines of research will indicate whether intellect is in fact

pluralistic and, if so, whether the delineation suggested by Gardner comports with emerging data. Within education, MI theory promises to continue to appeal to teachers whose daily experience supports a view of young persons as having quite individual profiles of intellectual strengths and weaknesses. Whether the policies supported by governments will honor these individual differences or seek to ignore or reduce them through the administration of standard curricula and assessments remains to be seen.

SEE ALSO Gardner, Howard.

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N

NEO-PIAGETIAN THEORIES OF DEVELOPMENT

In his 1992 review of Jean Piaget's theory, Harry Beilin compared its influence on the study of cognitive development to that of Shakespeare on English literature. Any theorist who has studied cognitive development in children from the middle of the twentieth century onward has been a neo-Piagetian in that broad sense. However, the subject of this entry is a smaller group of researchers who have called themselves neo-Piagetians. Because the *neo-* label directs attention back to a theory's origins, most neo-Piagetian researchers eventually chose other names that focused on their theories' new elements. Thus Kurt Fischer's neo-Piagetian theory became known as skill theory (Fischer & Pipp, 1984; Schwartz & Fischer, 2004) and Robbie Case's evolved into central conceptual structure theory (Griffin, 2004).

HOW NEO PIAGETIAN THEORIES DIFFER FROM PIAGET'S THEORY

Neo-Piagetian theorists kept Piaget's idea that the progress of cognitive development is more like climbing a series of stairs (the stages) than walking smoothly up a ramp. They also agreed with Piaget that biological maturation sets broad upper limits on the kinds of thinking children are capable of doing at particular ages. All of the neo-Piagetians also shared Piaget's conviction that children's thinking reflects their developing internal mental structures (Case & Okamoto, 1996). However, each of the neo-Piagetians combined this general premise with ideas about the influence of experience on development

that were more analytically specific and more attuned to cultural and individual differences than anything found in Piaget's theory. For example, they considered how biological maturation of the central nervous system during the first years of life increases the speed with which children process information—an idea introduced in 1970 by Pascual-Leone. The neo-Piagetians linked that maturing processing speed to increases in working memory capacity that, in turn, set upper limits on the complexity of problems a child is likely to be able to solve.

The neo-Piagetians also have drawn on information-processing and linguistic theorists' ideas about the content-domain specificity of cognition. Piaget's theory evolved to include provisions for unevenness in the sophistication of a child's reasoning across different kinds of problems, but this domain specificity is more fundamental to neo-Piagetian theories. The influence of the information-processing paradigm also is evident in the neo-Piagetians' tendency to analyze Piaget's and other cognitive tasks in ways that highlight why one problem may be more or less difficult than another, even within the same content domain. Australian neo-Piagetian Graeme Halford (Andrews & Halford, 2002) became especially well known for his focus on this kind of task analysis.

The neo-Piagetians also adopted principles from social-cognitive theories such as that of Lev Vygotsky. These principles allowed them to give more extensive consideration than can be found in Piaget's work regarding how culturally determined experiences and minute-by-minute interactions with teachers and peers influence a child's intellectual performance. Although biology sets upper limits on performance, a child's culture and everyday

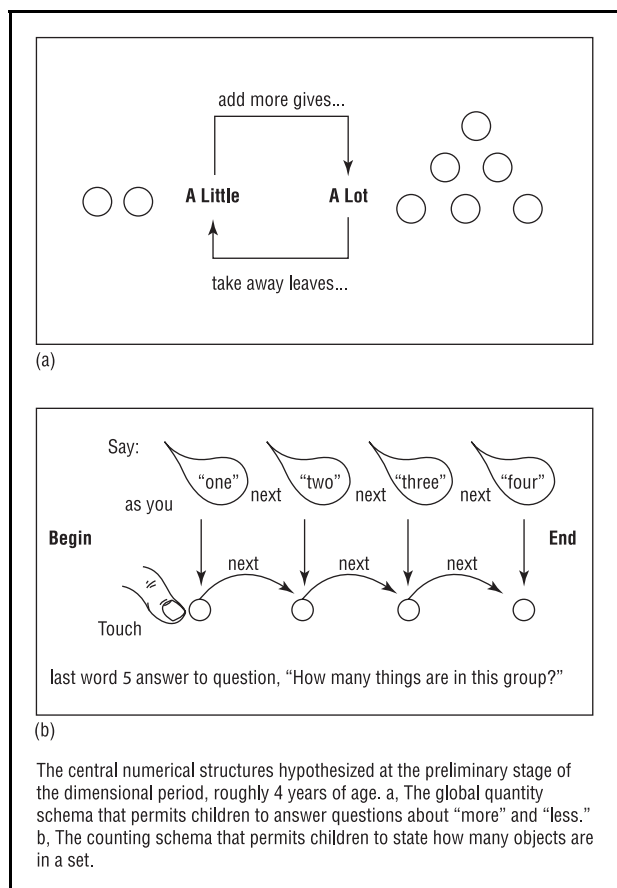


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

experience might not provide the information and practice needed for development up to that limit. Neo-Piagetian theories include mechanisms to account for cultural and socio-economic differences in patterns or rates of cognitive development. These theories also are compatible with the idea that individual children differ in their ability to absorb the experiences available in their culture.

With their joint consideration of biology, the precise requirements for doing a task, and the contributions of experience, the neo-Piagetian theorists have elaborated on possible mechanisms of developmental change, the *how* of development that was only sketched in very general terms by Piaget (Case, 1984; Case, 1996; Griffin, 2004; Schwartz & Fischer, 1994).

The neo-Piagetians' interests in mechanisms of development and in optimizing learning offer educators more explicit guidance than is available in Piaget's theory. A number of neo-Piagetians have proposed theories with relevance for classroom practices. However, Canadian psychologist Robbie Case (1945-2000) prob-

ably is the neo-Piagetian whose work has had the most influence on education.

OVERVIEW OF CASE'S THEORY

Case might be considered the quintessential neo-Piagetian researcher because he dedicated his own theorizing and research efforts to working explicitly within the historical framework of Piaget's ideas. However, Case tried to remedy some of the deficiencies in Piaget's theory by incorporating ideas and methods from other traditions, especially Vygotsky's social-constructivist theory, information-processing theories, linguistics, and new findings in developmental neuroscience (Case, 1996).

Like Piaget's own grand theory, Case's neo-Piagetian theory is hard to summarize because it developed changing substantially across the span of Case's own research career and with work that his colleagues continued after his death. In his early work, Case focused on the broad implications of central processing speed and working memory span (e.g., Case, Kurland, & Goldberg, 1982). These ideas were retained in later versions of the theory, but there was more attention to the nature and development of children's mental representations in each of several cognitive domains—the central conceptual structures. In a 1996 monograph, Case and his colleagues investigated central conceptual structures underlying reasoning about number, space, and narrative (Case, 1996). All of these structures were described as going through stages that were labeled pre-dimensional, unidimensional, bidimensional, and integrated bidimensional and that characterized children's thought at about ages 4, 6, 8, and 10 years. Figures 1 and 2 show the central conceptual structures for number hypothesized to be characteristic of middle-class children in a technological society at about age 4 years (Figure 1) and at about age 6 years (Figure 2). Figure 1 shows that typical 4-year-olds, who are in the pre-dimensional stage, have not yet coordinated two ideas about number—the idea of comparisons between smaller and larger quantities and the idea of counting off a set of objects, saying number names in sequence. In contrast, typical 6-year-olds (Figure 2) have a unidimensional central numerical structure that coordinates several ideas along a number line that they can use to do a variety of arithmetic reasoning tasks.

Case and his colleagues (Case, 1996) also described how a sequence of increasingly complete and coherent central conceptual structures might organize children's developing reasoning in other content domains besides number. Although these domain-limited structures were expected to develop more or less in synchrony because they were all affected by common biological limits, the content of each structure also was expected to be influenced by

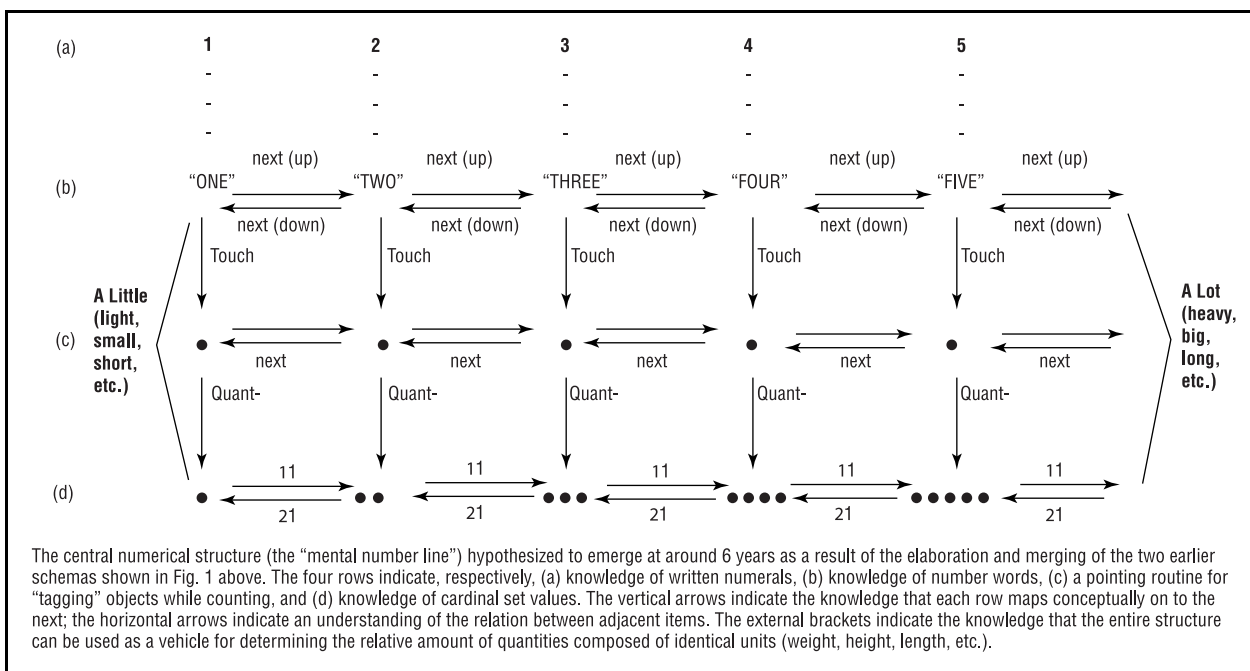


Figure 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

cultural and individual experience, which gave them some independence from one another.

The idea that biological maturation limits the speed with which a child of a given age is likely to be able to process information, or think, is central to Case's interpretation of development. With increasing age, the child's neurons become more extensively coated with a fatty myelin sheath, which speeds transmission of information along the nerve fiber. Another key change with age is that the pattern of connections among the nerve cells in the brain becomes better specialized—unnecessary connections drop out and important ones are strengthened with a combination of time and experience. Because older children can think faster than younger children, they can keep more concepts in mind at the same time. Case and his colleagues first demonstrated the link between thinking speed and memory span in a study of counting speed and memory for digits (Case et al., 1982). The principle extends far beyond arithmetic. In any content domain, familiarity and practice can help children process information more quickly and solve more complex problems. However, chronological age and biological maturation set limits on how much can be achieved with practice.

In Case's theory, one of children's developing mental structures is devoted to the representation of space. These spatial structures are reflected in children's drawings,

which become increasingly organized along multiple spatial axes as children grow older. A 4-year-old's figure is likely to be floating in space, but a 6-year-old's drawing of a person usually stands on a ground line and may be accompanied by other objects, such as an animal or tree, arrayed along the same horizontal axis. Dealing with the vertical and depth dimensions comes later, and it is not until age 10 years or more that children coordinate all of these dimensions well. Even precociously talented young artists are not likely to represent spatial axes in a way much beyond that typical of their chronological age, although their drawings of each figure may be beautifully detailed and realistic (Case & Okamoto, 1996). Thinking in a coordinated way about multiple dimensions of space also is important in playing games such as checkers, in reading or drawing maps, and in making scientific judgments about relations within a series of objects (Case, 1996).

The ways in which culture might influence the separate development of various central conceptual structures was illustrated dramatically in a study comparing children who had experienced Western technological culture and schooling with those who had not. Case's colleague Fiati found that children who were living in isolated rural villages in the Volta region of central Africa and who had not experienced any Western-style schooling, performed at the same levels as urban children their age on tasks involving the coordination of ideas in a story, a task hypothesized to

ROBBIE CASE

Canadian psychologist Thomas Robert “Robbie” Case was born in Barrie, Ontario, in 1944. After earning a B.Sc. in psychology from McGill University in 1965, he taught high school English and physics in a kibbutz in Israel for a year. Case received his M.A. (1968) and Ph.D. (1971) in education from the University of Toronto’s Ontario Institute for Studies in Education (OISE). He was a professor at the University of California Berkeley and at Stanford before becoming director of the University of Toronto Institute of Child Study, where he remained until his death in 2000.

Case’s research centered on child cognitive development, exploring the development of young children’s thinking patterns, aiming to improve how special needs and impoverished students learned. He included Piagetian theories with his findings to create most advantageous instruction for these students, especially in math. Just before his death, Case began to apply his findings about children to civilizations, working with social scientist Tom Rohlen.

Case contributed chapters to numerous books and wrote many theses, grants, and journal articles, as well as *Intellectual Development: Birth to Adulthood* (1985) and *The Mind’s Staircase* (1992). He also served as a consulting reviewer for several editorial boards.

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depend on Case’s central conceptual structure for narrative. This showed that there was nothing generally wrong with the children’s ability to do complex thinking. However, life in the village had offered very little experience with numerical tasks, and the children’s performance on tasks involving Case’s central conceptual structure for numbers (see Figure 1) was immature. In less extreme cross-cultural comparisons, Case and his colleagues found that central conceptual structures developed at about the same rate for children in the United States, Canada, China, and Japan. However, socio-economic differences within a culture could be associated with large differences in developmental rate (Case, 1996; Case, Griffin, & Kelly, 2001).

EDUCATIONAL APPLICATIONS OF CASE’S THEORY

Although some of Case’s early theorizing concerned development in infancy and the toddler years (Case,

1985), much of his work was concerned with how children’s thinking changes between about age 4 and age 10 or so (Case, 1996). This makes his work especially relevant for educators working with children in preschool and elementary school.

A major implication of Case’s work, consistent with the implications of information-processing theories, is that young children should not be expected to think about too many new ideas at once. For example, typical 6-year-olds are much more likely to give the correct answer to the problem “ $6 + 2 = ?$ ” than they are to the related problem “ $6 + ? = 8$ ”, which is expressed with a missing addend. To solve a missing addend problem, a child needs to understand several unfamiliar symbols. Case (1978) found that children were more successful with missing addend problems if they were gradually introduced to the non-numerical elements of an equation before doing the arithmetic. Throughout his career, Case was concerned with analyzing exactly what a child needed to know and manipulate in order to solve common school problems and with how age and cultural experience may have left some children unable to meet classroom expectations (Case, Griffin, & Kelly, 2001).

When everyday experience has not helped children develop a particular kind of central conceptual structure, carefully planned instruction has been shown to help children catch up. One of Case’s colleagues, Sharon Griffin, developed a compensatory education program for first graders from low-income families that she called Rightstart (Griffin, 2004; Griffin, Case, & Siegler, 1994). The goal of this program was to give these children lessons that would fill in gaps in their central conceptual structure for numbers (Figure 2). Children in the program and those in a control group were pre- and posttested using exams containing items influenced by Case’s theory, and those who had been in the Rightstart program did better on the posttest.

Case’s theory also has contributed to the design of more effective instruction on problems that are likely to be difficult for all children, regardless of their family background, such as understanding rational numbers. Rational numbers are percentages, decimals, and fractions. These topics usually are introduced in the late elementary years and often are not mastered fully even by adults. Moss and Case (1999) found that fourth graders achieved a deeper understanding of rational numbers in a curriculum that focused on step-by-step teaching of a conceptual structure for these numbers. The curriculum started with percentages, using exercises that involved observing and manipulating liquids in beakers and other objects that were partly full. Discussion at this point was all in terms of percentages. Then children were introduced to decimal notation using large number lines on the floor, and links

between decimal fractions and percentages were emphasized. Finally, traditional fractional notation was taught and linked with the other two forms of rational number notation. Children who experienced this curriculum had a deeper understanding of rational numbers than children in a control group.

SEE ALSO *Information Processing Theory; Piaget, Jean; Vygotsky, Lev Semenovich.*

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NORM-REFERENCED SCORING

Norm-referenced scoring is the process of comparing one person's score relative to a group in order to determine the relative standing of that person to the group in the area being tested (Thorndike, 2005). It is comparing one's score relative to the performance of others. Norm-referenced scoring is then a system of rank ordering and a way to give meaning to raw scores. Raw norm-referenced scoring does not indicate mastery and/or competency of skills. The group being compared against in norm-referenced scoring is termed the normative group or normative sample. The normative group should be representative of the person that is being compared against it (i.e., gender, race, geographical region, age, acculturation, language) in order for the scores to be meaningful.

Several key factors should be considered before using a norm-referenced assessment. One important factor is that the norming is recent, meaning that the sample that was used to collect the data is relatively recent. A good rule is to make sure that the norming data is no more than 10 years old. Also the normative groups should have been fairly large. Other important factors to consider are the reliability and validity of the scores that are given. Reliability refers to precision of scores. A highly reliable score is one which the tested person would achieve again if the same test were given a second time. Validity refers to the idea that the score is truly measuring what it purports to measure. Reliability and validity are reported in a range from zero to one. The closer to one the reported number is, the more reliable and valid the measure.

Norm-referenced scores are derived scores that can be reported in multiple forms. Raw scores (the actual number of items answered correctly) are not reported in norm-referenced scoring but are instead used to derive all other types of scores that can be reported. Norm-referenced scores can be reported in either a developmental format

Norm-referenced Scoring

or a relative standing format. Both formats have strengths and weaknesses associated with them.

DEVELOPMENTAL SCORES

Developmental scores are ordinal scores, ordered from best to worst or worst to least in which adjacent values indicate a higher or lower value (Thorndike, 2005). There are two forms of developmental scores: age-equivalent or grade equivalent. The norms in these forms are then the average raw score of a particular age or grade indicated in the norm sample. For example, when using age-equivalents, an age equivalent of 12 would have been calculated in the norm sample by averaging all raw scores obtained by 12-year-olds. This calculation works in the same manner for grade equivalents. To say that a child is scoring at the third grade level indicates that a child obtained a raw score that was equivalent to the average raw score of third graders in the normative group. This statement does not, however, indicate in which way the score was obtained. The questions answered correctly by the person may be different from which questions were answered correctly in the norm sample. There is not an equal interval between scores. Age and grade equivalent scores have the advantage of seeming to be easily interpretable. A person's level of performance is compared to familiar milestones of age or education, which makes them easily explainable to a person with limited knowledge of score interpretation. For example, it is easy for a teacher to tell parents that their child is reading at a third grade level.

There are several drawbacks, though. Typically in the norm sample, representation of every month in school or every age is not possible. For example, the norm sample may have included students in grade 2.0, 3.0, and 4.0. The average raw score is easily obtained for those grades. But raw scores that fall in between these levels have to be translated into grade equivalents. Therefore, if a raw score of 30 indicated a grade equivalent of 2.0, and a raw score of 38 indicated a grade equivalent of 3.0, the raw scores of 31 to 37 have to be interpolated (assigned arithmetically to grades between or inside those tested (Thorndike, 2005). Not all grade or age equivalents may be assigned a raw score and there may not be equal intervals between scores or equal growth between years. For example, a raw score of 35 may translate into an age-equivalent of 7 years, a raw score of 36 may translate into an age-equivalent of 7 years, 1 month, and a raw score of 38 may translate in to an age-equivalent of 7 years, 8 months. Also, there may be possible raw scores that fall outside average raw scores obtained in the norm sample, which would then require extrapolation (arithmetically calculating outside the range tested) for those raw scores. For example, Test A has raw scores

possible from 0 to 40. Grades 3.0 to 6.0 were included in the norm sample, and a raw score of 34 was the average for a sixth grader. The raw score of 40 falls outside the norm sample and would be calculated to be a grade equivalent greater than 6.0. Another important consideration with grade and age equivalents is whether there is meaning in assigning this type of score. For example, in most cases these types of score lose meaning in high school subject matter assessments. If a student is able to take biology in any grade of high school, it would not make sense then to administer a biology test and then to tell a student that he or she performed at, for example, a ninth grade equivalent.

SCORES OF RELATIVE STANDING

Scores of relative standing can also be broken into several formats: standard scores, scaled scores, and percentiles. These types of scores are useful for interpreting scores when grade or age is not a concern. Standard scores represent deviations (or the scatter of individual scores in the norm group) from the mean (Thorndike, 2005). Standard scores are considered to be at equal intervals; the difference between two points is the same throughout the scale. Standard scales are useful when the norm group is distributed among all scores possible. The standard score may be reported as a z-score, where the mean (or average) raw score is transformed to equal zero. Fifty percent of all scores will then fall above zero and 50% will fall below zero. This type of score is often complicated because raw scores may indicate a negative standard score. To help with this problem, standard scores are typically converted into other scaling systems which are easily comparable and retain the same properties. For example, the average IQ standard score of 100 is equivalent to a z-score of zero. A scaled score is a standard score that has been converted to a mean of 10 with a standard deviation of three.

Percentile equivalents are also directly comparable to standard scores. A percentile is the percentage of people in the norm group that the test taker performed as well as or better than (Thorndike, 2005). For example, a percentile score of 67 would indicate that a person performed as well or better than 67 percent of the norm sample. Percentile scores have one crucial difference from the scaled scores. Percentiles are not in an equal interval format. There is smaller variation in the percentiles nearer the mean and larger variation in the percentiles further from the mean. For example, there is little difference in raw scores that equate to percentile ranking of 50 or 55, whereas there is typically a great difference between the raw scores that compute to percentile rankings of 90 and 95.

Overall normative scoring is useful for making comparisons of performance against a similar group but not useful for determining mastery of content.

SEE ALSO *Criterion-Referenced Tests; Standardized Testing.*

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Krista Healy

NORM-REFERENCED TESTING

Norm-referenced testing is integral to the practice of psychological and educational testing. Originated in the work of modern statistics, this assessment method assumes that human traits and characteristics, such as intelligence, academic achievement, and behavior, are distributed along a normal probability or bell-shaped curve (hereafter, referred to as the normal curve). The normal curve represents the norm or average performance of a population and the scores that are above and below the average within that population. The norms for a test include percentile ranks, standard scores, and other statistics for the norm group on which the test was standardized. A certain percentage of the norm group falls within various ranges along the normal curve. Depending

on the range within which test scores fall, scores correspond to various descriptors ranging from deficient to superior.

A Norm-Referenced Test (NRT) compares an examinee’s test performance to those of the examinee’s same-age peers from the test’s norm group. This comparison permits a more meaningful interpretation of the individual’s score. An examinee’s test score is compared to that of a norm group by converting the examinee’s raw scores into derived or scale scores. As shown in Figure 1, derived scores correspond to the normal curve, thus providing an interpretive framework for examinees administered the NRT. The norm group can consist of a larger population, such as a representative population of children from the United States (i.e., a national norm group), or it can consist of a smaller, more limited population, such as all children in an individual school or school district (i.e., a local norm group).

DERIVED SCORES

The conversion of examinees’ raw scores into derived scores provides a system of common metrics that facilitate test interpretation. There are multiple derived scores reported for NRTs; however, the more common ones used for interpretive purposes are standard scores, standard deviations, scale scores, T-scores, percentile ranks, age-equivalent scores, and grade-equivalent scores. A standard score has a statistical mean or average of 100

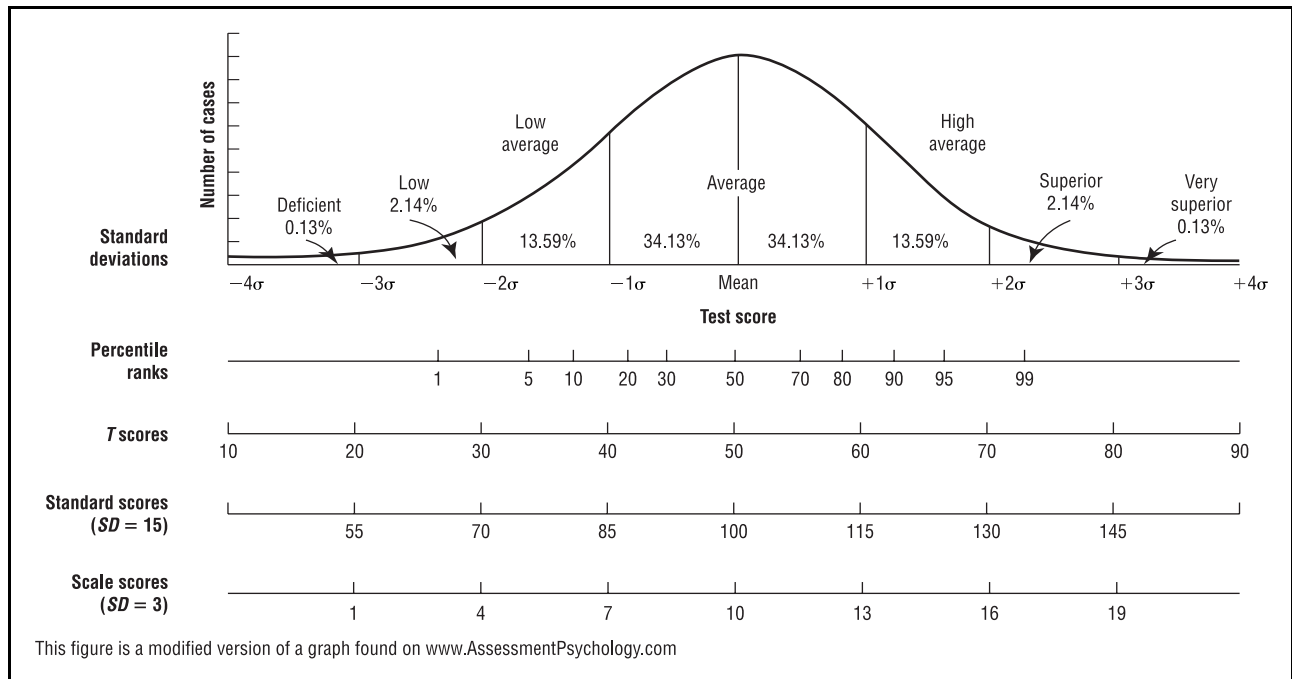


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

and conveys how far an examinee's test score varies or deviates from the average of the distribution. The extent to which a score varies or deviates from the average is expressed as a standard deviation. For example, a standard score of 115 on a NRT, such as an intelligence quotient (IQ) test, is one standard deviation above the mean of 100 and falls within the High Average range.

Scale scores yield information about an examinee's performance on a sub-domain or subtest of a NRT. These scores have a mean or average of 10 and a standard deviation of 3 points. Therefore, a scale score of 7 on a NRT subtest indicates that the examinee's skill, as measured by the subtest, is one standard deviation below the mean of 10 and corresponds to the Low Average range. T-scores are a different distribution of standard scores in that the mean of the distribution is 50 with a standard deviation of 10 points. NRTs assessing behavior typically report T-scores. Consequently, a T-score of 60 on a behavior rating scale is one standard deviation above the mean of 50 and corresponds to the High Average/At-Risk range. Percentile ranks indicate an examinee's position relative to the norm group. A percentile rank is a point in the distribution at or below which a certain percentage of scores falls. A child obtaining a percentile rank of 85 on an intelligence test indicates that the child's performance is equal to or greater than 85 percent of the child's same-age peers in the test's norm group. It does not mean the child obtained 85 percent of items correct on the NRT.

Grade- and age-equivalent scores are two of the most commonly used scores to report test results, yet they are also commonly misunderstood. These scores indicate that a student has attained the same raw scores (or number of items correct) as the average student of a certain grade or age level in the test's norm group. For example, if a student obtains a grade-equivalent score of 4.5 on a test of basic reading skills, this means the student obtained the same raw score as the average student in the fifth month of the fourth grade in the test's norm group. It does not mean the student acquired or demonstrated the same level of proficiency consistent with curricular expectations as the average student in the fifth month of the fourth grade at the student's school. Likewise, if a student obtains an age-equivalent score of 8.0 years on a test of basic reading skills, this means the student obtained the same raw score as the average 8-year-old student in the test's norm group. It does not mean the student acquired or demonstrated the same level of proficiency consistent with curricular expectations as the average 8-year-old student in the student's school. Consequently, grade and age-equivalent scores should not be interpreted literally. It is critical that test administrators and consumers understand the meaning and interpretation of these and other derived scores, as

misinterpretation can lead to serious consequences for the examinee, including possible misdiagnosis, misclassification, and/or inappropriate educational placement and services. Sattler and Lyman provide further, extensive information about these and other derived scores used for testing interpretive purposes.

Of note is the fact that NRTs are imperfect by nature. The scores yielded by NRTs are referred to as observed scores versus absolute or true scores. An observed score is one attained by an examinee, whereas a true score is one that is error-free and hypothetical in nature. For this reason, norm-referenced standard test scores have bands of error, which are expressed as either 90 percent or 95 percent confidence intervals. The 90 percent confidence interval indicates the range of standard scores within which an examinee's true score would fall 90 out of 100 times on repeated assessments. Likewise, the 95 percent confidence interval, a more conservative estimate, indicates the standard score range within which an examinee's true score would fall 95 out of 100 times on repeated assessments.

REVIEWING THE ADEQUACY OF A NORM GROUP

It is necessary to examine key characteristics of a test's norm group to ensure the adequacy of the norms, hence, the appropriateness of the test. Manuals that come with commercially developed tests should provide this information. According to Salvia and Ysseldyke, some of the important characteristics of a test's norm group are: a) the representativeness of the group, b) the number of individuals in the group, and c) the relationship of the norms to the purpose of testing. Adequate representation is dependent, in part, upon the demographic characteristics of the individuals in the norm sample, including their age, sex, race/ethnicity, parent education level, and geographic location. It is important that the sample of individuals in the norm group be proportioned across the aforementioned variables according to their prevalence in the reference population.

For example, the norm group of an intelligence test developed in the United States for children ages 6 years, 0 months to 16 years, 11 months, should include representative proportions of children within this age range according to selected demographic variables based on U.S. Bureau of the Census data. The age of the norms (i.e., the difference in time between the year in which the norm group was administered the test and the year an examinee is administered the test) is also a critical dimension when evaluating the representational aspect. In order for a norm group to be representative, it must be current. Reschly suggests that test norms older than 10 to 12 years may lead to inflated test scores, based on research indicating that intelligence in the general population

increases at a rate of approximately three points per decade. The test consumer should be aware that the older the norm group is, hence, the older the test norms are, the less accurately the group and norms represent the current reference population.

The number of individuals comprising the norm group is also important because a large norm group assures reliability of the test as well as representation of outliers in the reference population. Salvia and Ysseldyke recommend that the norm group should contain at least 100 subjects per age or grade level. Also of crucial significance is the relationship of the norms to the purpose of testing. For example, if the purpose of testing is to determine how a child performed on a school district reading assessment, the norms developed for the district for that particular test administration would be the most appropriate reference of comparison. If the purpose is to ascertain how a child is performing intellectually, then the norms of a nationally standardized test of intelligence would be the most appropriate reference of comparison.

Finally, norms that include the performance of individuals with special needs are an important consideration for accurate representation, particularly when evaluating individuals for eligibility for special education services and program placement. To the extent that test norms are adequate, they allow for meaningful comparisons and accurate information about the population. The Standards for Educational and Psychological Testing (AERA et al., 1999) states: "Norms, if used, should refer to clearly described populations. These populations should include individuals or groups to whom test users will ordinarily wish to compare their own examinees" (p. 55). To this end, test users must determine the applicability of a test to any given individual or group.

STRENGTHS AND WEAKNESSES OF NORM REFERENCED TESTS

Ornstein describes a number of strengths of NRTs, including but not limited to the following: a) they assume statistical rigor in that they are reliable (i.e., dependable and stable) and valid (i.e., measure what they are reported to measure); b) the quality of test items is generally high in that they are developed by test experts, pilot tested, and undergo revision prior to publication and use; and c) administration procedures are standardized and the test items are designed to rank examinees for the purpose of placing them in specific programs or instructional groups. Stewart and Kaminski report that local norms, based on the test performance of students from a specific locale, have the added advantage of providing meaningful information regarding average performance, for example, in a particular school or school district. These authors report many other advantages of using local norms, including

that they decrease the likelihood of bias in educational decision-making because a student's test performance is compared to other students whose demographic and background factors are similar. In addition, they afford school systems the opportunity to compare data on students' educational outcomes to instructional curricula to which students have already been exposed. Furthermore, local norms are useful in facilitating decisions such as identifying the educational needs of students, determining standards for student progress, and identifying and making decisions about students' eligibility for Chapter I, English as a Second Language, and academically gifted programs. Finally, these norms are useful for identifying students at risk for school failure.

The predominant criticism of NRTs is that their content is seldom aligned with curricular content taught in educational settings (with the exception of locally normed tests). Good and Salvia refer to the match between the items on a norm-referenced achievement test and the content taught in a curriculum as content validity. The underlying assumption of content validity is that the items on a NRT should correspond to the content of the curriculum taught in a classroom. Results of a NRT devoid of content validity make it difficult to determine effective interventions that are needed for a student experiencing academic and/or behavioral challenges. Also, NRTs do not allow for monitoring academic progress over an extended period of time; instead, they provide an index of achievement or performance in comparison to a norm group at one specific point in time. Furthermore, an underlying assumption of NRTs is that examinees have had opportunities to acquire skills and experiences comparable to those of examinees in the norm group.

If disparities exist between examinees and the norm group in terms of skills and experiences, the conclusions based on the examinee's test performance may be misleading. "When a child's general background experiences differ from those of the children on whom a test was standardized, then the use of the norms of that test as an index for evaluating that child's current performance or for predicting future performances may be inappropriate" (Salvia & Ysseldyke, 1991, p. 18). This potential problem is tied to the issue of cultural fairness, which has been the subject of significant consideration in test development and research. Essentially, no test is completely culturally fair. The responsibility for school practitioners is to ensure that a child's level of acculturation (i.e., the extent to which an individual has adjusted to the culture in which he or she lives) is considered when choosing a NRT. Flanagan & Ortiz have done extensive research on acculturation and language differences in the assessment of diverse children, and they provide in-depth information and guidelines on this topic.

With respect to limitations of local norms, Stewart and Kaminski cite misinterpretation as a primary disadvantage. Like the point made by Salvia and Ysseldyke, the group to whom a child's performance is compared should be well-defined (e.g., the age and grade of the students comprising the reference group as well as the size and stability of the group). Also, information about the measures administered to students as well as how the scores were derived should be provided. Stewart and Kaminski emphasize that the knowledge of how a student's performance in a particular subject area using local norms compares with that of their performance using national norms is quite significant. For example, a child may perform in the High Average tier of the local norm group in a particular subject area yet perform in the Below Average tier when tested on a nationally normed test in the same subject area. To report how the child performed only in relation to the local norms would be misleading.

THE STATUS OF NORM REFERENCED TESTING

In part, due to the shortcomings of NRTs, other types of assessments are used to assess individuals' aptitudes and abilities. Such methods include Curriculum Based Measurement (CBM) as articulated by Shinn; the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) as described by Good, Gruba, and Kaminski; and Curriculum Based Assessment (CBA) as described by Gravois and Gickling. Collectively, these methods use curriculum materials as the basis for assessing and monitoring students' academic progress. CBM and DIBELS assessment results are linked directly to instructional interventions, whereas CBA is used primarily to assess and modify a student's instructional environment for the purpose of placing the student in the most appropriate curriculum.

The Individuals with Disabilities Education Improvement Act passed in 2004 allowed states, for the first time, to use a student's response to scientific, research-based interventions as a basis for determining eligibility in the Specific Learning Disability (SLD) category of special education programs. This procedure, commonly referred to as Response to Intervention (RTI), is a significant shift from the traditional ability-achievement discrepancy model used in determining SLD eligibility. Although states have the option to continue using the ability-achievement discrepancy model, RTI, undoubtedly, will decrease the role of NRTs in qualifying students as learning disabled. Be that as it may, it is indisputable that NRTs facilitate meaningful comparisons between a student's test performance and that of the student's same-age peers in a test's norm group, and they will continue to be used and valued in the general education and special education arenas. It is also evident that CBA, DIBELS, CBM, and RTI procedures play a

significant role in instructional decision making and in the early 2000s were gaining an increasing role in special education eligibility decisions. Using a combination of these two assessment paradigms may well be the optimal solution for serving the educational needs of all children.

SEE ALSO *Standardized Testing*.

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NORMAL DISTRIBUTION

The normal distribution is a widely used statistical tool. The normal distribution is often referred to as a *bell curve*, given its bell-type shape and perfect symmetry. The normal curve

represents a distribution of individuals and generally indicates that most individuals are typical or normal on a particular measurement, but some individuals differ from that norm; as one moves further and further away from the center of the normal curve, individuals tend to exhibit characteristics that are more atypical of the norm. Normal distributions describe many phenomena. A normal distribution also is a fundamental mathematical assumption of many commonly used statistical techniques. The normal distribution can be used for many purposes, including calculating probabilities, examining students' performance on tests relative to the performance of other students, determining when certain students' scores are unusual or highly atypical, and deriving common metrics to compare students' scores across a variety of different assessments. The normal curve is the basis of many commonly used educational measures, including the SAT, the GRE, and many commonly used intelligence tests.

Many of the variables that are studied by educational researchers are assumed to come from a population of scores that are distributed normally. The normal distribution first was discussed by de Moivre in the 1700s; however, the normal distribution did not begin to be used as a statistical tool until mathematicians such as Pierre-Simon Laplace (1749–1827) and Carl Friedrich Gauss (1777–1855) began to study the distribution (Walker, 1934). The basic idea underlying the normal distribution is that as one examines large samples of individuals, the distribution of those individuals on many characteristics will often (but certainly not always) approximate a normal distribution. This is because most individuals will be typical or in the middle on the curve, whereas there will be fewer individuals who will be either extremely low or high on any given measure.

To start with a concrete example, imagine a distribution of SAT scores for first year students at a particular university. Most students will receive scores that are near the mean (and the median, and the mode), which would be displayed in the middle of a normal distribution. However, there are a few students who score extremely high (e.g., a perfect score of 800), and a few students who score extremely low on the SAT; those students' scores would be expressed at the extreme ends or *tails* of the normal distribution. This same type of curve would be evident for many other samples (e.g., the weight of bumblebees, the height of elephants, the number of barks emitted per day by pet dogs, IQ scores of third graders, etc.). In all of these cases, most measures will hover near a mean score, some will differ slightly from the mean, and there will always be a few cases that will be extremely low or high.

MEASURES USED TO ASSESS NORMALCY

Although the normal distribution is often what people expect to see, many distributions turn out not to look

exactly like a perfect bell curve. There are a number of criteria that can be used to assess the normality of a curve. The criteria often provide information regarding how much a particular distribution differs from a normal distribution.

First, distributions can be skewed. A distribution is skewed when the mean of a sample differs from the median. When the mean exceeds the median, a distribution will be positively skewed, or skewed to the right; when the mean is less than the median, the distribution will be negatively skewed, or skewed to the left. A skewed distribution is one that contains extreme scores at either end of the distribution; this causes one tail of the curve to look as if it is stretched outward. For example, if a researcher examined a distribution of family income in a particular neighborhood where a billionaire lived, then the distribution would be positively skewed, because this one extremely high income would affect the shape of the distribution by literally *pulling* the distribution to the right by affecting the mean. Statisticians often indicate the level of skewness with a numerical value; a curve with a skewness of zero is a perfect normal distribution; in contrast, a curve with a skewness greater than or equal to ± 2.0 is quite highly skewed. A positive skewness value indicates that the distribution is skewed to the right (i.e., the mean is larger than the median), whereas a negative skewness value indicates that the distribution is skewed to the left (i.e., the mean is smaller than the median).

Second, distributions also can be described in terms of their kurtosis. The term *kurtosis* refers to how flat or peaked a curve is. In terms of kurtosis, the normal curve is mesokurtic (i.e., neither too peaked or flat). In contrast, distributions that are rather flat and have high standard deviations are referred to as platykurtic distribution, whereas distributions with a thin, tall center and a low standard deviation are referred to as leptokurtic distributions. A platykurtic distribution might occur when there is a large amount of variability in a measure (e.g., scores on an achievement test in a particular school vary greatly, from some very low scores to some average scores to some very high scores); in contrast, a leptokurtic distribution might occur when there is little variability in a measure (e.g., scores on an achievement test for most students in the school were all very close to each other, with little variability).

INTERPRETATIONS OF THE NORMAL CURVE

The normal curve is generally measured in standard deviation units, most commonly referred to as z-scores. The normal distribution has a mean z-score of zero and a standard deviation of 1.0. A z-score for any individual can be determined by subtracting the mean score of the

Normal Distribution

distribution from the individual's specific score and then dividing by the standard deviation of the distribution.

One of the most interesting mathematical features of the normal curve is that the percentage of scores that fall within certain areas under the curve are consistent across all normal distributions. Mathematically, exactly 34.13% of the area under the normal curve falls between the middle of the curve (which is also the mean, median, and mode), and one standard deviation above the mean (or one z-score above the mean); similarly, exactly 34.13% of the area under the curve also falls between the middle of the curve and one standard deviation below the mean. The percentage of area under the curve decreases as the number of standard deviation units one moves away from the mean increases. Thus an additional 13.59% of the area under the curve falls between both +1 and +2 standard deviations above the mean, and -1 and -2 standard deviations below the mean; an additional 2.15% of the area under the normal curve falls between ± 2 and ± 3 standard deviations above and below the mean (Sprinthall, 1997). The percentages of the area under the curve continue to remain identical on both the left and right-hand sides of the normal distribution as one proceeds up through higher standard deviations (z-scores). The exact percentage of area under the normal curve between any z-score and the mean can be determined by using a z-score table, which can be found in most introductory statistics text books.

Normal curves are also related to percentile scores, which are commonly used by many educational practitioners. This is particularly important, because educators often need to report and interpret individual students'

test scores for parents. A percentile is the point in a distribution below which a certain percentage of scores fall; thus a student who scored in the 60th percentile on an examination scored higher than 60% of the students who took that examination (this does not mean that the student correctly answered 60% of the questions on the examination). On a normal distribution, the 50th percentile corresponds with the middle of the curve, or a z-score of zero. When z-scores are positive, percentile measures will be above 50, whereas when z-scores are negative, percentile measures will be below 50.

Some other scores that are typically used in the field of education also can be expressed in terms of normal distributions. One of these is T scores, which have a mean of 50 and a standard deviation of 10; another is a stanine score, which divides the normal distribution into nine distinct units. Thus a mean T score (50) corresponds to the 50th percentile, to a z-score of zero, and to a stanine score of 5.

SEE ALSO *Standardized Testing.*

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OBJECTIVE TEST ITEMS

An objective test item is defined as one for which the scoring rules are so exhaustive and specific that they do not allow scorers to make subjective inferences or judgments; thereby, any scorer that marks an item following the rules will assign the same test score. Objective tests began to be used early in the twentieth century as a means of evaluating learning outcomes and predicting future achievement, and their high reliability and predictive validity led to the gradual replacement of the essay test.

One common misconception about the objective test item is that it is limited to testing specific, often trivial, factual details, which would sometimes lead to the use of an essay or performance test to assess students' comprehension of broader principles or their ability to apply them. However, as Robert Ebel pointed out, well written objective tests (especially multiple choice tests) can actually assess such higher-order abilities to some extent. While it is true that some types of knowledge or abilities cannot be assessed by objective tests, educators also should keep in mind that what test items can assess depends largely on the skills and effort of the test constructor, rather the test format per se.

OBJECTIVE TEST FORMATS

A variety of different types of objective test formats can be classified into two categories: a selected response format, in which examinees select the response from a given number of alternatives, including true/false, multiple choice, and matching test items; and a constructed response format, in which examinees are required to produce an entire response, including short answer test items. This distinc-

tion is sometimes captured in terms of recognition and recall. These two general categories are further divided into basic types of objective tests, illustrated in the following examples (Figure 1).

The true/false test is the simplest form of selected response formats. True/false tests are those that ask examinees to select one of the two choices given as possible responses to a test question. The choice is between true and false, yes and no, right and wrong, and so on. A major advantage of the true/false test is its efficiency as it yields many independent responses per unit of testing time. Therefore, teachers can cover course material comprehensively in a single test. However, one apparent limitation of the true/false test is its susceptibility to guessing. It should be noted, however, that test givers can attenuate the effects of guessing by increasing the number of items in a test. In addition, some guessing might reflect partial knowledge, which would provide a valid indication of achievement.

Another selected response format type is the multiple-choice test, which has long been the most widely used among the objective test formats. Multiple-choice test items require the examinee to select one or more responses from a set of options (in most cases, 3-7). The correct alternative in each item is called the answer (or the key), and the remaining alternatives are called distracters. Examinees have less chance of guessing the correct answer to a multiple-choice test question compared to a true/false test question. In addition, the distracter an examinee selects may provide useful diagnostic information.

Related to the multiple-choice test is the matching test, which consists of a list of premises, a list of responses, and

Examples of objective test items

Letter symbols in parentheses indicate correct answers

True/false test item

(1) True/false items are those that ask examinees to supply a word, phrase, or number that answers a question or completes a sentence. (F)

Multiple-choice test item

(2) Which of the following situations will change the standardized regression coefficient in simple linear regression analysis? (C)

A The criterion variable is doubled.
 B A constant value of 10 is added to the predictive variable.
 C The predictive variable is squared.

Matching test item

(3) **Directions:** The first column below lists historical events. For each event, find the date it occurred on in the second column, and write the letter of the date on the line to the left of each event. Each date in the second column may be used once, more than once, or not at all.

(B) 1. Flight to Varennes	A. 1785–1789
(D) 2. Beginning of the First French Empire	B. 1790–1794
(C) 3. Coup of 18 Brumaire	C. 1794–1799
(A) 4. Attack on the Bastille prison	D. 1800–1804
(B) 5. Thermidorian Reaction	

Short answer item

(4) What is the name of the capital city of Japan? (Tokyo)

Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

directions for matching the two. Examinees must match each premise with one of the responses on the basis of the criteria described in the directions. A major strength of the matching test is that it is space-saving and, therefore, can be used to assess several important learning targets at once.

A typical example of a constructed-response format is the short-answer test, which asks examinees to supply a word, phrase, or number that answers a question or completes a sentence. Sometimes it is called a completion or fill-in-the-blank test. Although what a short-answer test item can assess is generally more limited to factual information, it does not require the development of plausible distracters. Moreover, short-answer items are much less susceptible to guessing than selected-response format items.

HOW TO CONSTRUCT OBJECTIVE TEST ITEMS

Basically, scoring objective test items is easy: It only requires one to follow the scoring rules. However, constructing good objective test items requires much more skill and effort. The first step is to develop a set of test specifications that can serve to guide the selection of test items. A table of specifications (or test blueprint) is a useful tool for this purpose. This tool is usually a two-way grid that describes content areas to be covered by the test as the row headings and skills and abilities to be developed (i.e., instructional objectives) as the column headings (Figure 2). After specifying the content and ability covered by the test using the

table of specifications, the appropriate test item format is selected for each item. At this point, not only objective test items but also other types of test items—essay test or performance assessment—should be considered, depending on the learning outcomes to be measured.

The next step is to create specific test items. Typically, it is particularly important for objective test items to be written in clear and unambiguous language to allow examinees to demonstrate their attainment of the learning objectives. If complex wording is used, the item simply reflects reading comprehension ability. It is also important for each objective test item to focus on an important aspect of the content area rather than trivial details. Asking trivial details not only makes the test items unnecessarily difficult, it also obscures what the test constructor really wants to measure. Similarly, relatively novel material should be used when creating items that measure understanding or the ability to apply principles. Items created by copying sentences verbatim from a textbook only reflect rote memory, rather than higher-order cognitive skills.

Many other specific rules exist for constructing objective test items. Test constructors must be very careful that examinees with little or no content knowledge cannot arrive at the correct answer by utilizing the characteristics of the test format that are independent of specific content knowledge. Jason Millman and his colleagues called this skill of the examinees “test-wiseness.” For example, in multiple-choice test items, all options

Content areas	Skills and abilities			Total (%)
	Knowledge	Comprehension	Application, analysis, or synthesis	
1. Univariate analysis: Central tendency and variability	3	2	1	6 (24)
2. Bivariate analysis: Correlation and regression analysis	2	3	3	8 (32)
3. Statistical hypothesis testing: Concepts, methods, and interpretation	1	3	2	6 (24)
4. Comparison of means: Paired t-test and analysis of variance (ANOVA)	1	2	2	5 (20)
Total (%)	7 (28)	10 (40)	8 (32)	25

Figure 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

should be grammatically correct with respect to the stem (questions or incomplete statements preceding options), and key words from a stem, or their synonyms, should not be repeated in the correct option. Any violation of these rules would obviously provide an advantage for testwise examinees. Test composers should also equalize the length of the options of an item and avoid using specific determiners such as *all*, *always*, and *never* because some testwise examinees know that the correct option is frequently long and without such specific determiners. Robert Thorndike and Anthony Nitko have provided more comprehensive guidelines, with detailed explanations for constructing objective test items.

EFFECT OF OBJECTIVE TEST ITEMS ON TEACHING AND LEARNING

One common criticism of objective test items is that students are encouraged toward rote learning and other surface-processing strategies. Another related criticism is that objective tests, if used to evaluate the educational attainment of schools, encourage teachers to place undue emphasis on factual knowledge and disregard the understanding of students in the classrooms. Some evidence suggests that both are the case.

Kou Murayama, in a series of studies, investigated the effects of objective test items on the use of learning strategies. In one study, junior high school students participated in a history class for five days and took either an essay or short-answer test at the end of each day. Results showed that in the last day, those who took the short-answer tests used more rote learning strategies and fewer deep-processing strategies than those who took the essay tests. George Madaus reviewed much literature about the effects of standardized testing on what is taught at schools and found that teachers pay particular attention to the form of the questions and adjust their instruction accordingly, suggesting that objective tests could narrow instruction to the detriment of higher-order skills. Madaus argued that high-stakes tests

tests that are used to make important decisions such as the ranking of schools have much more influence on teaching.

However, educators should be reminded that objective test items are not limited to testing for specific factual knowledge. Well written items may not have such negative effects on students' use of learning strategies or teachers' teaching styles. Thus, it is not the objective test items per se that should be changed. What is important is to change the stereotypical beliefs that objective test items require only rote learning of factual knowledge and avoid poorly constructed objective test items.

SEE ALSO *Standardized Testing*.

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Kou Murayama

OGBU, JOHN U(ZO) 1939–2003

John Uzo Ogbu was born in Nigeria on May 9, 1939. He earned a BA in anthropology at the University of California Berkeley in 1965, followed by an MA in 1969, and PhD in 1971. He taught at Berkeley from 1970 until

his death on August 20, 2003. His most influential contribution to education is his cultural-ecological theory, a grand theory explaining why some groups tend to experience low academic achievement and others do not. This work responds to other explanations for low minority group achievement such as cultural mismatch.

Cultural mismatch (also referred to as cultural discontinuity or cultural differences) suggests that minority students experience low academic achievement because some aspects of their cultures—language, dialect, perception of time and space, attitude toward collectivism and individualism—do not match the school culture. This mismatch puts them at a disadvantage compared to students who share cultural background with school teachers, text books authors, and standardized test writers. If cultural mismatch is powerful, asked Ogbu, why do immigrant minority groups such as Punjabis and Chinese that experience cultural mismatch and discrimination show relatively high academic achievement?

To answer this question Ogbu distinguished voluntary and involuntary minorities. Voluntary minorities are those who come to a society of their own choice, often through immigration. Involuntary minorities are those who come to a society through enslavement, conquest, or colonization. Voluntary minorities do not experience persistent or pervasive low achievement, whereas involuntary (castelike) non-immigrant minorities do. In the United States, Africans (like Ogbu) and Vietnamese are voluntary minorities, and African Americans and Native Americans are involuntary minorities. While Ogbu's theory focuses on Black academic disengagement and low achievement, it is intended as a theory of how voluntary and involuntary minorities fare in societies around the world.

According to his theory, involuntary immigrants experience a history of discrimination and prejudice that causes them to turn to each other in collective identity. If they know that they cannot turn to the dominant culture for help or support, they become more dependent upon and supportive of other members of their group. As they experience this fictive kinship, they also experience oppositional collective identity in which they reject behaviors and activities that represent the dominant, oppressor group. This pattern has been labeled "fear of acting White." Ogbu helped popularize, but did not invent, this label in an article that he co-authored with Signithia Fordham. According to Fordham and Ogbu, attitudes and behaviors that mark acting White include speaking standard English, listening to White music such as rock and roll or classical music, working hard in school, and getting good grades, which means students may actively undermine their own achievement in order to show solidarity with their group and to avoid feeling not truly Black.

Ogbu's theory has generated considerable research, commentary, and criticism. Criticisms include lack of attention to social class and gender, misuse of the term *caste*, and misconceptions regarding the social construction of race. Perhaps of most interest to educators, it has been criticized for blaming the victim. For example, in his last book (2003), about students in Shaker Heights, Ohio, he wrote that "Black students did not generally work hard" (p. 17) and "Black parents' educational strategies are not adequate and not effective in helping their children succeed in Shaker Heights schools" (p. 279). The theory has also been criticized because, while it purports to pay attention to history, it ignores historical facts about the avid pursuit of education by African Americans. Research generated by his theory, such as Bergin and Cooks (2002), showed that for some students, merely achieving high grades was not enough to elicit accusations of acting white. In addition, the theory has been criticized for not proposing solutions.

However, in his 2003 book, *Black American students in an affluent suburb: A study of academic disengagement*, Ogbu began to outline policy implications of his work. He suggested those policies will fail that do not address the community forces that foster underachievement. He was dubious about interventions such as school choice, cooperative learning approaches that capitalize on the assumption that Black and other minority groups value cooperation and collaboration, and culturally responsive education that supports cultural practices and learning styles allegedly common to African Americans. He wrote that they did not address community forces that foster avoidance of hard work. He recommended that schools implement minority achievement programs that reform community forces to support academic achievement. Such programs should demonstrate the link between schooling and adult futures, teach good study habits, and expose students to successful Black role models who thrived in school. The intent would be to create a collective identity that facilitates rather than undermines academic achievement.

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David A. Bergin

OPERANT CONDITIONING

Operant conditioning is defined as the use of consequences to modify the occurrence and form of behavior. "To put it very simply, behavior that is followed by pleasant consequences tends to be repeated and thus learned. Behavior that is followed by unpleasant consequences tends not to be repeated and thus not learned" (Alberto & Troutman, 2006, p. 12). Operant conditioning is specifically limited to voluntary behavior, that is, emitted responses, which distinguishes it from respondent or Pavlovian conditioning, which is limited to reflexive behavior (or elicited responses).

Operant conditioning was developed by B. F. Skinner (1904-1990), a psychologist at Harvard University, in 1938, and has continued into the early 2000s to be a popular approach for influencing behavior. Although the model was originally applied to animal learning (rats, pigeons; Skinner, 1938; 1963), it was subsequently commonly applied in educational settings. The model involves the operations of positive reinforcement, negative reinforcement, extinction, response cost punishment, and punishment with aversives, each of which is described below in this entry.

ASSUMPTIONS RELATED TO LEARNING

Gredler (2005) offers the following assumptions as the foundation of operant conditioning:

Learning is behavioral change (meaning that observers conclude that learning has occurred when behavior changes).

Behavioral change (i.e., learning) is related to changes in environmental events (these events being precursors of and consequences of an action).

One can determine relationships between behavior and the environment only if the characteristics of the behavior and the experimental conditions under which it occurs are defined in physically observable terms and observed under controlled conditions (the process must be systematic, observable, and controlled).

The only acceptable sources of information about the causes of specific behaviors are data from the experimental study of behavior (people must observe both the behavior and its causes).

The appropriate data source is the behavior of the individual (rather than the observers' expectations or inferences).

Of prime importance in the operant conditioning model is the focus on relationships between environmental events and behavior defined in physical terms, with an avoidance of the use of *inner states* as explanations.

VARIATIONS OF THE MODEL

There are four contexts or types of operant conditioning: positive reinforcement, negative reinforcement, positive (or response-cost) punishment, and negative punishment (or punishment with aversives) (Landrum & Kauffman, 2006). The last three of these are all associated with aversiveness or aversive control while only one, positive reinforcement, is associated with positive control. Thus, researchers can distinguish between two variations of the model, a positive one and a negative one. (There is also extinction, which occurs when reinforcement following behavior is discontinued, causing the behavior itself to eventually be discontinued.)

In the positive version of the model, a person who emits a desired behavior (e.g., raising her hand and waiting to be called on) receives something good—a positive consequence (referred to as positive reinforcement). This may be a smile or praise or a piece of candy. The result of the reinforcement is that the behavior is strengthened, that is, its likelihood of subsequent occurrence increases. This represents a positive form of control.

In the negative version of the model there are three possible consequences. One is to avoid something bad—negative reinforcement. If a student raises her hand and waits to be called on, rather than speaking out, there is no positive consequence, only the avoidance of a negative one. A second is to receive something bad—punishment with aversives—which may take the form of being yelled at or ridiculed, hence reducing the tendency to speak out (or,

perhaps, just suppressing it temporarily). The last negative approach, response-cost punishment, represents being deprived of something good, that is, a previously earned reinforcer being removed because of an undesirable behavior such as talking out in class, rather than raising one's hand and waiting to be called on (Walker, Shea, & Bauer, 2004). The punishment might be being placed in time-out or sent to the principal's office. These three approaches all represent aversive control, which may be associated with anxiety and fear (Skinner, 1953), and they may not result in a diminution of the strength of the undesirable response.

Another variation of the model is based on who or what precedes or occasions a response. After repeatedly pairing a response with a stimulus that precedes it, called a discriminative stimulus (S^D), the response will only occur in the presence of S^D , not in its absence. Such a response is said to be under stimulus control. "A behavior under stimulus control will continue to occur in the presence of the S^D , even when reinforcement is infrequent" (Alberto & Troutman, 2006, p. 306). Examples of stimulus control are answering telephones only when they ring (the sound of the ring serving as a discriminative stimulus), driving through intersections when the light is green (the S^D), not when it is red (although this is an imperfect S^D , because drivers often run red lights), and paying attention in class (a response) when being watched by the teacher (an S^D).

COMPONENTS AND ACTIVITIES OF THE MODEL THAT AFFECT EDUCATIONAL OUTCOMES

Various different positive reinforcers can be used to increase the likelihood of desired behavior in the classroom. They appear in the form of (a) consumable (e.g., candy), social (e.g., praise), (b) activity (e.g., time on the computer), (c) exchangeable (e.g., points or stickers), and (d) tangible (e.g., getting to sit in one's favorite chair). Activity reinforcers are among the most educationally relevant, since the activity can be done with educational value such as doing a jigsaw puzzle or watching an instructional video. However, it is of critical importance that the desired behavior immediately precede the activity reinforcer rather than follow it in order for the reinforcer to strengthen the response (this is called the Premack Principle, after David Premack, its discoverer), and in some cases this may be difficult to arrange, as, for example, when the activity reinforcer is a field trip (Kazdin, 2001).

Various reinforcement schedules (Skinner, 1969) have an effect on educational outcomes by affecting the likelihood of a particular response. A continuous reinforcement schedule, wherein every occurrence of a desired operant response is followed by a reinforcement, is desirable when operant conditioning is first taking place. However, once the desired response occurs on a regular basis, it

can be maintained by only occasional or intermittent reinforcement, thereby lessening the load on the teacher.

There are four possible intermittent reinforcement schedules: fixed ratio, fixed interval, variable ratio, and variable interval. In an educational setting (as in most settings), the two variable schedules best maintain the desired behavior, primarily because of their unpredictability. For example, if students were given the opportunity to listen to music, a reinforcement, after handing in some number of completed assignments, they would be more motivated to hand in completed assignments if the number required was not always the same (variable ratio) or the time during which they had to be handed in was not always the same (variable interval). By comparison, in the fixed interval schedule, where the reinforcement is provided after the desired behavior has been performed for a fixed amount of time (say 10 minutes), it does not take students long to realize that they can do nothing for nine and a half minutes and then perform the behavior to get the reinforcement. Similarly, if the fixed ratio is 4:1, students will perform the behavior four times in a row, and then relax after receiving the reinforcement.

Operant conditioning is a vehicle for teachers to achieve behavior modification in order to improve classroom management and facilitate learning. There are three techniques employed in particular to facilitate learning: prompting, chaining, and shaping. Prompting involves giving students cues (called *discriminative stimuli* in the lexicon of operant conditioning) to help them perform a particular behavior. When students are learning to read, a teacher may help them by sounding out a word (just as when actors forget their lines, someone prompts them by saying their next line). Prompting helps to make the unfamiliar become more familiar, but, if used too often, students can become dependent on it, so teachers should withdraw prompts as soon as adequate student performance is obtained (a process called *fading*). Also, teachers should be careful not to begin prompting students until students try a performing task without extra help.

Learning complex behaviors can also be facilitated through an operant conditioning technique called *chaining*, a technique for connecting simple responses in sequence to form a more complex response that would be difficult to learn all at one time. Each cue or discriminative stimulus leads to a response that then cues the subsequent behavior, enabling behaviors to be chained together. Skinner taught pigeons to steer torpedoes toward enemy vessels in World War II by chaining together responses that adjusted the direction of a torpedo relative to the target as it appeared on a screen. Although the technique was not actually used in the war, it appeared in trial runs that it would work successfully.

The third, and perhaps most generalizable technique is called *shaping*, a process of reinforcing each form of the behavior that more closely resembles the final version. It is used when students cannot perform the final version and are not helped by prompting. Shaping involves gradually changing the response criterion for reinforcement in the direction of the target behavior. If the student is given 10 math problems, for example, and gets three of them right, the student gets a reinforcement. On the next set of problems, the student needs to get six right for a reinforcement, then 10. By shifting the criterion for reinforcement, or successive approximations, a student's behavior is shaped in the direction of ultimate success.

According to Landrum and Kauffman, "Despite a rich history and extensive empirical underpinnings, the behavioral perspective on teaching and management is not highly regarded in the education community" (2006, p. 47). Its critics contend it is an unfeeling approach more suited to animals than to humans (Landrum & Kauffman, 2006). Nevertheless, operant conditioning is commonly used in classrooms and is viewed by many teachers as an effective approach to improving classroom practice. It provides teachers with a set of tools for improving classroom management and student learning.

SEE ALSO *Applied Behavior Analysis; Classical Conditioning; Skinner, B(urrhus) F(rederic).*

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Bruce W. Tuckman

OPPORTUNITY/ ACHIEVEMENT GAP

Among the wide-ranging challenges facing American educators, perhaps no issue is more pressing than the inequity in student achievement among racial/ethnic and socioeconomic groups—a problem that in the early 2000s is somewhat contentiously referred to as the achievement gap.¹ Since the early 1970s, analyses of nationally representative survey data have documented a persistent history of achievement differences, according to which Whites and especially east Asians enjoy relatively high average student performance while African Americans and some Hispanic subgroups experience relatively low average student performance. Moreover, children whose families are on the lower rungs of the social class ladder average far lower achievement and educational attainment levels than their wealthier counterparts. Thus, it is important to recognize that what is often characterized as a single gap between White students and all minority students is more accurately portrayed as multiple gaps between and within racial and social class groups.

However gaps are measured—whether by pre-school vocabulary, elementary school grades, middle school standardized test scores, or high school or college completion rates—the fact that there is a continuing history of race and social class differences in U.S. education is not debatable. Perhaps the best evidence comes from the National Assessment of Educational Progress (NAEP), widely known as the nation's report card. NAEP trend data demonstrate persistent, if somewhat fluctuating, racial test score gaps going back to 1971. Although Black-White and Hispanic-White gaps in mathematics and reading steadily narrowed between 1971 and 1988, trends toward test score convergence reversed in the late 1980s. Some gaps stabilized and others actually widened throughout the 1990s. Since 1999, however, Black-White and Hispanic-White math and reading test score gaps have held fairly constant across age groups—with the exception of slight convergence in the Hispanic-White math gap and the Black-White reading gap among 9-year-olds. This convergence is trumpeted by the U.S. Department of Education as evidence of the impact of the No Child Left Behind Act (NCLB) of 2001.

Figure 1 presents cross-sectional analyses of fourth and eighth grade students' mathematics and reading results from the 2007 main NAEP.² Whites and Asian Pacific Americans score above national averages at both grade levels. Asian fourth grade students exceed the national math mean by .48 standard deviations (.50 SD approximates one year of academic growth) outperforming by .19 SD their White counterparts who also score above the national average. African Americans and Hispanics score below the national average in fourth and eighth grade. The math gap is especially pronounced for

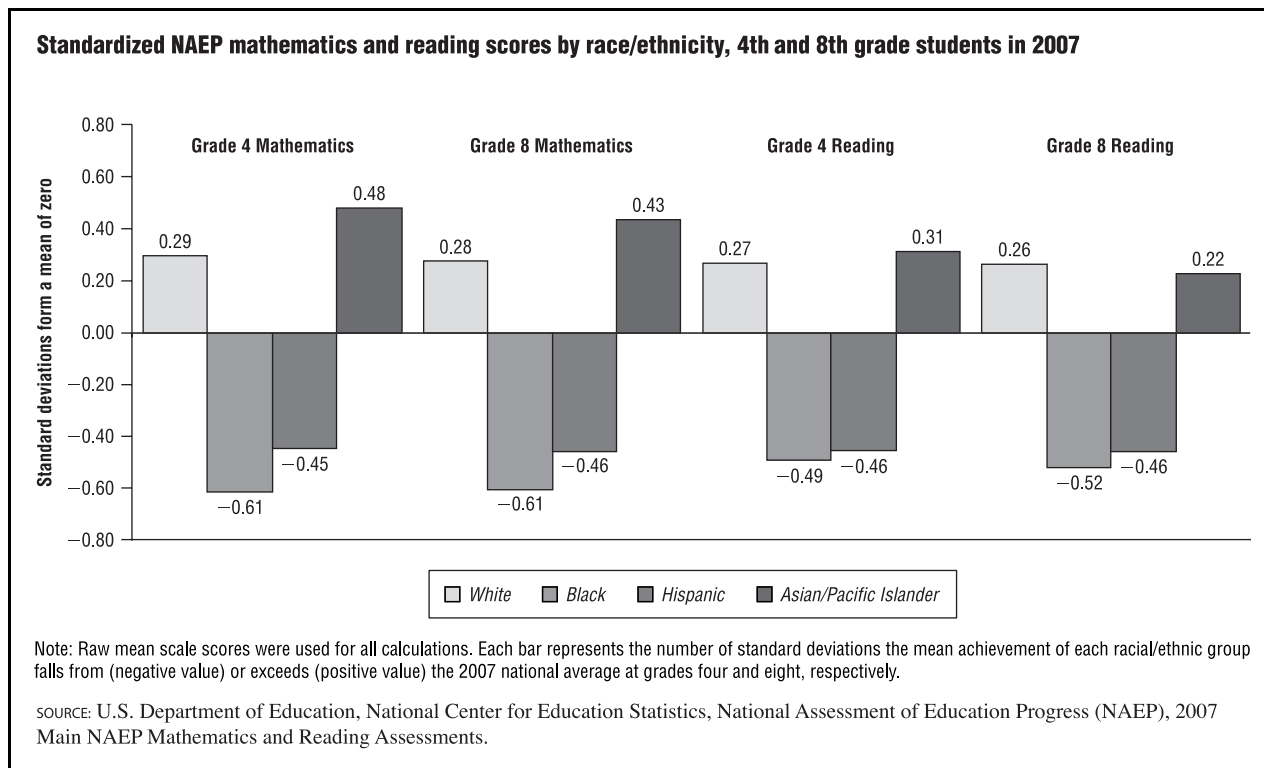


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

African Americans (.61 SD below the mean), whereas Hispanic students score approximately .46 SD below the national average in mathematics and reading at both grade levels.

While standardized achievement data reveal students' relative mastery of specific knowledge and skills, still other data document differences in group-level educational attainment by alternate measures. For instance, according to the National Center for Education Statistics, high school dropout rates for Blacks and especially Hispanics substantially exceed those for Whites and Asians. Although the gap between Blacks and Whites narrowed significantly between 1965 and 2005, the disparity in the graduation rates of Hispanics versus other racial/ethnic groups persists at double-digit rates. The alarmingly high Hispanic high school dropout rate 1.4 million Hispanics between the ages of 16 and 24 were dropouts in 2005 (NCES, 2005) is in fact twice that of Blacks and more than three times that of Whites and Asians (see Figure 2).³ These numbers prefigure similar trends in educational attainment at the college level, as Hispanics are about half as likely as their non-Hispanic peers to complete four years of college (Vernez & Mizell, 2002).

Dramatic demographic changes in the United States only heighten the importance of these described gaps in

academic performance. Population trend data indicate that by 2025 fully one quarter of all U.S. K-12 students will be of Spanish-speaking origin. At the same time the standards-based accountability movement in education, on the rise since the late 1980s and focusing especially on state assessments and K-12 test scores, has shone a bright light on unrelenting racial/ethnic and socioeconomic differences in academic performance. Many policymakers have redoubled their efforts (perhaps sometimes only symbolically) to achieve group-level equality of educational outcomes, if not inputs. Tellingly, the preamble to NCLB explicitly states the goal of eliminating test-score outcome gaps by the year 2014. In other words, during the first two decades of the 21st century, official interest in these described achievement gaps in American education may be at an all-time high.

MEASURING CONSEQUENCES

Policymakers are increasingly aware that the importance of closing gaps goes well beyond presumed links between improved minority student performance and improved job prospects for minorities. The moral and civic imperative to eliminate gaps is strong, but on a simply utilitarian rationale it can also be said that better educated students earn higher incomes, live healthier lives, pay

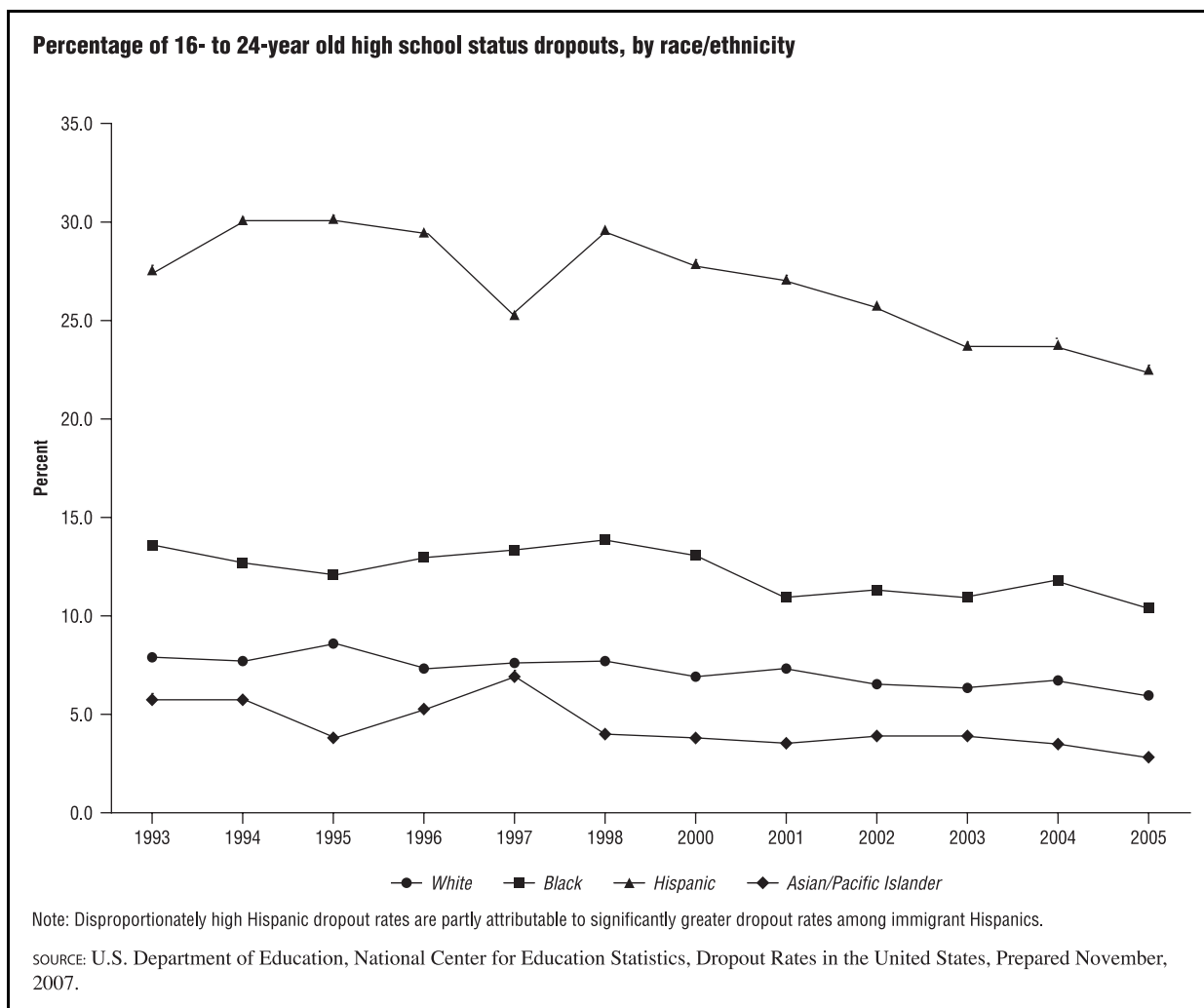


Figure 2 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

higher taxes, and are less likely to be involved in crime. Columbia University’s Henry Levin is a renowned researcher in the study of educational inequality and its costs. Working on the premise that high school graduation should serve as a minimal threshold for the standard of adequate education, he has investigated costs to society should educators fail to succeed in aiding greater numbers of students to procure a high school diploma. The report focuses on those individuals who at age 20 were not high school graduates in 2005, a group of approximately 700,000. The findings are sobering: For each of these individuals, over \$200,000 is lost to society in federal, state, and local tax revenues and costs to the public health and criminal justice systems over the lifetime of each dropout. When aggregated the fiscal consequences to society for this single group of 700,000 students who leave school without high school diplomas

is the staggering sum of \$148 billion in lost tax revenues and additional public expenditures over the lifetime. Clearly it is in the nation’s best interest to reduce dropout rates, particularly among non-Asian minorities, and to ensure that all children secure an adequate education (Levin et al., 2007).

GAPS EMERGE ON THE POLICY AGENDA

James Coleman was a sociologist at Johns Hopkins University when his controversial 1966 report to the U.S. Congress, *Equality of Educational Opportunity*, became the first national study to offer a systemic description of racial/ethnic differences in academic achievement among children of various ages. Prior to the Coleman Report, investigations of this nature had been focused on educational inputs: School effectiveness was measured by the resources that

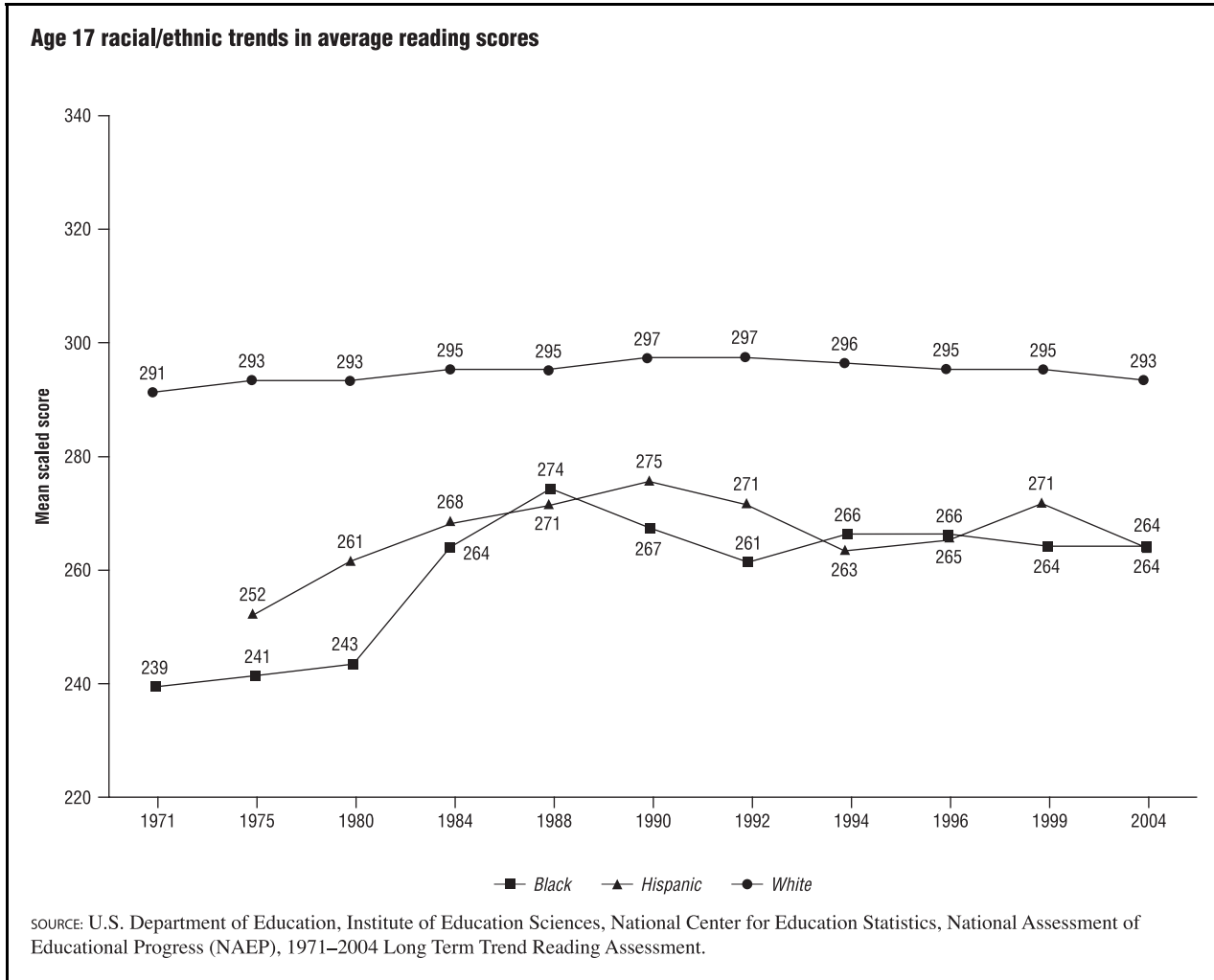


Figure 3 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

went into schools, not the quality of the students who came out of them. To his surprise Coleman found that (1) while schools certainly influence student achievement much of what tests measure must be learned in schools and (2) although school quality varies widely in the United States, the large documented differences in the quality of schools attended by Black and White children fail to explain most of the difference in average levels of achievement between Blacks and Whites (Rothstein, 2004). These rather controversial findings have been cross-examined by many researchers. Few, if any, dispute Coleman’s fundamental claims. Those who point to schools alone when searching for answers to stubborn outcome gaps may be ignoring the fact that children spend the vast majority of their waking hours each year somewhere other than the formal school setting. As developmental psychologist Urie Bronfenbrenner’s ecological systems theory emphasizes, children are

enveloped within families and they navigate social life with peers. They reside in neighborhoods and communities where schools are charged with their formal education, which takes place largely within individual classrooms. Each of these overlapping networks and domains conditions students’ educational performance in ways that are not mutually exclusive. Children lead nested lives.

Soon after publication of the Coleman Report, the federal government allotted substantial resources across multiple levels in an attempt to close the family/school/community input gap. In fact, desegregation in the wake of the 1964 Civil Rights Act combined with the Great Society’s War on Poverty programs (including Head Start and compensatory Title I funding) helped reduce glaring resource inequities and coincided with nearly 20 years of steady progress in reducing both the Black-White and Hispanic-White test score gaps since 1971, per Figure 3.

However, by the time U.S. Secretary of Education Terrel Bell released the landmark 1983 report to Congress, *A Nation at Risk*, concerns about inequality on the domestic front were pushed into the background, giving way to a growing preoccupation with educational efficiency and global competitiveness. Thus, targeted programs for the poor and compensatory education reforms were rolled back throughout the 1980s. By 1988 the progress in narrowing educational opportunity and achievement gaps had stalled.

The widening of test score gaps in the late 1980s went largely unnoticed until 1994 when experimental psychologist Richard Herrnstein and political scientist Charles Murray published *The Bell Curve* to much fanfare and subsequent controversy. Their conclusions about the genetic inevitability of the gap were deduced from the research of others and resurrected in particular the much disputed claims of education psychologist Arthur Jensen, which were first published in 1969 in the *Harvard Educational Review*⁴. When a special task force of the American Psychological Association reviewed the data used by Herrnstein and Murray the association arrived at a much different conclusion: The paucity of direct evidence of the Black-White differential in psychometric intelligence simply could not support the genetic hypothesis. Richard E. Nisbett, a professor of psychology at the University of Michigan, has charged the authors of *The Bell Curve* with having provided a “shockingly incomplete and biased” reading of the research (Nisbett, 1998, p. 96). As of 2008, what all psychologists agree upon is that a person’s developed capacity for intelligent behavior often differs in predictable ways from the person’s hereditary potential. So-called intelligence or aptitude tests measure the development of innate abilities. The collective research of American psychology leads one to conclude that environmental factors explain far more of the variance in achievement than the number of Blacks or Whites in a person’s family tree (Neisser et al., 1996).

SOURCES OF THE GAPS

When people turn to an examination, then, of contextual factors contributing to socioeconomic and racial education gaps, the breadth and depth of their sources quickly becomes apparent. Because causes are layered and overlapping, they are best considered simultaneously across domains. From a top-down structural perspective one might perceive broad economic conditions as being linked to, say, state and local tax rate policies that bear directly, if also differentially, upon community labor markets and housing values which, in turn, dictate school finance schemes. There are indeed sizeable gaps in educational resources that differentiate communities serving White and minority children. From a less structural, bottom-up perspective, concentrated on student effort and family

influence, one sees substantial variation in parents’ approach to child rearing. Whether children are talked at or listened to, how frequently they read and are read to, and whether or not they attend quality preschool and summer school are important factors that are conditioned by parents’ effort and resources. Children’s friends and peers pick up where families leave off, exerting increasing influence as students progress through schooling. In short, there is a dynamic and sometimes transformative relationship between the practices of real people including students, parents, and peers and the structures of school, society, and even history (Ortner, 2006).

Figure 4 shows a nested, albeit by no means exhaustive, depiction of the many structural and individual-level factors that have been examined to understand the causes of the gap. The embedded domains are not mutually exclusive categories. Rather, they are composed of related factors that act upon one another in complex ways that are often difficult to observe and quantify. One challenge, therefore, is to determine the extent to which the attributes of formal institutional settings and those of less formal student, family, peer group, and neighborhood and societal-level influences contribute to the gaps. A few of the better documented causes of these gaps are noted below.

Re-segregation and the Distribution of Teacher Quality.

In June 2007, a divided U.S. Supreme Court restricted the ability of public school districts to use race in determining which schools students can attend. Most voluntary desegregation efforts by school districts are now unconstitutional. According to Professor Gary Orfield of the UCLA Civil Rights Project, the re-segregation of U.S. schools has accelerated since the early 1990s and continues to grow in all parts of the country, most conspicuously among African Americans and Hispanics. Not since President Lyndon Johnson signed the Civil Rights Act have schools been as segregated as they are as of 2008. When people ask what it is about segregated schools that contributes to the racial achievement gap many point to course offerings, the composition of the student body, and perhaps especially the instruction gap. In a 1991 study of 900 Texas school districts, Harvard University’s Achievement Gap Initiative director, Professor Ronald Ferguson, found that nearly all of the school-level variation in the gap in achievement between Blacks and Whites was attributable to systematic differences in the skills of their teachers. The simple fact is that far fewer of the best prepared teachers are teaching in schools where the vast majority of students are Black and/or Hispanic. These disparities in access to high-quality teachers and teaching are large and growing worse (Darling-Hammond, 2007).

Although quality teachers are important, it is nevertheless the case that most of the group-level variation in student achievement outcomes can be attributed to factors

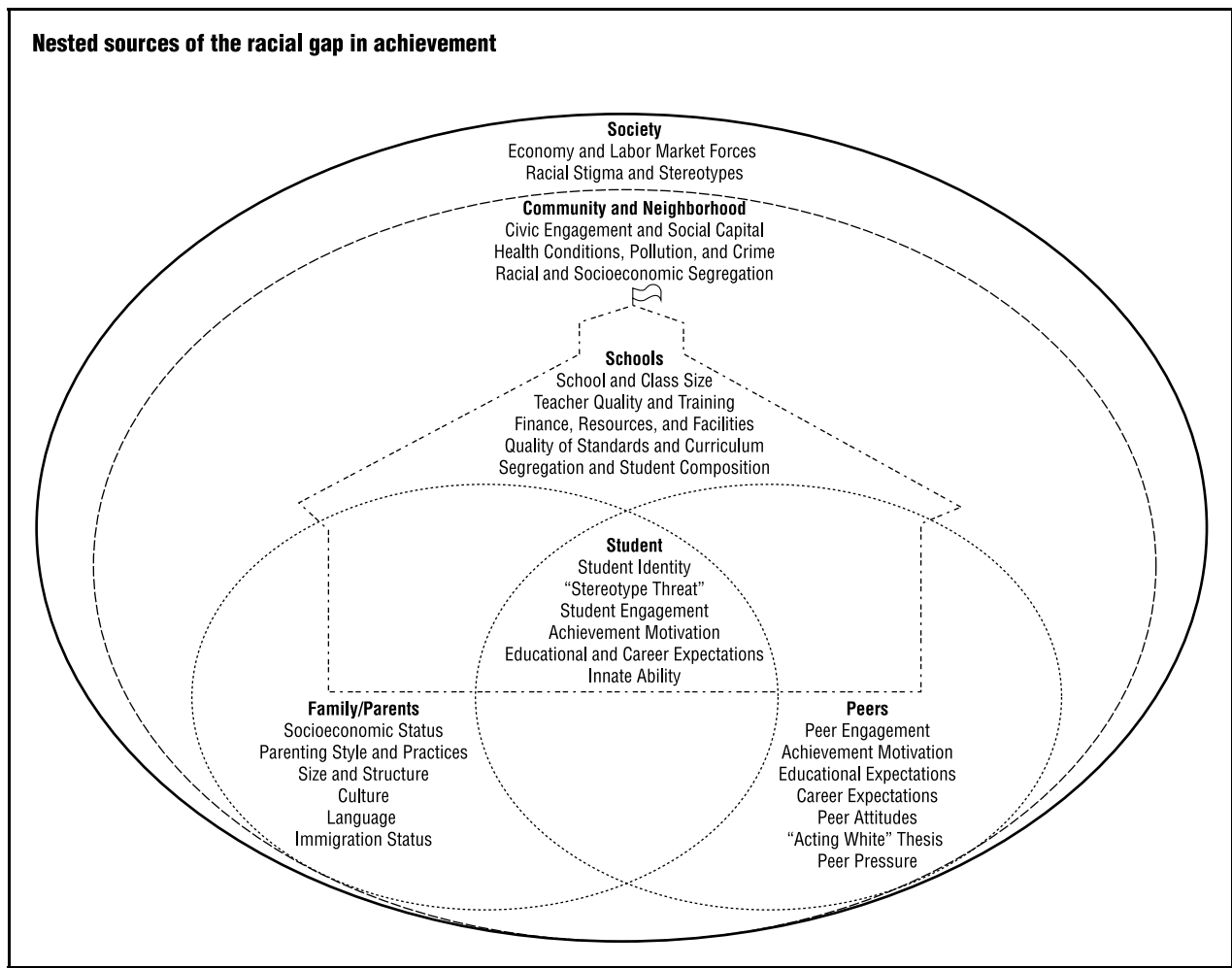


Figure 4 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

outside of schools. As findings based on and replicating the Coleman Report have time and again demonstrated, other structural conditions and individual-level factors apart from schools also affect gaps in achievement.

Socioeconomic Status and Parenting. Socioeconomic status (SES), a measure of parental education, employment, and income is among the most powerful predictors of student achievement. Many prominent social scientists have shown that the correlation between SES and race is inevitably linked to diminished access to quality education for underrepresented minorities, and thus, not surprisingly, to patterned racial inequality in educational outcomes. While only 7 percent of White mothers in the Early Childhood Longitudinal Study of the Kindergarten Class of 1998 1999 (ECLS-K) had failed to complete high school, a full 18 percent of Black mothers and 35 percent of Latina mothers had failed to do so. Likewise,

only 15 percent of White children (and 11 percent of Asians) under the age of 18 were living in poverty in 2005 compared to almost one-third of all Black and Hispanic children (NCES, 2006). Not only are Black and Hispanic children more likely to have parents who have not completed high school and are poor, but they are also more likely to attend schools with other poor children. To the degree that both family poverty and school poverty affect academic achievement, Hispanic and Black students are twice disadvantaged (Rumberger, 2007).

Some understanding of how SES influences achievement is provided by psychologists who study the interactions between parents and children. The research of psychologist Laurence Steinberg at Temple University indicates that a lack of school-specific knowledge and a lack of opportunity (good parenting takes a lot of time) are what differentiate high and low SES parents in their parenting styles and approaches to raising children (Steinberg, 1996).

Other research conducted by Betty Hart and Todd Risley, child psychologists at the University of Kansas, links children's language development to parents' communication style. In a well-known 1995 study, they found that by age 3 the children of professionals had vocabularies of about 1,100 words—the children of welfare parents had vocabularies of about half as many words as their peers not living in poverty. Comparing children's vocabulary scores with their home life, Hart and Risley concluded that children's vocabulary correlated most closely to the number of words the parents spoke to their child. In addition, the number and kinds of words that children heard varied markedly by social class. In short, early childhood parenting practices and communication styles matter greatly and are patterned along class lines.

To reiterate, only about one-third of the racial gap in achievement can be attributed to what goes on in schools. Moreover, emerging research consensus indicates that family socioeconomic status accounts for at least another one-third of the gap in educational outcomes (Hedges and Nowell, 1999). While the effect of schools on a child's academic achievement is near impossible to isolate from other influences (including family SES), many researchers agree that even eliminating vast resource differences between schools and among families would not entirely close the racial gap in achievement. In fact, one of the most perplexing aspects of the racial test score gap is its persistence among even middle-class students and among students at the top of the achievement spectrum—the very pool from which the nation's leaders are drawn (Jencks & Phillips, 1998).

Individual Identity and Stereotype Threat. The work of Stanford social psychologist Claude Steele helps to interpret the persistent achievement gaps even among students who are enrolled in the most competitive U.S. universities. In spite of the many obstacles that inhibit educational achievement among non-Asian minority students, many forge ahead to attain high levels of academic success. Some minorities within the academic vanguard, however, may encounter further achievement barriers corresponding to their relative identification with schooling. In his groundbreaking work on how stereotypes interact with students' identities to shape educational performance, Steele (1997) explains what he calls "stereotype threat." According to Steele, stereotype threat arises when school-identified African Americans are in a situation or doing something for which a negative stereotype about one's group applies and must therefore be disconfirmed. Thus, stereotypes become particularly threatening for those who associate their identity and self-worth with success in a domain where their own group has been obviously stereotyped. So above and beyond the K-12 instruction gap and the socioeconomic inequality noted above, stereotypes

about groups can influence the identity formation and cognitive functioning of individual group members. The burden of heightened awareness about stereotypes and social stigma affects especially test score outcome gaps among students of color who are otherwise apparently advantaged.

SOCIETY'S INTEREST IN ELIMINATING ACHIEVEMENT GAPS

The coincidence of dramatic changes in U.S. demographics and new information about gaps accompanying the standards movement has led policymakers to increase pressure particularly on schools to demonstrate annual progress in student achievement for all students. That achievement gaps and disproportionately high dropout rates among non-Asian minorities have re-emerged on the policy agenda may seem relatively unsurprising in light of research demonstrating that the average high school graduate pays nearly \$140,000 more in taxes over the course of a lifetime than a high school dropout. Baby Boomers whose overall well-being depends on the productivity of subsequent generations are concerned that the population base of American voters and taxpayers will increasingly come to be made up of persons less educated than they themselves were. Yet regardless of all researchers know about the incidence, consequences, and the causes of these gaps, government policy has only partially responded to this crisis. Even as most educational reform proceeds through almost entirely school-centered efforts to eliminate group-level achievement differences, the finding of the Coleman Report bears repeating: No more than 40% of the racial gap in educational outcomes can be attributed to the schools themselves (in isolation of other non-school factors). The ability to respond to the achievement gap problem will ultimately depend on whether people recognize and act on the broad range of factors that collectively shape student achievement.

NOTES

1. The very term "achievement gap" is considered by many to be a problematic misnomer. By reframing group-level differences in academic outcomes as the shameful product of a long history of discriminatory gaps in educational *inputs*, Gloria Ladson-Billings, in her 2005 presidential address to the American Educational Research Association, asserted that the so-called achievement gap is more accurately portrayed as an historically accumulated "educational debt" still owed underrepresented minority and poor students (Ladson-Billings, 2006).
2. Main NAEP data are not available for 12th graders in 2007.

Orthopedic Impairments

3. It should be noted, however, that Hispanics are also making real educational gains over generations improvements that are obscured by the continuing influx of new immigrants (Smith, 2003).
4. Jensen argued that programs like Head Start, which tried to boost the academic performance of minority children, were doomed to failure because I.Q. was so heavily genetic and impervious to environmental influences (Gladwell, 2007).

SEE ALSO *Ability Grouping; Culturally Relevant Pedagogy.*

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ORTHOPEDIC IMPAIRMENTS

Orthopedic impairments are the most common of physical disabilities. A physical disability is any condition that interferes with a student's ability to use his or her body. The term *physical disabilities* may be used interchangeably when referring to orthopedic impairments. In 2004 the U.S. Department of Education reported that 74,000 students between age 6 and 21 received special education services under the orthopedic impairments disability category.

ORTHOPEDIC IMPAIRMENT DEFINITION

According to the Individuals with Disabilities Education Improvement Act of 2004 (IDEA), orthopedic impairment is as follows: "a severe orthopedic impairment that adversely affects a child's educational performance. The term includes impairments due to the effects of congenital anomaly (e.g., clubfoot, absence of some member, etc.), impairments due to the effects of disease (e.g., poliomyelitis, bone tuberculosis, etc.), and impairments from other causes (e.g., cerebral palsy, amputations, and

fractures or burns that cause contractures)” (Pierangelo & Giuliani, 2007, p. 268).

Skeletal system impairments that involve the joints, bones, limbs, and associated muscles represent the musculoskeletal disorders. Orthopedic impairments often are divided into three main categories to help characterize the potential problems and learning needs of the students involved. These categories are neuromotor impairments, musculoskeletal disorders, and degenerative diseases. Although neuromotor impairments involve the central nervous system (brain, spinal cord, or nerves that send impulses to muscles), they also affect a child’s ability to move, use, feel, or control certain parts of the body. Clinically, they are separate and distinct types of disabilities with entirely different causes from musculoskeletal disorders, but they result in similar limitations in movement. Some examples of neuromotor impairments are spina bifida, cerebral palsy, and spinal cord injuries. Musculoskeletal disorders include defects or diseases of the bones and muscles, such as limb deficiency or clubfoot. Degenerative diseases are those that affect motor movement such as muscular dystrophy.

Orthopedic impairments involve a wide range of causes and a diverse group of students. Some children have impairments caused by congenital anomalies, whereas others have experienced injuries or conditions that have resulted in orthopedic impairments. Congenital causes include cerebral palsy, osteogenesis imperfecta, joint deformity, and muscular dystrophy. Motor vehicle accidents, sports injuries, premature birth, and other injuries and conditions may cause orthopedic impairments. Burns and broken bones can result in damage both to bones and muscles. Some children have their impairments from birth, while others acquire a physical disability, so age of onset varies widely. There does not appear to be any trend toward greater incidence of orthopedic impairment in boys or girls or based on cultural or racial factors.

Some children with skeletal deformities have surgery. Others have to use various types of braces, prosthetic, and orthotic devices before, after, or in place of surgery. Others may use adapted wheelchairs. Many children identified with severe and multiple disabilities have an orthopedic impairment that must be considered when assessing and establishing services.

ASSESSING ORTHOPEDIC IMPAIRMENTS

Evaluating children with orthopedic impairments can be complicated because there are so many different types of disabilities and causes of impairment. Most orthopedic impairments are identified before a child enters school, but sometimes they are missed or do not appear until a

later age. A teacher may notice signs of poor coordination, frequent accidents, or complaints of acute or chronic pain.

The assessment must include a thorough medical evaluation of the child’s orthopedic impairment by a licensed physician. Other data generally include documentation of observations and assessments of how the orthopedic impairment affects the child’s ability to learn in the educational environment, as well as observations concerning mobility and activities of daily living. It is important to assess a student’s social and physical adaptive behaviors through various checklists, inventories, rating scales, and interviews with those who know the child best. The severity of functional limitations must be such that they adversely impact the child’s education performance.

A social history supplements the medical history, as does basic screening information on hearing, vision, speech and language skills, and development in areas such as cognition and social/emotional, or self-help behaviors. A team approach is taken for assessment and recommendations. The team that assesses a child with an orthopedic impairment must involve a parent and at least one of the child’s general education classroom teacher(s). It should also include a licensed special education teacher, school counselor and/or psychologist, a licensed physician, and other profession personnel as appropriate. For example, a licensed physical therapist or occupational therapist should assess specific motor dysfunction in gross and fine motor development, neuromuscular development, daily living activities, sensory integration, and the need for adaptive equipment. The assessment also considers the permanent nature of the child’s impairment. Usually the condition will not be considered an orthopedic impairment if it is not going to last at least 60 days.

More than one test always should be used to evaluate a child’s needs for services. In all, the assessment must take into consideration the entire education from all angles, not just physical access to buildings, computers, libraries, or equipment that facilitates learning. For instance, a child may need to receive occupational therapy or other treatments, requiring time away from the general education classroom. Educators will need to develop adaptive strategies and adopt a hands-off approach at times to help students develop some independence. Then, too, social and peer issues also must be considered. The final evaluation should describe how the orthopedic impairment adversely affects a student’s areas of development.

CHARACTERISTICS OF CHILDREN WITH ORTHOPEDIC IMPAIRMENTS

Children with orthopedic impairments have a wide range of characteristics that are specific to the underlying diagnosis. Therefore, it is difficult, perhaps even impossible, to generalize about the students in this category. For

example, a child with a spinal cord injury could have immobility limited to one side of his or her body, just the arms or legs, or total paralysis. A child with cerebral palsy may have movement but need a wheelchair because he or she has slow, uncontrolled movements that make it difficult to walk.

It also is difficult to know prior to a thorough assessment, including input from medical professionals, what types of associated symptoms to expect. However, many students with orthopedic impairments have problems with motor skills, such as those involved in using standard writing tools, turning pages or books, or exploring and participating in typical classroom activities. Some students have associated speech impairments or multiple disabilities that may affect particular academic areas.

Some students with physical disabilities may lack common experiences and knowledge or common places, items, and activities as compared with general education students. This is due to a lack of mobility and, if their condition has existed since birth, the lack of typical childhood play and exploration. These students' social interactions often are limited because of limited motor, self-help, and self-care skills. Sometimes, standard instructional materials includes mention of objects and experiences or assumes comprehension that is beyond the experience and background of the child with an orthopedic impairment. Children with orthopedic impairments may have pain and discomfort, may sleep poorly and therefore be fatigued in class, and may be on medications. They also may miss school more frequently than other students because of their medical conditions.

Poor self-concept and poor self-advocacy skills may affect an individual student's performance or behavior. Some students with orthopedic impairments feel helpless or depressed as a result of their physical disability.

Some diseases, such as muscular dystrophy, are progressive, which means a child's need for services is likely to increase and certainly to change throughout the continuum of education. Other orthopedic impairments, particularly those caused by injury or temporary impairments from surgery, may lessen over time. Advances in medical care have allowed for better diagnosis and treatment of some disorders and diseases that cause orthopedic impairments. It is important to realize that some children with orthopedic impairments also face issues related to having both chronic and terminal illness.

EXAMPLES OF ORTHOPEDIC DISORDERS

More than 50 diseases and disorders are associated with orthopedic impairments. Along with subgroup types for these disorders. Spina bifida, scoliosis, cerebral palsy, and muscular dystrophy are some of the more well-known

conditions that cause orthopedic impairments in children. Spina bifida is a cleft spine, or incomplete closure of the spinal column. It is the most common permanently disabling birth defect. Spina bifida occulta is the mildest and most common form; next in severity is meningocele. With this type, the spinal cord develops normally, but the meninges, or protective covering, push through the opening in the vertebrae. Meningocele can be repaired surgically. Myelomeningocele is the most severe form of spina bifida. The bones of the spinal cord do not completely form and the spinal canal is incomplete, resulting in the spinal cord and meninges protruding out of the child's back. Spina bifida may be associated with hydrocephalus.

Scoliosis is a side-to-side curvature of the spine, measured by x-ray examination as greater than 10 degrees. It makes the shoulders, hips, or both appear uneven and can cause pain in the back. Most cases of scoliosis have no known cause, and although scoliosis can occur in children with other orthopedic impairments, it normally occurs in otherwise healthy children.

Cerebral palsy (CP) includes a number of chronic disorders that impair movement control. They appear early in life and generally do not worsen as children age. Cerebral palsy affects about 500,000 people in the United States; about 8,000 infants and 1,500 preschool-age children are diagnosed with it each year. Cerebral palsy is caused by injury to parts of the brain that control the ability to use muscles. The injury can occur before birth, during delivery, or soon after birth. Early signs normally appear by the time a child is 18 months of age. The three main types of CP are spastic, where muscle tone is too high or too tight; athetoid or dyskinetic CP, which can affect the whole body with slow, uncontrolled movements and low muscle tone; and mixed CP, a combination of the symptoms from both athetoid and spastic CP. A child with mixed CP has some muscles that are too tight and others that are too loose so that some movements are involuntary and mobility is limited in other areas by stiffness.

Muscular dystrophy (MD) is a group of genetic diseases characterized by progressive muscle weakness. The muscles most affected by MD vary, as do the types of the disease. Some are ultimately fatal, such as Duchenne muscular dystrophy, which also is the most severe form and the most common form affecting children. Although Duchenne MD results from a defective gene, it often occurs in families with no known history of the disease. Muscle weakness, rapid progression, and difficulty with motor skills are some of the characteristics of Duchenne MD. It primarily affects boys and symptoms usually begin in early childhood. There are several forms of muscular dystrophy, each with unique characteristics.

For example, Emery-Dreifuss MD typically causes symptoms in late childhood and early adolescence.

EDUCATIONAL PRACTICES

Several laws ensure an inclusive education for students with physical disabilities. The Individuals with Disabilities Education Improvement Act (IDEA) was introduced in 1975 and passed in 1990. It was reauthorized in 1997 and 2004 and includes provisions for children with orthopedic impairments as defined above. Students with orthopedic impairments also may be eligible for accommodations for general classroom inclusion under Section 504 of the Vocational Rehabilitation Act, passed in 1973. In addition, the Americans with Disabilities Act (ADA), which was passed in 1990, includes provisions concerning discrimination against individuals with disabilities and requirements that school facilities are accessible to all.

Placement is a key consideration for students with orthopedic impairments. The goal is inclusion in general education classes, but some students may need services from resource rooms, special classes, schools, or residential facilities, as well as hospital or homebound programs. In 2004, the U.S. Department of Education reported that about 46% of school-age children receiving special education services under the orthopedic impairments category were educated in general education classrooms. Setting up the appropriate placement, services, and environment begins with asking the student what he or she needs and evolves through the assessment and individualized education plan (IEP) process.

Students with orthopedic impairments may present unique challenges in adapting instructional environments that call for creative solutions. Some students may be paralyzed and require assistance moving from place to place. A student may require assistance with basic self-care such as toileting. These and other needs call on teachers to perform duties that historically have not been part of their role in school. Becoming familiar with orthotics, prostheses, adaptive devices, and the specific characteristics of a student's impairment can improve the experience for student and teacher.

To assist with academic tasks, a teacher might secure papers to a student's work area with tape, clipboards, or magnets; place rubber strips or pads on work tools such as rulers and calculators to help keep them from slipping during use; and provide writing instruments that require less pressure to produce a mark, such as felt-tip pens or soft lead pencils. Communication technology can assist the student and teacher in the classroom as well.

Specialists such as physical therapists and orthopedic therapists will be involved in the educational assessment and often will have ongoing involvement in the care of students with orthopedic impairment. States may have

specific qualification requirements for teachers who participate in special education programs for children with orthopedic impairments, including basic study of disabilities, anatomy, physiology, and therapeutic movement.

ASSESSMENT AND INSTRUCTIONAL ISSUES

The varying degrees and types of physical disabilities can present special challenges to those local schools and educators who instruct students with orthopedic impairments. Providing the least restrictive environment and promoting eventual independence for students with physical disabilities requires addressing each case specifically, working in a team approach with the student, parents, and education and health professionals to provide a plan that best meets the student's needs. It is important that the teacher can carry over techniques from these professionals into the classroom.

Alliance of state laws with IDEA is an important consideration. The team must consider all applicable laws and regulations in planning for the education of a child with a physical disability. This work includes testing of students under state and federal guidelines such as the No Child Left Behind (NCLB) Act, which was signed into law in 2002 by President George W. Bush. The act revised the Elementary and Secondary Education Act, which is the primary federal law in pre-collegiate education. NCLB requires annual testing of all students in reading and math proficiency.

The NCLB Act initially allowed up to 1% of special education students to take alternate tests; in 2005 the number was raised to 3%. Students may take alternative tests if they meet certain legal criteria. Several options are available, including having different achievement criteria or taking the regular assessment with approved accommodations or modifications.

SEE ALSO *Individualized Education Program (IEP); Special Education.*

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P

PARENT INVOLVEMENT

Parental involvement in education and, its related term, family school relationships, have been conceptualized through multiple disciplinary lenses and through educational agency, as well as from local, state, and federal policy perspectives. Parental involvement in education and family school relations are terms that have been used interchangeably. However, there are subtle distinctions. Family-school relations are often conceptualized as the interactions, especially the communication, between families and schools pertaining to academic progress of students, academic or behavioral problems, and expectations for home engagement. This is the type of involvement that is often included in school policies pertaining to involvement. It is also evident in federal policies such as the No Child Left Behind Act, which defines parental involvement in education as “the participation of parents in regular, two-way and meaningful communication involving student academic learning and other school activities” (107th Congress, 2002).

More broadly, parental involvement in education has been defined as “parents’ interactions with schools and with their children to promote academic success” (Hill et al., 2004). Such interactions extend beyond the engagement with schools, to the home life and the expectations and values for education that are communicated directly and indirectly to children. These conceptualizations focus on individual students and their families. Other disciplines, such as economics, have defined it in a way that gives parental involvement a different focus or level of analysis.

Within the field of economics, parental involvement in education is often defined collectively across parents

within schools and across schools within districts, rather than at the individual or family level. Parental involvement has been conceptualized as “collective parental pressure” on schools or the impact of collective utilization of school policies such as school choice, exiting public schools and district assignments in favor of private, charter, and magnet schools (Epple & Romano, 1998; McMillan, 2000). Collective parental pressure can also occur through organized parent-teacher associations or simply through concerned parents monitoring the schools. It can impact school quality and climate and, in turn, school performance. In addition, economic conceptualizations include parental influence by voting for (or against) school board members, school district budgets (e.g., levies, bonds), and involvement in school governance and administration. These, in turn, impact school processes and learning outcomes (Jimenez & Sawada, 1999; Nechyba, McEwan, & Older-Aguilar, 1999). In addition to focusing on collective influence of parents, the outcomes of interest often are focused at the collective performance of schools or school districts, rather than individual students’ academic progress. The involvement of just a few parents may influence the quality of instruction in a classroom or a school and, thereby, influence the academic development of many students (McMillan, 2000).

There are at least three theories that have guided research and practice (Comer, 1995; Epstein, 1987; Grolnick & Slowiaczek, 1994). Each of these theories conceptualize parental involvement in education as a multi-dimensional construct that includes communication between families and schools, parental involvement in education at school (e.g., volunteering at school) and

parental involvement at home (e.g., helping with homework; providing educational experiences outside of school). Whereas these theories were based on elementary school contexts, additional research identifies appropriate types of involvement for middle and high school. For example, some theories distinguish involvement that reflects “academic socialization” such as communicating the importance or value of education and linking schoolwork to students’ interests or goals (Hill & Tyson, 2007) and “structural involvement,” which includes providing students with the space, materials and expectations for achievement that is especially important for adolescents (Chao, 2000).

Assessments of parental involvement vary widely across studies and typically reflect assessments from parent, teachers, and students’ perspectives. As research shows that these reports are often only moderately correlated with one another, their often unique relation with academic outcomes supports the premise that each reporter has a unique and important perspective (Reynolds, 1991). There are few “gold standard” measures of parental involvement and family school relations. However, most measures attempt to account for frequency of involvement, especially frequency of communication and parental visits to the school. Longer and more detailed measures attempt to account for who initiated contact. Initiation is important because parents and teachers tend to initiate contact for different reasons (Epstein, 1996). Teachers tend to initiate contact, beyond the regulated parent-teacher conferences, in the context of academic or behavioral problems. Parents, in contrast, tend to initiate contact for more proactive reasons and their initiated contact is positively associated with achievement.

DEVELOPMENTAL TRENDS

Beyond the variations in assessments of parental involvement, there are some consistent developmental trends in the normative levels of parental involvement in education. In general, parents tend to be more involved in their children’s education when the children are younger, especially in elementary school, than they are in middle and high school (Eccles & Harold, 1996; Stevenson & Baker, 1987). School transitions (i.e., school entry; middle school and high school transitions) mark times when parental involvement changes in amount or type. Schools may be more or less welcoming; parents may feel more or less efficacious about being involved. Despite lower mean levels of involvement in middle and high school, parental involvement in education remains positively associated with academic outcomes (Hill et al., 2004). However, the types of involvement that are most influential for adolescents are not accounted for in extant theories and measures of involvement and, thus, one can conclude

that parental involvement does not decline during middle and high school but changes form and shape (Hill & Taylor, 2004).

DEMOGRAPHIC FACTORS

In addition to changes across developmental stages, demographic factors shape the type, amount, and influence of parental involvement. The most notable are socioeconomic and ethnic/cultural factors. Motivations for parental involvement are based in parents’ perceived role in their children’s academic lives, a role which is culturally derived. Further, families’ experiences with and perceptions of their ethnic minority status vis-à-vis the school culture and population influence their engagement with their children’s schooling. Extant literature suggests that there are socioeconomic and ethnic differences in levels of involvement and its influence on achievement. For example, being college educated and from higher income levels is associated with higher levels of involvement in children’s schooling (Kohl, Lengua, McMahan, & Conduct Problems Prevention Research Group, 2000; Moles, 1993; Reynolds, Mavrogenes, Bezruczko, & Hagemann, 1996).

However, the research on ethnic differences is less conclusive. Some find that African Americans and Latinos are involved less than Euro Americans (Moles, 1993; Reynolds, Mavrogenes, Bezruczko, & Hagemann, 1996), others find no differences (Harris, Kagey, & Ross, 1987; Hill & Craft, 2003) and still others find that African Americans and Latinos have high expectations and involvement in their children’s education (Chavkin & Williams, 1989; Lopez, Sanchez, & Hamilton, 2000). In contrast, Asian American families have been found to have the lowest levels of involvement in their children’s education, especially when involvement is defined by interactions with the school (Kao, 1995; Sui-Chi & Willms, 1996). Variations across studies may be due to types of measurement and potential confounds between ethnicity and other demographic factors such as socioeconomic status and community resources. For example, the extent to which Latino families were the numerical minority within their communities and their children were numerical minorities among the school population influenced the amount and effectiveness of parental involvement in education (Rodriguez, 2002).

Beyond mean level differences, ethnic and socioeconomic differences have been documented in the goals for involvement and in the associations with academic outcomes. African American and Latino families often report that one of the reasons for being involved at school is to demonstrate to their children’s teachers that they are committed to their children’s education (Gutman & McLoyd, 2002). This is a goal that is often necessary because of biases teachers often hold about the academic potential of

African American and Latino children and the value their parents place on education (Ferguson, 1998; Hill, 2001; Lareau, 1987). This goal is unnecessary for Euro American and Asian American families, who often benefit from positive stereotypes held by teachers and other school personnel. Further, there is evidence that processes by which involvement influences vary by ethnicity and socioeconomic status. Hill and Craft (2003) found that parental involvement was associated with academic outcomes because it increased academic skills for African Americans. In contrast, for Euro Americans, it improved social and emotional competence in children (Hill & Craft, 2003). Similarly, parental involvement was differentially associated with achievement based on whether parents had college degrees (Hill et al., 2004).

Despite differences in the amount and types of involvement across demographic background, parental involvement and family school relations are positively associated with academic achievement and children's aspirations (Hill & Taylor, 2004). Two meta-analyses have been conducted on the extant literature that attest to its positive influence. Meta-analyses aggregate across empirical studies to ascertain a level of effect in a way that accounts for differences in sample size and quality of measurement. Looking at studies across developmental levels, the relation is positive and practically meaningful (Fan & Chen, 2001). The relation is strongest for parents' expectations and aspirations for their children. For studies focusing specifically on middle school age children, a developmental stage that is notable for its issues of adjustment, the relation is also positive (Hill & Tyson, 2007). The strongest positive influence was for involvement characterized as "academic socialization," defined as communicating the importance or value of education and linking schoolwork to students' interests or goals. Interestingly, for middle school students, parental assistance with homework was negatively associated with achievement (Hill & Tyson, 2007).

Given the positive influence parents have on their children's academic development, many programs and policies look toward involving parents as a way to mitigate gaps in achievement and help children reach their potential. Among the barriers to parental involvement, the most significant ones include conflicting schedules (time), feeling unwelcomed and unappreciated, and feeling unheard. Creating ways for parents to interact with teachers and school personnel as their schedule permits will improve communication. This may include the use of technology, including e-mail, e-bulletin boards, and voice mail (Bouffard, 2006). Further, schools and families may differ in their implicit and explicit expectations for parental involvement. Communications between families and schools that affirm and celebrate differences, acknowledge and build upon strengths, and make explicit

the goals and assumptions of involvement are essential in helping families feel welcomed and involved.

SEE ALSO *Parenting Styles.*

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Nancy E. Hill

PARENTING STYLES

Parenting style refers to the normative patterns of behavior and tactics that parents use to socialize and control their children. Early work on parenting styles in the 1950s (e.g., Sears, Maccoby, & Levin, 1957) documented that adults who were nurturing and able to exert control were especially influential on children's development of self-regulated and disciplined behavior. Others (Lewin, Lippitt, & White, 1939) documented that adult leadership styles in classroom-like settings resulted in different levels of engagement on the part of children, with relatively warm and egalitarian styles resulting in greater task involvement, more self-regulated and autonomous behavior, and more competent performance than either highly controlling or permissive styles. From this work evolved a general approach to the study of parenting styles focused on socialization strategies reflecting demandingness and responsiveness. Demandingness, or control, refers to the degree to which parents attempt to integrate a child into the family social system by enforcing family rules and standards for behavior, setting expectations that are developmentally appropriate, and providing structure; responsiveness, or warmth, refers to parental attempts to support the development of their child's individuality and self-assertive tendencies by being attentive to the child's emotional well-being, special needs, and interests.

BAUMRIND'S TYPOLOGY OF PARENTING STYLES

Following this early work, Diana Baumrind (1971) conducted extensive observations of parents interacting with their children in their homes and concluded that four dimensions of parent-child interactions reflecting types of responsiveness and control could predict reliably children's social, emotional, and cognitive functioning. Parental control reflected consistent enforcement of rules, provision of structure to children's activities, and persistence in gaining child compliance; maturity demands reflected expectations to perform up to one's potential,

and demands for self-reliance and self-control; clarity of communication reflected the extent to which parents solicit children's opinions and feelings, and use reasoning to obtain compliance; and nurturance reflected parental expressions of warmth and approval as well as conscientious protection of children's physical and emotional well-being.

These dimensions were then used to develop a typology of qualitatively different parenting styles based on levels of responsiveness and control: authoritative, authoritarian, permissive indulgent, and permissive uninvolved (Baumrind, 1971; Maccoby & Martin, 1983). Authoritative parenting is responsive and demanding in that parents communicate high expectations, provide clear standards for behavior, monitor child behavior, and discipline based on reasoning and explanation rather than power assertion or withdrawal of love. Authoritarian parenting is similar to authoritative parenting in terms of being demanding; however, parents are described as less responsive in that they are more likely to use power assertive disciplinary techniques and rely on love withdrawal to gain child obedience. Permissive indulgent parents display relatively high levels of responsiveness but low levels of control. Specifically, this style is typified by low levels of control and maturity demands, but high levels of solicitation and demonstrations of warmth. In contrast, permissive uninvolved parenting is described as being relatively low on both warmth and control. At its extreme, this style is considered to be rejecting or neglectful of children.

CORRELATES OF PARENTING STYLES

There is widespread recognition that Baumrind's dimensions describe socialization processes central to the development of childhood and adolescent social and cognitive competence (Grusec & Goodnow, 1994; Maccoby & Martin, 1983). Baumrind's studies established that elementary-aged children of authoritative parents display adaptive levels of self-reliance and self-esteem, and socially responsible, independent, and achievement-oriented behavior; children with authoritarian parents display relatively less independent behavior and lower levels of self-reliance and self-esteem; and children with permissive parents display less positive behavior and self-reliance but high levels of self-esteem. Work by Steinberg and his colleagues (Steinberg, Lamborn, Darling, Mounts, & Dornbusch, 1994) supported the validity of the four-dimension typology in that adolescents with authoritative parents fared best with respect to a range of social, emotional, and academic competencies; students with authoritarian parents reported relatively lower levels of psychological well-being; those with indulgent parents were characterized as enjoying high levels of psychological and emotional well-being but lower levels of achievement

The four parenting styles and their effects	
<p>The authoritative parent Affectionate and engaged Sets limits and enforces consequences Uses reason, logic, and appropriate negotiation Empowers a child's decision making</p>	<p>His or her child is likely to be Happy, responsible, and kind Good at problem-solving Self-motivated and confident Cooperative An excellent student A leader</p>
<p>The authoritarian parent Emotionally aloof Bossy; likely to say, "Because I said so" Uses physical punishment or verbal insults Dismisses a child's feelings.</p>	<p>His or her child is likely to be Moody and anxious Well-behaved An average to good student A follower</p> <p>His or her child is likely to be</p>
<p>The permissive parent Affectionate Anxious to please, ends every sentence by asking, "OK?" Indulgent Can't say no and stick to it Easily manipulated</p>	<p>His or her child is likely to be Demanding and whiny Easily frustrated Lacking kindness and empathy A poor to average student A follower</p>
<p>The passive parent Emotionally removed or indifferent Uninvolved Abdicates discipline Inconsistent and unpredictable</p>	<p>His or her child is likely to be Clingy and needy Inappropriate and rude Likely to get into trouble A poor student A follower</p>

ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

coupled with higher levels of misconduct; and students with uninvolved/neglectful parents were characterized as demonstrating the lowest levels of competence in all areas. Moreover, over the course of the high school years, the academic functioning of adolescents with neglectful parents declined and levels of delinquency and internalizing symptoms such as depression increased significantly, especially in comparison to that of students with authoritative parents.

Other researchers have documented similar advantages for children with authoritative parents such that they demonstrate competent social interaction skills, self-reliant and independent problem solving, emotional well-being and overall psychological adjustment, and few maladaptive internalizing and externalizing behaviors (Grusec & Goodnow, 1994; Pomerantz, Grolnick, & Price, 2005). These children enjoy academic success, demonstrate socially responsible and prosocial forms of classroom behavior, and competent relationships with their peers. They also report strong intrinsic interest in learning, positive beliefs about ability and control, and mastery goal orientations toward learning (see Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). It is important to note, however, that few of these findings reflect comparisons of parenting styles based on

Baumrind's typology, but rather on parenting described more generally along dimensions of control or warmth or in terms of authoritative versus non-authoritative parenting.

CLASS, ETHNICITY, AGE, AND GENDER

The benefits of authoritative parenting have been documented mostly in samples of middle-class families in industrialized Western societies. However, some evidence indicates that parenting in working class and low socioeconomic status families tends to be more authoritarian, with fathers using power assertive discipline more often than mothers. Children raised in more communal and extended family networks such as those found in Native American cultures, tend to be treated more permissively than European American children. Chinese mothers tend to demonstrate more controlling, authoritarian parenting practices than their European American counterparts (Fisher & Lerner, 2005). Research on age-related differences suggests that as children get older, outward displays of warmth and affection and direct disciplinary encounters by parents lessen, as verbal communication and discussion increase. Parents also tend to provide greater opportunities for autonomy and self-regulation as children enter adolescence and early adulthood (Maccoby, 2007).

Despite these group-level differences, the positive effects of responsiveness and developmentally appropriate levels of control are quite similar for all children. However, work on gender differences suggests that girls tend to be generally more susceptible to socialization practices than boys, whereas parental control tends to be more critical for boys' well-being than for girls' (Pomerantz et al., 2005; Weiss & Schwartz, 1996). Authoritative parenting also tends to predict social competence and adaptive psychological functioning for African American, Asian American, European American, and Hispanic American children; positive relations between authoritative parenting and academic outcomes have been found mostly for European American children.

CONCEPTUAL AND METHODOLOGICAL ISSUES

Although findings have been fairly robust and consistent with respect to the benefits of responsive and demanding parenting, several conceptual and methodological issues preclude strong conclusions about the effects of parenting styles on children. A central issue is that most researchers document parenting on the part of just one parent, most often the mother. Little is known about the frequency with which both parents display similar parenting styles or about the effects of discordant styles on children's development. Similarly, few studies document parenting styles

within the context of broader family systems. It also is not clear how consistent parenting styles are across contexts and age of the child. In this regard, the degree to which consistency moderates the effects of parenting styles on child outcomes is not known. However, inconsistent parenting has been related to aggressive and noncompliant behavior throughout childhood and adolescence (Wentzel, 1994).

Additional concerns surround the methods employed to document parenting styles (Maccoby, 2007). In studies of young children, observations of mother-child interactions during prescribed laboratory-based activities typically are used to identify specific parenting styles. Or mothers are asked to self-report on their parenting behaviors. In the case of observational studies, issues focus on how to capture behavior in real time and take into account the sequential and reciprocal nature of parent-child interactions. Decisions concerning whether to interpret interactions as a function of time, event, or context also are cause for debate. The use of mothers' reports has been met with concern given the psychological investment that mothers have in presenting themselves and their children in the best light. In studies of older children, self-report methodologies typically are used to ask children about their parents' behavior. In this case, researchers place importance on children's cognitive understanding of their parents' actions rather than on objective forms of behavior. However, the degree to which these reports are reliable and valid assessments of parents' behavior as opposed to characteristics of the child is not well understood.

Of final interest are the processes and mechanisms by which parenting styles might have their influence on child outcomes. To illustrate, reasons for why responsive parenting should be related to a child's academic performance have not been well articulated. Darling and Steinberg (1993) argued that parenting styles are part of a more complex system of parental inputs that include goals and expectations for their children (e.g., expectations for academic performance) and provisions of opportunities, resources, and instruction (e.g., academic enrichment programs, help with homework) targeted at achieving specific outcomes (e.g., mastery of academic subject matter). Additional research and theorizing that clarifies these possibilities is needed.

SEE ALSO *Parent Involvement.*

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*Kathryn R. Wentzel
Shannon L. Russell*

PEER RELATIONSHIPS

This entry contains the following:

- I. OVERVIEW
Allison M. Ryan
- II. FRIENDSHIPS
Kathryn R. Wentzel, Sandra A. Baker
- III. PEER GROUPS
B. Bradford Brown
- IV. PEER PRESSURE
Helen Davidson
- V. SOCIOMETRIC STATUS
Kathryn M. LaFontana

OVERVIEW

Experiences with peers constitute an important developmental context for children and adolescents (Rubin, Bukowski, & Parker, 2006). Children's experiences with peers occur on several different levels: general interactions with peers, friendships, and in groups. Social competence reflects a child's capacity to engage successfully with peers at different levels. This section will provide an introduction and overview of friendships, peer groups, and sociometric status, with attention to developmental changes that occur during childhood and adolescence.

FRIENDSHIPS

Friendship refers to a close, mutual and voluntary relationship. For many decades Harry Stack Sullivan's 1953 theorizing has provided a conceptual framework for the development and functions of friendships. Sullivan described friendships as providing the following functions: (a) offering consensual validation, (b) bolstering feelings of self-worth, (c) providing affection and a context for intimate disclosure, (d) promoting interpersonal sensitivity, and (e) setting the foundation for romantic and parental relationships. Sullivan believed these functions developed during childhood and that true friendships were formed around the age of 9 or 10.

More recently, Thomas Berndt's 2004 study described four types of support that friends provide for each other: informational support, instrumental support, companionship support, and esteem support.

Informational support refers to guidance and advice in personal problems with parents, romantic relationships, teachers or other friends. Instrumental support refers to help on any type of task, such as homework or chores. Companionship support refers to reliance on friends to do things with, such as someone to eat lunch with or go to a dance or sporting event. Esteem support refers to the encouragement friends provide both when life is going well (e.g., congratulating each other) and when life does not go as one hoped (e.g., consoling in the face of failure).

In general as individuals move from childhood to adolescence, they spend more time with their peers and less time with their family. There is less adult supervision when they are with their friends and increasingly they have more friends of the opposite sex (Brown, 2005). In addition, individuals' conceptions of friendships change as they progress through childhood and adolescence.

Friendship conceptions are measured by asking children questions such as "What is a best friend?" For very young children, friendship conceptions are driven by the social activities in which they are engaged. As they age, children become more sophisticated in their notions of friendship. Generally, friendship conceptions progress from

concrete to more abstract with age. During childhood and into adolescence, friendships become more stable as well as increasingly characterized as reciprocal and intimate. The development of children's friendship conceptions has been studied by Robert Selman and James Youniss. Selman (1980) emphasized the evolving perspective-taking abilities that underlie the changes in friendship conceptions. Youniss (1980) emphasized the importance of reciprocity in the development of children's friendship conceptions.

PEER GROUPS

The term *peer group* refers to an individual's small, relatively intimate group of peers who interact on a regular basis (often referred to as a clique). Peer groups consist of individuals who share friendship, hang around and talk to each other as well as do activities together. As children develop into adolescents, they spend an increasing amount of time with their peers compared to their parents or other adults (Csikszentmihalyi & Larson, 1974). The nature of peer groups also changes during adolescence. Typically, in early adolescence peer groups are single-sex but by middle adolescence mixed-sex peer groups are more prevalent. During late adolescence peer groups start to disintegrate as individuals spend more time as part of a romantic couple (see Brown, 2005 for a review).

Research has documented that peer groups exhibit similarity in many characteristics and attributes. The tendency of individuals to affiliate with others who share similar attributes is a social dynamic called homophily. Homophily of peer group beliefs and behaviors has been found across a wide range of outcomes. For example, adolescent peer groups have been found to be more homogeneous than the student body as a whole on reported frequency of smoking, drinking, drug use, and dating (see Rubin and colleagues, 2006, for a review). Homophily of peer groups has also been found among peers along academic characteristics such as GPA, college aspirations, time on homework, and general engagement in schoolwork. Two processes contribute to homophily: socialization and selection. Socialization refers to the tendency for friends to influence similar attributes in each other over time. Selection refers to the tendency for individuals to choose friends with similar attributes.

Socialization (also referred to as peer influence or peer pressure) most likely manifests itself in both direct and indirect ways. For example, social reinforcement may play a role. Beliefs and behaviors that are discouraged or received negatively by the peer group are less likely to be displayed again by an individual. Conversely, beliefs and behaviors that are encouraged or positively received by the peer group are more likely to surface again in the presence of one's peers. However, peer influence is also likely to occur in less direct ways. For example, modeling processes

are likely to be involved in peer influence. Observing a friend's commitment to schoolwork or voicing a belief about the meaning of school could introduce an individual to new behaviors and viewpoints. Depending on the consequences, observation of a model can strengthen or weaken the likelihood that the observer will engage in such behavior or adopt such beliefs in the future (Bandura, 1986). Finally, peer influence is also likely to occur through subtle means such as gossip, teasing, and humor. Gossiping about others, for example, is a means of clearly communicating unacceptable behavior without direct confrontation (Eder & Sanford, 1986). Thus, students share experiences and exchange information (in subtle and not so subtle ways) and out of these interactions among peer group members a context emerges regarding norms and values. This peer group context is likely to influence many outcomes, including adolescents' motivation and engagement in school (Kindermann, 1993; Ryan, 2001).

SOCIOMETRIC STATUS

Sociometric status is distinct from friendship or peer group membership and concerns overall peer acceptance (i.e. the experience of being liked or disliked by peers). Research in the field of developmental psychology has a long tradition of using sociometric assessment techniques to assess peer acceptance. Sociometric assessment techniques are used to identify who is liked or disliked. For example, children might be asked to nominate three to five peers who they "really like," or "like to play with," or "do not like" or "do not like to play with." The peer nominations are then used to classify students into different social status categories. Coie, Dodge and Coppotelli (1982) devised five different categories that are widely used by researchers: (a) popular children who receive many positive and few negative nominations, (b) average children who receive an average number of positive and negative nominations, (c) neglected children who receive few positive and negative nominations, (d) rejected children who receive few positive and many negative nominations, and (e) controversial children who receive many positive and many negative nominations.

Much research has examined the characteristics of children classified as popular, average, neglected, rejected, and controversial (see Rubin and colleagues, 2006, for a review). While there are some general trends there is variability within each group. Popular children tend to be sensitive, cooperative, easily join others in social activities, and often take on a leadership role. Neglected children are low in peer interaction of any kind and generally do not call attention to themselves. Rejected children are the most at risk. Researchers have distinguished between rejected children who are aggressive, those who are withdrawn, and those who are aggressive-withdrawn. In the short-term, aggressive, rejected

children have conduct problems and antisocial behavior in school. Withdrawn children report feeling lonely, are more depressed, and have low self-image. Aggressive-withdrawn children are the most at risk for all of these problems. In the long-term, rejected children are more at risk for mental health problems, delinquency, low achievement, and dropping out of school. Controversial children have characteristics that are represented in many of the groups.

It is important to note that there are other measures of peer acceptance or social status besides sociometric techniques. For example, researchers have measured popularity in different ways. The sociometric tradition asks children to list who they like and who they dislike in a classroom. Another way is to ask children directly to identify who is popular or ask them to rate their own popularity (referred to as perceived popularity). Different measures highlight different aspects of peer acceptance and social status. Sociometric techniques highlight the likeability of students whereas the measures of perceived popularity highlight social centrality and visibility. Researchers interested in aggression have noted that these different measures can lead to different conclusions about how the peer system operates. For example, sociometric popular children tend not to be aggressive but there is a positive correlation between perceived popularity ratings and aggression (Cillessen & Rose, 2005).

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Allison M. Ryan

FRIENDSHIPS

Relationships with peers are of central importance to children throughout childhood and adolescence. Children who enjoy positive relationships with peers experience levels of emotional well-being, beliefs about the self, and values for prosocial forms of behavior and social interaction that are stronger and more adaptive than do children without positive peer relationships. They also tend to be engaged in and even excel at academic tasks more than those who have peer relationship problems (Rubin, Bukowski, & Parker, 2006; Wentzel, 2005).

Researchers who study peer relationships typically focus on one of two peer contexts: children's dyadic friendships and their larger peer groups and crowds (Rubin et al., 2006). The major distinction between friendships and involvement with the broader peer group is that friendships reflect relatively private, egalitarian relationships often formed on the basis of idiosyncratic criteria. In contrast, peer groups are defined by publicly acknowledged and therefore easily identified and predictable characteristics that are valued by the group. Larger peer groups often are comprised of students who have formed close dyadic friendships with each other. However, friendships are enduring aspects of children's peer relationships at all ages, whereas peer groups and crowds emerge primarily in the middle school years, peak at the beginning of high school, and then diminish in prevalence as well as influence by the end of high school (Brown, 1989).

FUNCTIONS, QUALITIES, AND CORRELATES OF FRIENDSHIPS

Friendships have been described most often with respect to their qualities and functions (Newcomb & Bagwell, 1996; Parker & Asher, 1993). They provide a source of companionship and entertainment; help in solving problems, personal validation, and emotional support; and especially during adolescence, offer a foundation for identity development. Research on friendship formation based on interviews and observations of children at school suggests that positive friendships are most likely to be developed and maintained over time when children display personal attributes such as the ability to communicate responsively,

exchange information, and establish common ground, and when they can self-disclose, extend and elaborate the activities of others, resolve conflict, and provide emotional support (Gottman, 1983). These characteristics tend to differ as a function of age. Young children describe their friendships in terms of specific overt characteristics such as spending time together or having common interests; older children are more likely to include psychological characteristics such as intimacy, self-disclosure, loyalty, and commitment in describing their friends. Friendships also become more stable as children develop (Rubin et al., 2006).

Researchers also have documented differences in the quality and type of interactions that children have with friends and with non-friends (Newcomb & Bagwell, 1995). In this research, friendships are determined most often on the basis of students' nominations of their best friends at school, which are then matched to determine reciprocity, or best friendships. Characteristics of reciprocated friends are then compared to those of children who do not mutually nominate each other. These studies indicate that when children interact with friends they display significantly greater amounts of social contact such as talking, cooperation, and positive affect, they demonstrate more concern with resolving interpersonal conflicts and are less likely to instigate conflict, and they are more productive and use resources more efficiently when engaged in cognitive-related tasks together than they do with non-friends. Relationships of friends also are characterized as more balanced with respect to mutuality and reciprocity, as having stronger affective bonds, and stronger levels of mutual trust and commitment than those of non-friends. Compared to non-friends, friends also have in common more interests, values, activities, levels of prosocial as well as aggressive behavior, and personality characteristics (Wentzel, 2005). Research on school-based motivation indicates that friends are similar in the degree to which they value academic achievement, set goals for educational accomplishments, and pursue goals to behave in prosocial ways (e.g., Wentzel, Barry, & Caldwell, 2004).

Moreover, researchers have studied the relations of having friends to children's development (Wentzel, 2005). For the most part, simply having one friend as opposed to no friends appears to be related to a range of positive outcomes for students of all ages (e.g., Parker & Asher, 1983). When compared to their peers without friends, children with reciprocated friendships tend to be more sociable, cooperative, self-confident, independent, emotionally supportive, altruistic and prosocial, and less aggressive. Elementary school and middle school students with friends also tend to earn better grades and score higher on standardized tests, and to be more involved and engaged in school-related activities than those who do not have reciprocated friendships. Children without friends are

often more lonely, emotionally distressed, and depressed than children with friends.

The supportive function of friendships is demonstrated in research showing that students who make school transitions with friends show overall better adjustment during and after transition periods (e.g., when they enter formal schooling, middle school, and high school) than those who do so without friends (e.g., Ladd & Price, 1987; Wentzel et al., 2004). Students who have established friendships with classmates also are more likely to enjoy a relatively safe school environment and are less likely to be the targets of peer-directed violence and harassment than their counterparts without friends (e.g., Schwartz et al., 2000). This safety net that friends appear to provide each other is critical in that peer-directed violence and harassment is a fairly pervasive problem in U.S. schools and can have an enormous negative impact on students' social and emotional functioning.

Although the importance of friendships in early development should not be understated, it is well documented that friendships play their most pivotal role in development during the adolescent years (Youniss & Smollar, 1989). During this time friendships are believed to provide a unique avenue for identity development; furthermore, during this time the strongest relationship between the experience of positive friendships and the numerous associated positive outcomes are found. In this stage of development, children exhibit increased psychological investment in their peers and dependence on friends for support.

HOW FRIENDSHIPS INFLUENCE DEVELOPMENT

It is likely that significant associations between having friends and other positive competencies partly reflect the fact that students who demonstrate competence in one domain of functioning (i.e., making friends) often do so in other domains. Of interest, however, is the extent to which these significant relations also reflect a process whereby change in competencies occurs as a result of friend influence (Hartup, 1966). For instance, simply having a close friend might have developmental significance for healthy adjustment over time. Individuals also might adopt or develop specific behavioral styles or interests because they are considered to be desirable characteristics of their close friends.

In general, however, there are many unanswered questions concerning how friendships exert their influence on development. Some of these questions concern the timing, stability, and quality of friendships. For example, one unknown concerns whether there are critical periods during which friendships have more powerful effects on certain developmental outcomes. Can a child be friendless in middle school, establish a friendship in

high school, and still experience the protective effects friendships are proposed to offer? Some researchers have suggested that the cumulative experience of friendships is important to development rather than any one particular friendship in one place or time (Hartup & Stevens, 1997). Another question concerns the directionality of influence: Do children have high quality friendships because they already possess the necessary skills to make friends, or do they develop positive social skills within the context of their friendships? As of 2007, empirical evidence that addresses these questions is limited. Longitudinal studies that assess the characteristics of both friends at multiple points in time are necessary to determine the nature and magnitude of change in each individual over time. There is also an evident gap in the literature addressing friendships outside the classroom or school. The role of neighborhood friends or friendships within a family network in development and learning are in the early 2000s studied infrequently.

In spite of these limitations, presumably some form of influence from friends is likely to take place. If such influence does occur, however, an important question is why. Explanations of influence often focus on the likelihood that positive emotional attachments to friends promote healthy psychological functioning; feelings of relatedness and belonging that results from having friends are believed to contribute directly to positive feelings of self-worth and self-esteem. In turn, these levels of emotional well-being are believed to contribute to adaptive functioning in social as well as academic domains. Substantial evidence based on children at all ages supports this perspective (Wentzel, 2005).

Some scholars posit an observational learning explanation of influence in which a friend models behavior that is subsequently adopted by a child who observes the behavior (Wentzel et al., 2004). Empirical findings provide support for this position in that children have the opportunity to observe their friends' behavior with greater frequency than non-friends' behavior. In addition, behavior that is learned by observing others is likely to be enacted to the extent that an individual is motivated to do so (Bandura, 1986). Therefore, a child's behavior might become more similar to a friend's behavior because of a change in underlying motivational processes such as goals and self-concept. Research on motivation documents that peers serve as powerful models that influence the development of academic self-efficacy, especially when children observe similar peers who demonstrate successful ways to cope with failure (Schunk, 1987). These modeling effects are especially likely to occur when students are friends, although students who have higher achieving friends tend to have lower levels of self-efficacy than those with lower-achieving friends (Altermatt & Pomerantz, 2005).

Finally, theorists have proposed that positive interactions with peers contribute directly to intellectual development and functioning. For example, Piaget (1965) argued that mutual discussion, perspective taking, and conflict resolution with peers can motivate the accommodation of new and more sophisticated approaches to intellectual problem solving. Research has supported his position in that active discussion, problem solving, and elaborative feedback among peers are associated with advances in a range of cognitive competencies, including problem-solving skills, conceptual understanding, and metacognitive reasoning in samples ranging from preschool to high school (Gauvain & Perez, 2007). Of relevance for understanding the influence of friends on cognitive development is research indicating that interactions with friends rather than acquaintances tend to yield more predictable cognitive advances, presumably because friends have well-established interaction patterns and are sensitive to each other's interests and needs. In this regard, working with friends rather than acquaintances tends to result in positive outcomes for girls more than for boys (Newcomb & Bagwell, 1995).

SCHOOL BASED INFLUENCES ON STUDENTS' FRIENDSHIPS

Of final interest for educators and practitioners is evidence that teachers can have a significant influence on the nature and establishment of students' friendships (e.g., Donohue, Perry, & Weinstein, 2003; Stormshack, Bierman, Bruschi, Dodge, & Coie, 1999). For example, teachers' perceptions of students' academic aptitude, intelligence, and tendency to misbehave are related to students' choice of friends. Elementary-aged students appear to be aware of the categorizations their teachers make about their classmates and will reject or accept them based on characteristics such as their troublesomeness or smartness accordingly. Students perceived to be smart are consistently viewed in a more positive light, whereas those ranked as troublemakers tend to be socially rejected. This phenomenon is especially true for girls.

The instructional approach a teacher adopts, and the resulting classroom organization, also has an impact on students' opportunities to make friends (Epstein, 1983). Adolescents with teachers who employ learner-centered practices (e.g. involve students in decision making, emphasize the importance of building positive social relationships) as opposed to teacher-centered practices (e.g. focus on rote learning, evaluation) report having more close friends and obtain a greater number of friendship nominations in general. Middle and high school students in classrooms where frequent interactions with classmates are condoned, that is, where students are encouraged to talk to each other about class assignments, to work in small

groups, and to move about while working on activities, also are less likely to be socially isolated or rejected by their classmates, enjoy greater numbers of friends, and experience more diversity and stability in their friendships. The degree to which middle schools and high schools are ethnically diverse, as opposed to having clear majority and minority groupings, also can influence the nature and stability of students' friendships (Urberg, Degirmencioglu, Tolson, & Hallidayscher, 1995).

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PEER GROUPS

Peers constitute one of the most important contexts for child development and socialization. Beyond their function as companions in leisure activities they serve as sources of instrumental and emotional support, help a child formulate values and beliefs, and oversee a child's adherence to behavioral norms of the peer culture and broader society. Much of a child's interactions with peers takes place in peer groups, making it important for others to understand how peer groups are organized, how they operate, and how these factors change from early childhood through adolescence. North American youth are more likely to encounter peers in schools than any other single social context, making schools a major locus of peer group interactions (Brown, 2004). This entry gives an overview of child and adolescent peer groups, paying particular attention to the role that schools play in these groups.

EARLY EXPERIENCES WITH PEER GROUPS

During the toddler and preschool era, young people's interactions with peers tend to be organized and closely supervised by adults, giving young people little opportunity

to choose their peer groups (Ladd & Golter, 1988). Moreover, peer groups are often ephemeral, emerging from a specific, structured activity (such as a play group organized by parents) and dissolving when the activity ends. In this context children are expected to master the tasks of group entry and group interaction. According to Putallaz and Gottman (1981), those who can adjust to the group's ongoing interests, rather than disrupting group functioning by trying to impose their own agenda, are more successful entering groups and better prepared to participate in the peer groups that will emerge in school settings.

Once young people enter more stable peer settings, such as a school classroom, they can exercise more choice in their peer associates and their groups become more stable. Nevertheless, Kindermann (1993) notes that in these early school years peer groups feature high turnover in membership from one month to the next. Most groups are formed among youth who have ample opportunity to interact (e.g., live in the same neighborhood or are in the same classroom at school) and share a strong interest in the activity that inspires the group's formation. Once past the preschool years, both girls and boys show a preference for forming groups of same-sex peers, an inclination that Ennett and Bauman (1996) found will continue until middle adolescence.

PEER GROUPS IN MIDDLE CHILDHOOD

As young people move past early childhood and the primary grades of elementary school, peer group interactions typically expand. Young people try to join structured after-school activities or organize informal after-school interactions that include the friends they have in school classrooms. Despite this behavior, peer group membership remains highly volatile. Cairns and his colleagues (1995) found that, over the course of a school year, the core of a group may remain intact while more peripheral members float among groups, but it is unlikely that a group will experience no changes in membership over this time period. One reason for this flux is the rather loose structure of peer groups that characterizes middle childhood. Shrum and Cheek (1987) reported that in any given classroom several sets of students will band together into cliques, but collectively they may constitute little more than half of the students in a class. Other students will seem to have attachments to two or more cliques and often serve as a conduit of information between groups (someone who can facilitate a child's transfer between cliques). Still others may bond together in a close friendship and confine interactions to the dyad, while a small cadre of students can be regarded as isolates without close relationships with any classmates (although they may have strong ties to a friend or clique outside the

classroom). Researchers disagree about the percentage of youth who belong to cliques, largely because of differences in the ways that these groups are defined or identified. It seems, however, as if membership in a tight-knit peer group actually diminishes across time, contradicting the stereotype of early adolescents as highly clique oriented (Shrum & Cheek, 1987).

More consensus exists on the average size of peer groups. Cliques usually contain between five and eight members. Ladd (1985) found that boys' groups tend to be larger than those of girls, possibly in order to facilitate boys' more active pursuits (e.g., sports) on the playground. Also, according to Ladd (1985), children who are well liked by classmates belong to larger cliques than peers who are generally disliked.

Cliques bring together children who share common interests and social backgrounds (socioeconomic status or ethnicity). One might also expect clique members to share similar personality dispositions or temperaments, but this is not always so. Whereas many people believe that relatively aggressive youth coalesce into peer groups that are distinct from those of nonaggressive youth, Farmer and colleagues (2002) discovered that aggressive children actually are widely dispersed among cliques. However, cliques do vary in the average level of aggressiveness of group members, and this group average correlates significantly with the level of academic and social adjustment of group members (Farmer et al., 2002). If a student who is relatively aggressive and disliked by peers belongs to a relatively aggressive peer group, the child will have difficulty mastering the social skills necessary to move into a more prosocial peer group and gain a more favorable reputation among classmates.

As is true among older youth or adults, children are inclined to favor members of their peer group over outsiders. They recognize and accentuate group differences in attitudes and behaviors. Toward the end of childhood, however, young people are likely to differentiate highly regarded, core group members from more peripheral and less popular members, especially if these peripheral members do not adhere closely to group norms. A child may even favor peers who are members of so-called out-groups over fellow clique-mates who tend to deviate from the clique's norms, especially if the peers in the out-group are not highly committed to their group's norms (Abrams, Rutland, & Cameron, 2003). Bigler, Brown, and Markell (2001) demonstrated that school adults can exacerbate rivalries and hostilities among peer groups by calling attention to the groups (e.g., allowing children to form their own work groups or teams at recess), even if the adults show no favoritism of one group over another.

EXPANSION OF PEER GROUPS IN ADOLESCENCE

The peer group system grows more complex in early adolescence, especially if young people move from neighborhood-based elementary schools to larger secondary schools that are no longer based on self-contained classrooms. The most significant change is the emergence of a second layer of peer groups, often referred to as crowds. In contrast to cliques, which identify students who routinely interact with each other, crowds differentiate individuals who share a similar reputation or image among peers, whether or not the crowd members routinely interact with one another (Brown, 2004).

Crowds are organized around the most salient features of the peer social system. They also tend to address developmental mandates of adolescence as a life stage (Brown, Mory, & Kinney, 1994). In the dominant mainstream of American culture, young people of this age are expected to become more autonomous from adults, cultivate a sense of identity, and master the skills necessary to participate in heterosocial interactions and relationships that form the normative social patterns of adulthood. Accordingly, peer crowds reflect different prototypic identities or lifestyles, based on individual abilities and interests: jocks, brains, delinquents, partyers, goths, skaters, and so on. Crowds also tend to be arranged in a social hierarchy, according to their status among peers (Brown et al., 1994). Sometimes group status forms the basis for a crowd's name: populars, nerds, rejects. Important cultural elements endemic to a particular school or community may also be reflected in the crowd system, such as when groups emerge that are based on ethnic background, religious orientation, or family economic background. Thus, the crowd with which an adolescent is associated by peers is an indicator of the child's status, public identity, and values or behavior patterns that are most noticeable to peers.

The importance of belonging to a crowd grows through early adolescence, peaks in middle adolescence (about the beginning of high school), then fades (Brown, Eicher, & Petrie, 1986). Nevertheless, Schwendinger and Schwendinger (1989) reported that even in middle adolescence, not all young people are associated definitively with one particular crowd. Some display a "split image," in which peers associate them with two different crowds, whereas others are not well enough known by peers to place in any crowd. It appears to be more difficult for adolescents to change crowd affiliations than it is to change clique membership.

In addition to their role in identity development, crowds help to regulate social interactions by indicating which peers are acceptable candidates for friendship or dating relationships (Brown et al., 1994). Crowds at either end of the status hierarchy in Eckert's 1989 study

of high school youth displayed rivalries or animosities that precluded close relationships between members. These may be manifest in physical confrontations, such as between rival gangs, but they are more likely to be expressed in verbal exchanges or criticisms of the rival group. Research by Cillessen and Mayeux (2004) revealed that members of high status groups are rated by peers as more verbally aggressive than low status crowd members. Their aggressive behaviors often serve to affirm and reinforce their superior status in the peer system. But there is a price to pay for such aggression, in that members of high status crowds are not necessarily well liked by peers.

Although there are strong antipathies or rivalries among certain crowds in a school, there can be close affinities among other combinations of crowds. This fact may explain why, at least in high school, Urberg, Degirmencioglu, Tolson, and Halliday-Scher (1995) found that friendship groups often contain members of multiple crowds. The inclination to form cliques from within a given crowd appears to be stronger among certain crowds than others, and during early adolescence rather than later years (Kinney, 1993). However, patterns of exclusiveness in clique formation can be exacerbated in schools or communities that emphasize distinctions among students by virtue of residence, ethnicity, religion, or other demographic markers.

Ethnographers who have studied clique dynamics have focused on early adolescent groups of high-status girls. They have observed a complex structure that involves multiple roles and a hierarchy of authority, often enforced through a pattern of relational aggression that makes the groups appear to undermine members' psychological well-being (Adler & Adler, 1998). It is unlikely that the same structure and group dynamics typify adolescent cliques, especially after the middle school years. Finders (1997), for example, found that within-group relations were much less intense and more supportive in a lower status girls' clique than the high-status counterpart in the middle school that she studied.

A major function of adolescent cliques is to socialize youth into heterosexual roles and relationships (Connolly, Furman, & Konarski, 2000; Dunphy, 1963). Accordingly, although same-sex groups still dominate the adolescent social landscape, mixed-sex cliques become increasingly common. Youth who are involved in mixed sex groups begin dating and romantic relationships earlier and with more confidence than young people who remain in single-sex cliques (Connolly et al., 2000).

Peer groups are instrumental in promoting prosocial behavior, such as academic achievement, as well as anti-social activities, depending upon the norms of the group. In Ellis and Zarbatany's 2007 study of Canadian youth, group influences toward deviant behavior were

significant only among low-status cliques, whereas group influences toward prosocial behavior were strongest in cliques of high-status students. Cliques do not have equal influence on all members. Tarrant, MacKenzie, and Hewitt (2006) found that those who identify strongly with their clique are more subject to its influence than members with more casual ties to the group. Cliques have indirect as well as direct effects on members' behavior and well-being. Lansford and colleagues (2003) reported that a strong and supportive friendship group can moderate the negative impact of poor parenting on young people.

As is the case for childhood cliques, schools can affect the dynamics of adolescent peer groups. Sponsoring ethnically based clubs or organizations helps to legitimize ethnically oriented crowds. Favoring one group of students over another (e.g., spotlighting athletes or giving them special consideration) can boost the cliques or crowds to which that group belongs. Separating students by academic ability or English language fluency creates divisions in the student body that affect the formation of friendship groups.

COALESCENCE OF CROWDS IN LATE ADOLESCENCE

By the final years of high school, most students have begun to solidify their sense of identity, located enduring friendships, and grown more comfortable with heterosocial activities. Having thus facilitated adolescent development, peer crowds diminish in importance and influence. In fact, the boundaries between crowds often dissipate, making it difficult to discern a crowd's members and making friendship groups that cut across several crowds more common (Brown et al., 1994). Young people's attention turns away from crowds, back toward their circle of friends. Peer groups function more as support systems than as powerful entities that direct student behavior, which helps to prepare students for the type of peer group experiences they are likely to encounter in adulthood.

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B. Bradford Brown

PEER PRESSURE

Peer pressure is the influence that a group has on an individual. Although in common parlance peer pressure is frequently used to describe a negative influence, peer pressure can be both positive and negative. Young people are more susceptible to peer pressure at certain stages of development, but everyone is influenced by peers to some degree, even adults.

TYPES OF PEER PRESSURE

Peer pressure has been of interest to researchers for decades. In a series of experiments performed in 1955 and 1956, researcher Solomon Asch demonstrated the power of peer pressure to make otherwise intelligent individuals go against the evidence of their own eyes. He showed participants a straight line on a card and asked them to pick out which straight line on another card matched it. The straight lines on the second card were of quite different lengths, and when subjects performed the task alone they chose the correct line more than 99% of the time. However, when confederates of Asch became involved, the situation changed drastically. When every confederate chose the same, incorrect, line, the participant would choose the same, incorrect, line more than 36% of the time (Asch 1955). In general, the more confederates participating and choosing the incorrect line, the stronger this effect was found to be. This clearly demonstrated that, among the college student participants at least, the opinion of the group could exert such a strong influence that it could cause participants to choose against their better judgment. Interestingly, when even one confederate chose the correct line participants were more much more likely to choose the correct line (Asch 1956). This suggests that peer pressure is reduced when the group is not unanimous.

Asch's study was alarming because it showed that the influence of peers on judgment is so strong that it could make even intelligent college students choose the opinion of a group over the evidence of their own eyes. Since his groundbreaking experiments thousands of studies have

been done demonstrating the presence of peer pressure on children and adolescents in dozens of different situations and at nearly every age. Much of this research has focused on negative peer pressure, the peer pressure most likely to be of concern to parents and educators.

Peer pressure has the capacity to be an extremely negative influence on a child or adolescent. Many studies have documented that children whose friends engage in negative or antisocial activities, such as smoking or using drugs, are much more likely to engage in such behaviors themselves. Salvy and colleagues' 2007 study even found that overweight girls who ate with a friend who was also overweight consumed more calories on average than overweight girls who ate with friends who were of normal weight. This kind of influence on day-to-day habits, outside even the realm of traditional antisocial activity, demonstrates how prevalent peer influence can be. Ad campaigns such as the "just say no" campaign of the 1980s and early 1990s and the "above the influence" campaign, begun in the mid 2000s, are aimed at encouraging children and adolescents to recognize the influence of peer pressure and to overcome its pressure to engage in antisocial activities.

Although peer pressure is most frequently used in conversation with a negative connotation, not all peer pressure is negative. Peer pressure is a necessary and important part of development. It helps to socialize children, provide a sense of identity, and can encourage positive behaviors. Peer pressure can encourage children and adolescents to strive for excellence in areas such as sports, theater, and science. Peer pressure might make children feel pressured to take an honors class with all of their friends, which would not necessarily be right for every child but would by no means be antisocial. Peer pressure is an important fact of life at all ages; it is even a significant motivator for adults. A 2006 report to the House Science and Technology subcommittee reported peer pressure more effective at making American adults conserve energy than concern for the environment, the desire to save money, or even social responsibility. Given that peer pressure exists at all ages, it may be more effective to help children and adolescents identify negative peer pressure than to try to eliminate peer pressure.

SUSCEPTIBILITY TO PEER PRESSURE

Susceptibility to peer pressure varies with age and specific personal traits. In general, the role of peer pressure increases with age into adolescence. When children are very young, parents and other caregivers tend to choose play groups and babysitting situations. Parents limit the amount of time they allow children they believe to be bad influences to have contact with their children. Very young children also tend to spend less time in the company of

other children and more time with parents or other adult figures. Therefore, the presence of peer pressure is somewhat limited. As children enter school full time and begin to spend more of the day playing with peers outside the direct supervision of adults the potential for peer pressure increases.

Research is somewhat divergent about what age group is most susceptible to peer pressure. Some research indicates that the influence of peers steadily increases through middle school and peaks during the later years of high school. Recent research has suggested that this may not be the case. A 2007 study by Steinberg and Monahan found that resistance to the influence of peer pressure actually increases fairly linearly between ages 14 and 18, and does not increase significantly after that. They found that among the participants studied, ranging in age from 10 to 30, resistance to peer influence did not increase significantly from ages 10 to 14 or after age 18 (Steinberg, 2007).

In addition to changing with age, susceptibility to peer pressure also varies by individual. Children who have low self-confidence and a low sense of agency are more likely to be influenced by their peers. Children who are somewhat ostracized from the general group of peers may gravitate towards children who have also been ostracized, who may be more likely to engage in antisocial behavior. Children who are pushed out of the group may feel more pressure to conform in an attempt to be accepted by a group, even if the group is not engaging in prosocial activities.

FRIENDS VERSUS PEERS

Peer influence can come from many areas. It is not often found in the guise of one adolescent telling another adolescent directly, "Hey, everybody's doing it." It is usually more subtle but in many ways more insidious than that. Peer pressure most often comes from a peer group larger than the set of friends that the child or adolescent regularly interacts with. In this way peer pressure can be exerted indirectly, such as when everyone in school wears a certain type of sneakers or carries a certain brand of backpack. Although the influence is extremely dispersed, and it is not likely anyone will directly tell the children they need to buy those shoes or that backpack, the influence is none the less extremely strong.

Friendship group refers to the group of friends with which children or adolescents spend most of their time; the group to which they most closely relates. Friendship choice is often influenced by habits and interests the child already has. For example, an adolescent who smokes is more likely to be friends with a group of adolescents who also smoke than an adolescent who does not. Although already occurring traits can heavily influ-

ence friendship group choice, once the group has formed the members exert increased pressure on one another to conform.

Friendship groups are more likely than peer groups to exert direct, spoken pressure on a child or adolescent. The pressure to conform to the friendship group is also greater because fear of losing the primary friendship group can be severe. The friendship group can also help the child or adolescent resist pressure by the larger peer group to engage in antisocial activities. As was shown in the Asch experiment, even one other person standing against the group can provide enough incentive for individuals to go with their beliefs instead of with the group.

SEE ALSO *Self-Esteem*.

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Helen Davidson

SOCIOMETRIC STATUS

Sociometry is defined as the quantitative measurement of social relationships. Jacob Moreno (1889-1974) is considered the founder of sociometric analysis, with his 1934 book *Who Shall Survive?* Sociometry, as Moreno and others since have envisioned it, has two major objectives. The first is to describe the structure of the peer group as a whole, for example, by creating sociograms or visual diagrams of peer group structure. The second objective is to assess the status of individuals within the group. Sociologists have generally been more interested in group structure, while social and developmental psychologists have tended to focus more on the sociometric status of individuals, although there is considerable overlap between the sociological and psychological research on

this topic. Bukowski and Cillessen provide an excellent review of the history of sociometry that explains its development during the twentieth century.

A vast number of empirical studies have investigated sociometric status among schoolchildren in the classroom setting. In the U.S. educational system, children spend an enormous amount of time with same-age peers in the classroom, so it is critically important to understand how each child fits within that group and to understand what are the consequences, both short-term and long-term, of having a particular status within the group. Furthermore, particularly in younger grades, the classroom setting provides researchers with a readily available, relatively self-contained peer group, which enables them to conduct sophisticated quantitative analyses of peer status and obtain very rich information about how the peer group functions and its effects on individual children.

MEASURING SOCIOMETRIC STATUS

The most common method of measuring sociometric status is to collect confidential nominations from the members of a peer group regarding who each person likes and who each person dislikes within the group. Occasionally, teachers, parents, or trained behavioral observers provide the data, but peer nominations are usually considered the best form of measurement. Peers understand the group from the inside, rather than viewing it from the outside, as others do. Also, the measurements are more direct with peers (“Who do you like?”) than with teachers or observers (“Who is well-liked by peers?”). Furthermore, while there will be some degree of bias no matter what the source of information is (parents, teachers, observers, or peers), one can obtain more reliable information by surveying a large group of peers than one would get from a single individual such as a teacher or an observer. Often researchers use multiple sources for collecting the data, and they can learn a great deal about peer status by examining the similarities and differences among these various sources of information.

Sociometric status is usually measured by counting the number of liked votes and the number of disliked votes that each person receives from peers, a method that was introduced into developmental psychology by Coie, Dodge, and Coppotelli in the early 1980s. There is some controversy from an ethical perspective about whether to include the negative (disliked) nominations when collecting data or simply collect the positive (liked) nominations only. Some teachers, parents, and/or school administrators believe that asking about disliking will lead some children to be ostracized when they would not have been so otherwise. However, others argue that these measures are simply assessing relationships and attitudes that already exist. More importantly, the prob-

lem with not using negative nominations is that there is a substantial difference between failing to name someone as liked and actually naming the person as disliked. Only by using both types of nominations can researchers categorize children into the five different categories of sociometric status (described below) upon which most of the research in this field is based.

The five-category model proposed by Coie and colleagues involves counting the number of votes received by each student for liking and disliking and standardizing those votes within the classroom. In some cases, children are allowed to make an unlimited number of nominations, while in other cases, they are restricted to a specific number of nominations, (three, for example). Also, sometimes the nominations are only for same-sex peers (especially in younger grades) and sometimes they are across both genders. The first two categories that can be derived from these nominations differ along a dimension of social preference. The first category is sociometrically popular, which includes children who receive a large number of liked nominations and very few if any disliked nominations. The second category, sociometrically rejected, includes children who receive a large number of disliked nominations and very few if any liked nominations. The popular children are (obviously) more preferred than the rejected children. The next two categories differ along a second dimension, called social impact. These categories are sociometrically controversial, which includes children who receive many liked nominations and many disliked nominations, and sociometrically neglected, which includes children who receive very few of either type of nomination. The controversial children, who receive high numbers of both types of nominations, have more impact or prominence in the peer group than do neglected children, who receive low numbers of liked and disliked nominations. Finally, the last category is sociometrically average, which includes everyone who is not particularly high or low on either type of nomination.

BEHAVIORAL AND COGNITIVE CHARACTERISTICS OF STATUS GROUPS

Much research on sociometric status has focused on the rejected category (see Asher and Coie for a comprehensive review of peer rejection). The reason for this focus is that rejected children are most at risk for current and future behavioral problems. However, researchers have examined the behavioral characteristics and cognitive thought patterns of children in all these categories, as well as the antecedents and consequences of membership in a particular status group. What follows is a brief review of this research.

Five major sociometric statuses and their characteristics		
Status	Sociometric ratings	Characteristics
Popular	<ul style="list-style-type: none"> • Many well-liked ratings, few disliked ratings • Many positive ratings 	<ul style="list-style-type: none"> • Popular and have many friends • Viewed as leaders • Friendly and sociable • Cooperative and helpful • Understand social cues well and have high levels of social competence • Respect authority • Follow social rules • Described as having a good sense of humor and being positive
Controversial	<ul style="list-style-type: none"> • Both well-liked and disliked ratings • Ratings highly variable with many at each extreme 	<ul style="list-style-type: none"> • Disruptive and aggressive • Socially competent • Active • Disregard social rules • Viewed as leaders and as having an impact on peer group • Perceived as having both positive and negative attributes • Share characteristics of both the popular and rejected aggressive groups
Neglected	<ul style="list-style-type: none"> • Ratings are near the mean on scores of social preference and social impact • No extreme positive or negative ratings • This is the most unstable of statuses 	<ul style="list-style-type: none"> • Ignored or over looked by peers • Not treated poorly but not treated well by peers • Solitary and withdrawn • Not aggressive • Do not differ behaviorally from either the popular or average group
Average	<ul style="list-style-type: none"> • Ratings are near the mean on scores of social preference and social impact • No extreme positive or negative ratings 	<ul style="list-style-type: none"> • Perceived as neither popular nor unpopular • High levels of positive social behaviors • High levels of social competence
Rejected	<ul style="list-style-type: none"> • Many disliked and very few well-liked ratings • Many negative ratings 	<ul style="list-style-type: none"> • Associated with future maladaptive behaviors • Difficulties reading social cues <ul style="list-style-type: none"> • Perceived as bossy, non-cooperative, and impulsive
<i>Rejected aggressive</i>		<ul style="list-style-type: none"> • Aggressive and disruptive • Viewed as bullies • Externalize problems
<i>Rejected withdrawn</i>		<ul style="list-style-type: none"> • Perceived as sad and depressed • Do not actively engage in classroom activities • Have high negative self-perceptions • Actively ignored by classmates and often victims of bullying

SOURCE: Paige Shalter Bruening

ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Researchers have determined behavioral profiles for the various status categories, and this research is nicely summarized in a review article by Newcomb, Bukowski, and Pattee. Sociometrically popular children tend to be helpful, cooperative, sociable, and demonstrate leadership within the peer group. Sociometrically rejected children tend to fall into two subgroups: rejected-aggressive and rejected-withdrawn. Rejected-aggressive children are physically aggressive and bullying toward peers, while rejected-withdrawn children are often the victims of aggression by other children. Both groups display maladaptive behavior that makes it difficult for these individuals to get along with other children. Controversial children share characteristics with both popular and rejected children. They are very active in the peer group and demonstrate leadership and cooperativeness, but they also tend to display aggres-

sion toward peers and do not abide by the rules. The neglected category is not stable over time; in other words, if a child is categorized as neglected during one measurement session, he or she is likely not to have that same status if measurements are taken several months or a year later. Although the neglected category may seem to be similar to the rejected-withdrawn group, there are important differences between the two. Rejected-withdrawn children are actively ostracized by the peer group, while neglected children are essentially ignored and not treated particularly well or particularly poorly by peers.

In addition to behavioral differences, children in the various status groups also differ in their patterns of thinking. Rejected-aggressive children tend to make hostile attributions regarding other children's behavior, whereas rejected-withdrawn children tend to make self-defeating

attributions that interfere with their ability to make friends. Also, rejected children are less accurate overall than are other status groups at interpreting peers' behavior. Popular and average children have higher levels of social competence and are able to achieve their goals more readily in social situations than are rejected children.

ANTECEDENTS AND CONSEQUENCES OF SOCIOMETRIC STATUS

As one might imagine, children in these different status categories have different prognoses for future success. Longitudinal studies that follow children as they grow older (such as the study by Hymel, Rubin, Rowden, and LeMare) and retrospective studies that look at the childhood experiences of adults have both shown that early peer rejection is associated with later mental health problems, criminal behavior, and early school withdrawal. Rejected-aggressive children are more likely to engage in impulsive and delinquent behavior, while rejected-withdrawn children are more likely to suffer from depression and anxiety. Rejected children as a whole display maladaptive behavior as early as infancy, demonstrating more difficult temperaments and more insecure attachment to parents than do those from other status groups.

It is very important to note that most of the research on antecedents and consequences of sociometric status has been correlational rather than causal in nature. In other words, researchers have not established that temperament and attachment problems or faulty thinking patterns cause sociometric rejection, nor have they established that being sociometrically rejected in school causes later problems in life. There might be other variables as yet uninvestigated which could be responsible for the child's status as well as his or her past and future problems. If there is not a causal relationship between status and these other variables, it means that helping children to be more accepted by their peers will not necessarily improve their outcomes later in life.

Furthermore, it is important to realize that the link between sociometric status and present and future problems may be moderated or weakened by other variables. For example, research on friendships (such as the study by Parker and Asher) shows that friendship and peer status are two independent constructs, and children may have close dyadic friendships regardless of their status in the overall peer group. Having such friendships can make adjustment much easier for rejected children, and not having such friendships can attenuate the positive effects of being sociometrically popular.

GENDER AND DEVELOPMENTAL DIFFERENCES

Sociometric status differs somewhat depending on gender and stage of development. Rejected boys are distinguished from popular boys primarily based on aggression levels, whereas popular and rejected girls differ primarily in the degree to which they cooperate with others. Boys tend to display more physical aggression, while girls display indirect or relational aggression (spreading rumors or excluding or ostracizing peers). From a developmental perspective, a number of researchers have examined the stability of sociometric status over time and have found that status remains fairly stable over a child's time in school and often carries over to a new school environment. More interesting from a developmental point of view is the way in which children's and adolescents' stereotypes about popularity change as they grow older. If status is measured by asking about peers' reputation ("Who is popular in the peer group?" or "Who is unpopular?"), the results are very different from the findings on sociometric status, especially for older children and adolescents. Peers whom children name as popular may have more in common with sociometrically controversial children than with sociometrically popular children. A cross-sectional study by LaFontana and Cillessen shows that peers with a popular reputation are more dominant, demonstrate both prosocial and antisocial behaviors, and possess more resources such as money, athletic ability, and physical attractiveness, than do sociometrically popular peers. The differences between sociometrically popular and perceived popular children increase with age, peaking in middle school and early adolescence. Girls reach this peak somewhat earlier than do boys.

CAVEATS AND FUTURE DIRECTIONS

Despite the massive amount of research on sociometric status, there are several limitations to this literature. Most of the research has focused on the United States, so researchers do not know whether the same principles hold true in other cultures. There is a heavy emphasis on the role of cognition because the cognitive perspective dominated developmental psychology during the 1980s and 1990s when much of this research took place. There is also a strong emphasis on the individual and how he or she is affected by sociometric status. Future research must focus more on dyads and groups as the units of analysis. Much of the research has taken place with racially undiverse populations. Only in the early part of the twenty-first century did researchers begin in earnest to explore gender and ethnic differences in sociometric status. Finally, interventions depend on whether researchers view certain behaviors as adaptive or maladaptive. For example, is the aggression that reputationally popular children display considered good (assertiveness) or bad (bullying)? Should

it be encouraged or discouraged? Parents, teachers, and researchers must work together to determine the future direction of research on sociometric status.

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Kathryn M. LaFontana

PEER TUTORING

Peer tutoring is an intervention in which students work in pairs to master academic skills or content. Peer tutoring can involve partners who are the same age or different ages (cross-age). Cross-age peer tutoring involves older students serving as tutors for younger, lower-functioning students. Cross-age tutoring occurs, for example, when students in a high school child development class spend regularly scheduled time each week reading with struggling students in a fourth grade class. In this instance, the tutors might be expected to gain less from the content being tutored but may be expected to gain more in social responsibility or understanding of learning as a process.

In same-age tutoring, in which students of the same age tutor each other, more skilled students may be paired with less skilled students. In this case, students with stronger skills may provide the first responses, providing a model for the less skilled partner. In other cases, the teacher may decide to pair students of similar ability and have them alternate tutoring roles, which is sometimes referred to as reciprocal peer tutoring. Class-wide Peer Tutoring (CWPT) occurs when the teacher creates highly structured tutoring materials for use during the tutoring session. Peer tutoring is differentiated from tutoring between adults, such as community volunteers, and students. It is also distinguished from cooperative learning, in which students work collaboratively in groups.

Clearly, peer tutoring is a general term that encompasses many tutoring models. All methods are designed to increase practice, responding, and feedback for students, and they often result in increased student motivation and achievement. These models differ, however, in how tutoring pairs are assigned, how tutoring content is developed, and how extensively the tutoring is employed. For example, in cross-age tutoring the expert tutor is typically the older student, while in reciprocal peer tutoring and CWPT the paired students are the same age and can take turns assuming the expert role. In cross-age and reciprocal tutoring, the student tutor is typically responsible for learning the content and then teaching the information to the tutee, while in CWPT the teacher is more responsible.

The instructional components of the peer tutoring model include: (a) explicit teaching of students in how to be tutoring experts, (b) purposeful partner assignment, (c) careful preparation of tutoring materials, (d) highly structured tutoring procedures that include specific feedback for tutors to provide tutees, (e) expert role reversal, and (f) active teacher monitoring. Also, some type of systematic performance is typically included. Explicit teaching of students in how to be tutoring experts can include modeling examples and non-examples of appropriate tutoring interactions, posting tutoring guidelines as reminders for students, giving feedback on how well students are meeting expectations for tutoring, and re-teaching procedures as necessary. Partner assignment can be based on student academic skills, tutoring activity content, and/or interpersonal relationships between students. Preparing tutoring materials carefully is necessary to ensure success in the tutoring experience and may include differentiation of materials. Materials typically include highly structured tutoring procedures that indicate how tutors can determine if a response is correct and how to respond to both correct and incorrect responses. Finally, teachers actively monitor peer tutoring and may give feedback to students both on content and procedures.

Peer Assisted Learning Strategies (PALS) is one peer tutoring activity that has been researched for grades kindergarten through 12. This tutoring program is designed to help students improve in reading and other academic skill areas. The steps to the program for reading are: (a) predicting, (b) partner reading, (c) retelling, and (d) summarizing. In this program, the stronger reader is the expert tutor. Students begin by making a prediction about the passage they are about to read. They then take turns reading the same passage with the stronger reader going first. Then the stronger reader prompts the weaker reader to retell the passage and then summarize the information with the following steps: (a) "Name the who or what the passage is about," (b) "Tell the most important thing about the who or what," and (c) "Say the main idea in 10 words or less." A modified version of this peer tutoring model has also been used in mathematics.

Another example is peer tutoring with differentiated instructional materials targeted toward classrooms with students of different learning needs. Differentiation of materials can include: (a) differential practice time, (b) embedded strategic information, and (c) increasing levels of difficulty. Differential practice time allows for students to have as much time needed to master a concept before proceeding to the next skill set. Embedded strategic information can include specific strategies for improving memory or comprehension of important concepts, such as mnemonic strategies or comprehension questioning. Increasing levels of difficulty might include varying levels of supports that can be provided to students on an as needed basis. For example, students can begin with identification formats (in which they are asked to identify the correct response from an array) and advance to production formats (in which they produce the correct response independently) or to answering tutor questions under prompted or non-prompted conditions.

Peer tutoring models were applied systematically as early as 1789, but they gained popularity in toward the end of the twentieth century, with accumulating research evidence in support of the practice. Learning gains commonly observed in peer tutoring programs are generally attributed to increased active academic engagement and opportunities to respond on the part of students, particularly in contrast to models in which all instruction is delivered by the teacher or by independent seat work. Peer tutoring has been studied in many academic areas, including science and social studies, in addition to skill areas such as reading and spelling. Peer tutoring has also been effectively implemented in classrooms that include students with diverse learning needs, such as students with disabilities and students for whom English is a second language.

Academic gains have been consistently observed in peer tutoring programs, with treatment effects in the medium to high range for both tutors and tutees. Effects have also been observed for students acting as tutors in the role of expert. Social benefits of peer tutoring, including improved self-esteem and self-efficacy, improved attitude toward school, and improved interpersonal functioning, are commonly reported anecdotally. Research support for these more general outcomes has been inconsistent, although students commonly improve in their attitude toward the content being tutored and in their attitude toward their tutoring partner. Teachers who have implemented peer tutoring typically respond favorably to the practice.

SEE ALSO *Communities of Learners*.

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PIAGET, JEAN **1896-1980**

Jean Piaget was born in 1896 in Neuchâtel, Switzerland, and died in Geneva in 1980. He graduated from the University of Neuchâtel in 1918 as a Doctor of Natural Sciences with a dissertation on mollusks, but he had always been deeply interested in philosophy. Subsequently, he studied psychology, logic, and philosophy of sciences in Zurich and at the Sorbonne in Paris. He held various professorships in sociology, philosophy of sciences, history of scientific thought, experimental psychology, and developmental psychology at the Universities of Neuchâtel, Geneva, and Lausanne, and the Sorbonne, but his research interest starting in the 1920s was in epistemology. He is often viewed as a psychologist,



Jean Piaget ARCHIVES OF THE HISTORY OF AMERICAN PSYCHOLOGY. THE UNIVERSITY OF AKRON.

but child psychology for him was a means for answering epistemological questions such as: How do we know what we think we know, and how did humanity build knowledge since its prehistoric beginnings? As a scientist, he insisted that such questions had to be answered scientifically, but historical evidence was no longer available. He studied children's construction of knowledge because children furnished empirical data that seemed most relevant to humanity's construction of knowledge.

PIAGET'S CONTRIBUTION TO THE PSYCHOLOGY OF CLASSROOM LEARNING

Piaget made many contributions to the psychology of classroom learning. Two will be highlighted here. One is his constructivism, the theory that states that human beings acquire knowledge and moral values by constructing them from the inside in interaction with the environment, rather than by internalizing them directly from the environment. Young children's construction of language illustrates the constructive process. Because most American children learn English, and most French children learn French, it is easy to think that children learn language by internalization from their environment. When one looks more carefully,

however, one finds that babies begin by uttering one word such as "Ball!" and go on to say two words, such as "Ball gone." By the time they go to school, children utter sentences like "I thought it in my head." These examples cannot be said to have been acquired by internalization because no one in the environment talks in these ways.

In the moral realm, too, most adults in the early 21st century believe that moral values and rules are acquired by direct internalization from the environment. However, Piaget showed that moral values, too, are constructed by each child from the inside in interaction with the environment. For example, he asked 6-to-14-year-olds why it was bad to tell lies. Young, heteronomous children replied, "Because you get punished when you lie." By contrast, older, more autonomous children tended to say that lies are bad even when one is not punished for them because lies destroy the bond of trust. The importance of mutual trust is an example of a moral value that has been constructed from the inside. For older, more autonomous children, lies are bad independently of reward and punishment.

Many psychologists think that Piaget's major contribution was the stages of development he found, but the stages are important only because they furnish the evidence that supports constructivism. Many bits of knowledge and morality can be learned by internalization, but this learning is often superficial and/or temporary.

An important part of Piaget's constructivism is his epistemological position against empiricism.

For centuries, philosophers had been arguing about the truth of two major epistemological traditions: empiricism and rationalism. Piaget's sympathy was with the rationalist side of the fence as can be seen in the conservation-of-number task. In this task, if the child uses one-to-one correspondence to put out as many chips as the interviewer has aligned, the interviewer says, "Watch what I am going to do," and moves the chips to make one of the rows look longer than the other. The crucial question then put to the child is: Are there as many chips in my row as in your row, or are there more in yours, or more in mine? Nonconservers usually say that the longer row has more because it looks like more. Nonconservers thus base their judgments on the empirical knowledge of what they can see. When their logico-mathematical knowledge later becomes stronger, they begin to deduce logically that the two rows have to have the same number.

Piaget's method of data collection must be noted here. At a time when only standardized questions were considered to be "objective" and "scientific," he invented the "clinical method," arguing that researchers must probe into each child's reasoning to get valid data. For example, if a child gave the correct answer in the conservation-of-number task,

Piaget believed that the interviewer should ask, “How do you know (that the two rows have the same number)?” If the child’s response was “I just knew it,” he further probed into the child’s reasoning to ascertain the strength of his or her logic.

A second major contribution Piaget made to the psychology of classroom learning is his conceptualization of autonomy as the aim of education. In his theory, autonomy does not mean the right to make decisions. It means the ability to make decisions by taking relevant factors into account, independently of reward and punishment. These decisions are about right and wrong in the moral realm, and about truth and untruth in the intellectual realm. Autonomy is the opposite of heteronomy, which means being unable to make decisions for oneself and therefore being governed by others. For an autonomous person like Copernicus, the heliocentric theory had to be promulgated even though it was rejected by his fellow scientists.

Schools are now generally run with ready-made rules and curricula supported by reward and punishment, as if heteronomy (obedience) were the aim of education. Piaget’s theory has changed some classroom practices in the early grades, but its influence is yet to take roots. When educators adopt moral and intellectual autonomy as the aim of education, schools will be run very differently and produce graduates with a strong sense of responsibility about themselves as well as the welfare of others. Schools will also endeavor to produce thinkers capable of creating new knowledge rather than merely repeating what others have said.

SEE ALSO *Cognitive Development: Piaget’s Theory.*

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Constance Kamii

PINTRICH, PAUL ROBERT 1953–2003

Paul Pintrich was born on November 4, 1953. He died of a heart attack July 12, 2003, while riding with a group of bicyclists on the road back from Hell, Michigan.

Pintrich received a B.A. in psychology from Clark University in 1975 and a Ph.D. in education and psychology from the University of Michigan in 1982. He remained at Michigan until his death, rising through the ranks to become professor and chair of the Combined Program in Education and Psychology and associate dean for research in the School of Education.

Although Pintrich died before reaching the age of 50, he was unusually productive, publishing well over 100 articles and book chapters as well as coauthoring or co-editing nine books. He was an excellent mentor and colleague, publishing with many collaborators in the United States and abroad. He helped build bridges to psychology in Europe, participating in the European Association for Research in Learning and Instruction (EARLI) and serving as president of the Division of Learning, Instruction, and School Psychology of the International Association of Applied Psychology. His professional service also included the editorship of the *Educational Psychologist*, the presidency of APA Division 15 (Educational Psychology), and president of the AERA Special Interest Group on Motivation.

In the early 1980s Pintrich and Wilbert J. McKeachie developed one of the first courses in Learning to Learn. This course differed from traditional study skills courses in that students not only learned strategies for learning but also learned the cognitive and motivational theories that underlie student learning so that they could apply the theories in new learning situations (Pintrich, McKeachie, & Lin, 1985). Followup studies showed that the course improved learning in later courses (McKeachie, Pintrich, & Lin, 1985). An outgrowth of that work was the development of the Motivated Strategies for Learning Questionnaire (MSLQ), which was used all over the world (Pintrich, Smith, Garcia, & McKeachie, 1991).

Beginning with studies of student self-efficacy (Pintrich & Blumenfeld, 1985), Pintrich was soon writing about the dynamic interactions between cognition and motivation in learning (Pintrich, 1988, 1989, Marx, & Boyle, 1993). In their seminal research on self-directed learning, Pintrich and his wife, Elizabeth De Groot, integrated cognitive, motivational, and behavioral factors affecting learning (Pintrich & De Groot, 1990). Well before self-regulation became a major research area, Pintrich was publishing research and theory that formed a foundation for later work. He and his students expanded the original cognitive approach to self-regulation to

include regulation of motivation and emotion as well (Garcia & Pintrich, 1994; VanderStoep, Pintrich, & Fagerlin, 1996).

Shortly thereafter Pintrich and his students became involved in research on goal theory. Their work was designed to answer questions such as the following: Are students primarily studying to get a good grade or is their primary goal to gain a good understanding of the subject? Are they more concerned with doing better than other students (performance motivation) than with mastering the subject (mastery motivation)? Although goals are usually thought of in positive terms, Pintrich and his collaborators also looked at avoidance goals (Zusho & Pintrich, 2000).

In later years Pintrich and Barbara Hofer (his student) began studying epistemological beliefs. Their paper “The development of epistemological beliefs: Beliefs about knowledge and knowing and their relation to learning” (Hofer & Pintrich, 2002) won the AERA award for best review article of the year.

Pintrich was a pioneer in developing an integrated theory of motivation and cognition and in showing how classrooms influence the development of student motivation for learning. He was one of the world’s leading scholars in the area of student motivation, cognition, and self-regulation.

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Wilbert J. McKeachie

PORTFOLIO ASSESSMENT

Portfolio assessment is an evaluation tool used to document student learning through a series of student-developed artifacts. Considered a form of authentic assessment, it offers an alternative or an addition to traditional methods of grading and high stakes exams. Portfolio assessment gives both teachers and students a controlled space to document, review, and analyze content learning. In short, portfolios are a collection of student work that allows assessment by providing evidence of effort and accomplishments in relation to specific instructional goals (Jardine, 1996). At its best, portfolio assessment demands the following: clarity of goals, explicit criteria for evaluation, work samples tied to those goals, student participation in selection of entries, teacher and student involvement in the assessment process, and self-reflections that demonstrate students’ metacognitive ability, that is, their understanding of what worked for them in the learning process, what did not, and why. These elements enhance the learning experience and the self-understanding of the student as learner.

ASSUMPTIONS AND PROCEDURES

Portfolio assessment is not defined by a single procedure, nor is there a single best way to use portfolios. However, the following components are generally assumed integral. The portfolio itself is a container of some sort, for example, a folder, crate, file, or virtual space for online portfolios. The selected contents should demonstrate student accomplishments over time. All selections and parts are authentic in that the included pieces provide evidence that the goals and objectives of the curriculum have been met, with added student reflections that review the process and /or products of learning. Participants in the portfolio assessment process (instructors, students and parents or administrators, if applicable), should be aware of assessment standards in advance. Depending on the type of portfolio, the contents may vary widely. Possible contents include writing samples that may vary in genre, content, and style, laboratory reports, journals, taped performances, recordings, art, research papers, projects, photos, interviews, conferences, tests, quizzes, observations, and reflections.

In some schools, material from a semester’s or year’s portfolio is digitalized and stored for future reference as a record of student accomplishments over a specified time. Colleges requiring licensure for a profession may require students to keep evidence of each standard met in an online or physical portfolio, ensuring ready access to reviewers or accrediting agencies that all work has been completed. Because a portfolio contains a variety of artifacts that provide evidence of work completed, it is particularly useful in these assessment circumstances.

KEY ELEMENTS FOR EFFECTIVE PORTFOLIO ASSESSMENT

Clear criteria for evaluation, including what must be included in the portfolio and rubrics for evaluation, are vital to successful portfolio assessment. When teachers develop unambiguous assessment criteria, they necessarily use a shared discourse, clarify beforehand any unfamiliar vocabulary (Rodgers, 2002), and assure that they and students have a mutual understanding regarding the theoretical foundations of the task before it takes place. Understanding these criteria can help reduce or eliminate criticism about subjectivity or unfairness of grading, a common criticism of those who prefer standardized assessments. The use of comprehensive rubrics that present structured information about organization, required components, length and content of entries and reflections, in addition to any specific assignment rubrics that clearly outline the goals, obligations, and constraints of particular entries, are valuable. The more precise and comprehensive the rubric, the more objective the assessment. Through explicit direction, instructors should make clear all guiding principles or policies for what may or may not be included in the portfolio.

Reflective pieces require students to articulate and review components of the portfolio and are a part of a comprehensive assessment. Reflections allow students the time and space to analyze their achievement in relation to class standards, evaluate their final products, and determine growth as well as needs (Fernsten & Fernsten 2005). The metacognitive exercise of figuring out how they know what they know about the learning that has taken place can be an invaluable learning tool and helps participants take responsibility for their own learning.

TYPES OF PORTFOLIOS

There are a variety of portfolio types, each designed to help assess either the process or the products of learning.

Showcase portfolios. Showcase portfolios highlight the best products over a particular time period or course. For example, a showcase portfolio in a composition class may include the best examples of different writing genres, such as an essay, a poem, a short story, a biographical piece, or a literary analysis. In a business class, the showcase portfolio may include a resume, sample business letters, a marketing project, and a collaborative assignment that demonstrates the individual's ability to work in a team. Students are often allowed to choose what they believe to be their best work, highlighting their achievements and skills. Showcase reflections typically focus on the strengths of selected pieces and discuss how each met or exceeded required standards.

Process portfolios. Process portfolios, by contrast, concentrate more on the journey of learning rather than the final destination or end products of the learning process. In the composition class, for example, different stages of the process—an outline, first draft, peer and teacher responses, early revisions, and a final edited draft—may be required. A process reflection may discuss why a particular strategy was used, what was useful or ineffective for the individual in the writing process, and how the student went about making progress in the face of difficulty in meeting requirements. A process reflection typically focuses on many aspects of the learning process, including the following: what approaches work best, which are ineffective, information about oneself as a learner, and strategies or approaches to remember in future assignments.

Evaluation portfolios. Evaluation portfolios may vary substantially in their content. Their basic purpose, however, remains to exhibit a series of evaluations over a course and the learning or accomplishments of the student in regard to previously determined criteria or goals. Essentially, this type of portfolio documents tests, observations, records, or other assessment artifacts required for successful completion of the course. A math evaluation portfolio may include tests, quizzes, and written explanations of how one went about solving a problem or determining which formula to use, whereas a science evaluation portfolio might also include laboratory experiments, science project outcomes with photos or other artifacts, and research reports, as well as tests and quizzes. Unlike the showcase portfolio, evaluation portfolios do not simply include the best work, but rather a selection of predetermined evaluations that may also demonstrate students' difficulties and unsuccessful struggles as well as their better work. Students who reflect on why some work was successful and other work was less so continue their learning as they develop their metacognitive skills.

Online or e-portfolios. Online or e-portfolios may be one of the above portfolio types or a combination of different types, a general requirement being that all information and artifacts are somehow accessible online. A number of colleges require students to maintain a virtual portfolio that may include digital, video, or Web-based products. The portfolio assessment process may be linked to a specific course or an entire program. As with all portfolios, students are able to visually track and show their accomplishments to a wide audience.

BENEFITS OF PORTFOLIO ASSESSMENT

Portfolio assessment research substantiates the idea that students greatly benefit from assessments that go beyond

simple letter grades and involve participants in the evaluation process. By taking part in the development of their portfolios, analyzing the criteria for what constitutes good work, and learning to evaluate their own work through guided reflective practices, students grow and develop in their knowledge and understandings. Portfolio assessment is part of a substantial body of research documenting the student benefits that emerge from an awareness of the processes and strategies involved in learning. (Hamp-Lyons & Congdon, 2000; Martin-Kniep, Cunningham, Feige, 1998)

The benefits of portfolio assessment are numerous. To begin with, they are a more individualized way of assessing students and have the advantage of demonstrating a wide range of work. They may also be used in conjunction with other types of required assessments, such as standardized or norm referenced tests. Often, portfolio contents are selected collaboratively, allowing students an opportunity to make decisions about their work and encouraging them to set goals regarding what has been accomplished and what needs further work, an important skill that may serve them well in life endeavors.

Portfolio assessment can promote a dialog between teacher and students about the individualized nature of the work. Too often, students may have papers or projects returned with a number or letter grade only and fail to understand what might be necessary for improvement. Required reflections in conjunction with conferencing reduce the possibility that students will be unclear about the assessment or what must be done to make improvements. This one-to-one aspect is an additional bonus for those students who may be too shy to initiate conversations with instructors as well as for those who enjoy speaking about their work and may better understand what worked and what did not through a verbal exchange.

Most importantly, portfolio assessments provide an authentic way of demonstrating skills and accomplishments. They encourage a real world experience that demands organization, decision making, and metacognition. Used in a thoughtful, carefully planned way, portfolio assessment can foster a positive outlook on learning and achievement.

SEE ALSO *Classroom Assessment*.

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Linda A. Fernsten

POSSIBLE SELVES THEORY

Self-concept is one's theory about oneself, the person one was in the past, is now, and can become in the future, including social roles and group memberships. A well-functioning self-concept helps make sense of one's present, preserves positive self-feelings, makes predictions about the future, and guides motivation. The contents of the future-oriented component of self-concept have been termed *possible selves* (Markus & Nurius, 1986). Possible selves are the selves one believes one might become in the near and the more distal future and are therefore important in goal setting and motivation (for a review, see Oyserman & James, in press). Possible selves are valenced; that is, each individual has both positive images of the selves he or she desires and expects to become and negative images of the selves he or she wishes to avoid becoming.

While current self-concept focuses on who one is now, by focusing on the future, possible selves allow for self-improvement, malleability, and personal growth. They provide a chance to experiment with and try on various potential futures ("Maybe I'll be a teacher or maybe I'll be a nurse. What would it be like to become a teacher or a nurse? How would I get there? What are the stages and obstacles along the way?"). The future is the target of much of our efforts as individuals. Homework is done and broccoli is eaten all in pursuit of some future state. As noted by Oyserman & James (in press), doing or not doing homework one night really does not make that much difference, but if each night's homework is viewed in this way, homework will rarely get done and that does matter. Whether one eats or does not eat the potato chips with lunch today does not make or break one's likelihood of being overweight, but, over time, each of these small choices adds up. In this sense, current actions are taken due to individuals' beliefs about their consequences in the future. Generally speaking, individuals are motivated to reduce the gap between their present and future positive possible selves while increasing the gap between their present and future negative possible selves.

Because possible selves provide both positive images of one's self attaining future goals and negative images of one's self failing to attain these goals (and of the feared selves one might become instead), possible selves are an integral part of a well-functioning self-concept. By focusing on the future, possible selves can improve well-being and optimism about the future. Things may not be going well now, but a possible self suggests the promise of change. Possible selves can improve one's ability to self-control and self-regulate because possible selves help one to focus on goals and lessen the influence of distractions in one's social world. Possible selves are most likely to improve self-regulatory ability when they are salient, linked with strategies, feel congruent with other aspects of self-concept, and when difficulty attaining them feels like proof one really cares rather than evidence for withdrawing effort (Oyserman & James, in press).

In terms of content, school-focused selves are common in childhood and adolescence regardless of socioeconomic status (for a review, see Oyserman & Fryberg, 2006). School-focused possible selves describe positive expectations regarding one's school success and academic attainment, including specific, immediate goals such as passing eighth grade or not failing the math test and more general long-term views such as being smart or getting a GED (Oyserman, Bybee, Terry, & Hart-Johnson, 2004). Youth are likely to have multiple, potentially competing possible selves, not all of which will influence behavior at any particular point in time (Oyserman & James, in press).

DEVELOPMENT OF POSSIBLE SELVES: INDIVIDUAL AND CONTEXTUAL FACTORS

Possible selves are influenced by both individual and contextual factors. Others can serve as role models and anti-models for both positive and negative possible selves. These others can be particular individuals with whom one has a relationship or simply a general sense of what others like oneself have been able to do.

Past Experiences. One's own past experiences of success or failure in a domain clearly influences one's beliefs about the relevance or attainability of possible selves in that domain as well as one's ability to articulate strategies to work on the possible self. Past failures may make it harder to articulate both what success would look like in a particular domain and which strategies are likely to be effective. Past successes may make it easier to articulate both what success would look like and which steps are needed to attain a desired possible self. For example, youth with a history of juvenile delinquency and school failure are less likely to articulate education and job focused possible

selves, students from low income families are less likely to generate multiple strategies for how to attain school-focused possible selves like doing well and getting good grades (Oyserman & Fryberg, 2006; Oyserman & James, in press; Oyserman & Markus, 1990).

Developmental Context. Content of possible selves reflects developmentally relevant self-tasks. During the school years, these tasks focus on being competent in school, being connected to others, and developing a sense of self. Not surprisingly, common possible selves are focused on school, relationships and avoiding becoming off-track such as using drugs or becoming pregnant (Oyserman & Fryberg, 2006). With development, the focus of these tasks evolves. College students and young adults are focused on occupational, educational, and interpersonal possible selves (such as getting married), whereas family and parenting possible selves become more important in young and middle adult years. As adults age, job-focused possible selves recede and physical health related possible selves become more prominent. However, some possible selves persist even when they are not easy to attain (for a review, see Oyserman & James, in press).

Social Context. Possible selves are also influenced by others' expectations and by historical and sociopolitical contexts. Some social contexts provide easy access to role models and reminders to focus on school while other contexts rarely provide these cues. Minority, low-income, and rural youth may be less able to imagine school-focused possible selves or to sustain these possible selves if their contexts include few models of overcoming barriers to success or are rife with stereotypes that are not congruent with school-focused possible selves. Research has shown that if going to college does not feel like an option as early as middle school, students withdraw academic effort (Oyserman & Fryberg, 2006; Oyserman, Gant, & Ager, 1995).

ASSESSING POSSIBLE SELVES

This section draws heavily from the review of measures and measurement strategies presented in Oyserman and Fryberg (2006). Oyserman and Fryberg (2006) provide specific references for both close- and open-ended measures used to assess possible selves and the interested reader is referred to their more detailed discussion.

Close-Ended Measures. Respondents are provided a list of possible selves and either asked to check off which possible selves are relevant or rate their likelihood of attaining each possible self or sort and rank the importance of these possible selves. Close-ended measures are easy to code but require preparation to be sure that the content is relevant to the sample of interest. Moreover,

with close-ended measures, one can only learn how much respondents endorse the items provided, not what they would have said given free rein. Though past research results can form a basis, to make sure that content is relevant, pilot work is needed. Given the potential diversity of possible selves, a pre-set checklist may not accurately reflect content of possible selves.

Open-Ended Measures. Open-ended tools typically open with a brief statement of what possible selves are and ask respondents to generate their own possible selves and, where relevant, their strategies for attaining them. The strengths of an open-ended measure are that it allows participants to describe their possible selves without constraint and that the format is easily adapted to different groups and contexts. The limitations of this method are that it requires content-coding of responses and generating one's own responses (rather than simply endorsing a pre-set list as is done in the close-ended method) is likely to be more effortful.

MOTIVATIONAL CONSEQUENCES OF POSSIBLE SELVES ON CHOICE, PERSISTENCE, ACHIEVEMENT

The future is an important component of self-concept and doing well in school is a common element of youths' future possible selves (Oyserman & Fryberg, 2006). In their review, Oyserman and Fryberg report on studies linking possible selves with reduced risk of substance use and sexual activity. Thus, sixth through ninth graders with fewer positive possible selves were more likely to report cigarette smoking and alcohol consumption and eighth graders whose possible selves focused on being popular rather than academic success were more likely to report smoking and drinking alcohol in the ninth grade. Seventh grade African American boys reported less initiation of sexual activity after participating in an intervention to develop possible selves.

However, possible selves do not always sustain self-regulatory action. Youth do fail algebra and engage in risk-taking behavior. Possible selves succeed in focusing effort when they are linked to behavioral strategies, they feel congruent with important social identities, and they are balanced so that difficulty working on the possible self is not construed to mean that the possible self is unimportant (much as the 'no pain, no gain' metaphor in sports, see Oyserman, et al., 2006). Each of these issues is described below.

Strategies to Attain Possible Selves. Imagining what is possible for one's future can increase optimism, but articulating a possible self is not enough to produce sustained effort and behavior change. For that to occur, possible

selves need to be linked with specific strategies (Oyserman et al., 2004). Strategies are concrete behaviors such as studying or setting an alarm clock. Strategies help one to focus on goals while anticipating and planning for setbacks by developing plans of action and fall back plans. In one study, by the end of the school year, students whose school-focused possible selves included detailed strategies reported feeling more efficacious; results were not limited to positive feelings, according to school records, students with strategies attained better grades than those without them (Oyserman et al., 2004). In another study, an intervention increased students' possible selves and strategies to attain them succeed in improving outcomes, including grades and in-class behaviors, even when other conditions suggested risk of school failure (Oyserman, Brickman, Rhodes, 2007).

Social Identity. One is more likely to engage in strategies to attain a possible self when the possible self and the strategies feel congruent with one's important social identities (e.g., racial-ethnic, gender, social class). Otherwise, the possible self itself or working on attaining the possible self will feel like it conflicts with the rest of who one is. For example, if boys believe that only girls raise their hands to participate or do their homework or stay after class for help, they are less likely to engage in these activities, even if they believe that these strategies would help them attain school-focused positive possible selves (for the general model, see Oyserman, et al., 2006).

The Carrot and the Stick: Balance in Possible Selves. It is tempting to focus only on the positive since thinking about how things can go wrong may feel discouraging. However, focusing on both positive and negative possible selves in the same domain improves focus and is associated with better outcomes. Balanced school-focused possible selves occur when one has both a positive possible self (e.g., going to college) and a feared or to-be-avoided possible self (e.g., being an unemployed drop-out) in the same domain (Oyserman, et al., 2006). Having both images serves as a carrot and a stick, simultaneously reminding the student of the goal (the carrot) and of where the student may end up if effort is not sustained (the stick). Students with school-focused balance in possible selves are less likely to be involved in delinquent activities (Oyserman & Markus, 1990) and are more likely to attain better grades (Oyserman et al., 2006), and the presence of balance in possible selves may be particularly important in social contexts in which one is likely to encounter obstacles to achieving one's goals.

IMPLICATIONS OF POSSIBLE SELF THEORY FOR TEACHERS

Teachers, parents, and students all have possible selves images of how things might be in the near and more distal future. These images illustrate that change is possible. Possible selves can undergird self-improvement by showing a path toward the future and by highlighting where one might end up if effort is not maintained. Intervention to help teachers, parents, and students focus on what they want to become and avoid becoming, what they value, and how they expect to engage in becoming like their desired selves and avoiding becoming like their undesired selves can be highly effective. Indeed, the theory of possible selves has been used to understand progress and life transitions for both youth learners and adults in continuing education and other settings.

Perhaps the most important message that educators can take from the research on possible selves is that possible selves are malleable and can be influenced by intervention to enhance the content of possible selves. Changing possible selves through intervention can lead to positive changes in academic behavior, in better academic performance and lower risk of depression (Oyserman et al., 2002; 2006). Of particular note is the School-to-Jobs (STJ) intervention that focused explicitly on improving academic outcomes by changing possible selves. STJ was tested both as an after-school and an in-school intervention, running twice per week for six weeks so that it was completed by Thanksgiving break.

Each STJ session focused on developing an aspect of possible selves. Beginning sessions linked school-focused possible selves to important social identities (e.g., gender or racial-ethnic groups), linked proximal possible selves (e.g., graduating from eighth grade) to desired but distant adult possible selves (e.g., going to college, getting a good job), discussed how possible selves are influenced by role models, and linked present action to possible selves. Later sessions focused on identifying specific strategies to be enacted in the present that would help youth obtain their possible selves. Students articulated how they would cope with difficulty that they might encounter in attaining their desired possible selves. Program activities involved individualized activities such as creating a timeline into one's future, active participation by students, and group exercises. Two final sessions involved parents, with the goal of providing youth and parents structured activities in which to talk about possible selves and strategies to attain them (see Oyserman et al., 2006). Evaluation indicated that STJ successfully improved time spent engaged in strategies (e.g., improved in-class behavior, time spent doing homework) and long-term academic attainment, as measured by standardized test scores and attendance (Oyserman et al., 2004; Oyserman et al.,

2002). Additionally, participation in STJ reduced participants' depressive symptoms (Oyserman et al., 2006) and buffered youth from the negative effects on grades and behavior of low parent involvement in school (Oyserman, et al, 2007). Effects were sustained through two years of follow-up assessment. In sum, possible selves are useful as descriptive and predictive tools and can be modified by in-school activities resulting in significant long-term benefits for children.

SEE ALSO *Relevance of Self-Evaluations to Classroom Learning.*

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PRAISE

The word praise originates from the Latin verb *pretiare*, meaning to highly value. The seminal work on the use of praise within the classroom context was produced by J. Brophy who defined praise as "commending the worth

of' or "to express approval or admiration" (1981, p.5). J. Thomas (1991) used the term "descriptive reinforcement" to describe praise. He outlined a three stage model for providing praise in the classroom as follows: (a) personalize the praise by using the student's name, (b) use one of 110 praise statements, and (c) outline what the student did to merit being praised. P. C. Burnett (2001) referred to Thomas's 110 statements as general praise noting examples such as "that's great," "well done," "terrific job," and "that's fantastic." In summary, teacher praise involves positive words, accompanied by positive affect, and as such is a targeted, affective response to students' behaviors or performance.

The term feedback is often used alongside praise but is quite different. Feedback is used to guide students in ways to improve their performance by providing information about their ability or inability to achieve success (Hattie, 1993). One type of feedback is attributional feedback. Teachers who note that students' success is attributed to their hard work are providing effort feedback (for example, "Tim, your great results reflect your hard work"), while teachers who ascribe success to ability (for example, "Great result, Rachel, you are clever at math") are providing ability feedback. Effort and ability feedback are referred to as attributional feedback because they attribute success and performance to either effort or ability.

EFFECTIVE AND INEFFECTIVE PRAISE

Brophy conducted a functional analysis of praise in the classroom and noted that teachers' verbal praise did not equate to positive reinforcement because praise was typically used infrequently, without reference to specific behaviors and often without credibility and sincerity. Brophy noted that classroom research suggested that only 6% of interactions involved praise, and he concluded that high rates of praise were not evident in classrooms. Brophy described 12 guidelines for both effective and ineffective praise.

The key ingredients for effective praise according to Brophy (1981) are:

Praise should be delivered in response to a specific behavior.

The behavior, deserving of praise, should be described in specific terms.

Praise should be sincere, credible, and spontaneous.

Praise should reward the attainment of clearly defined and understood performance criteria.

Praise should provide information about the student's competencies.

Praise should be given in recognition of noteworthy effort or success at a difficult task for that particular student.

Praise should attribute success to effort and ability implying that similar success in the future.

Ineffective praise:

Is delivered randomly or unsystematically,

Is restricted to global positive reactions delivered in a bland fashion with minimal attention to the student or behavior,

Rewards participation unrelated to performance,

Compares the student's performance to other students,

Is given without regard to the effort needed to complete the task,

Attributes success to ability alone or to external factors such as luck or the ease of the task, and

Is given by the teacher who acts as a power figure and external authority in a manipulative manner.

Not all of the literature is supportive of the use of praise in the classroom even when used effectively. R. Hitz and A. Driscoll (1994) noted literature that suggested that praise led to low expectations of success, discouraged children from judging for themselves, created anxiety, invited dependency, evoked defensiveness, and was delivered in the context of a power relationship. The major concern expressed was that praise was intrusive and controlling. Hitz and Driscoll advocated giving encouragement not praise and hence the mantra, encourage don't praise, emerged and formed part of many teacher training programs.

There has also been some debate regarding the use of ability feedback by teachers following a student's success. Brophy's guidelines noted ability feedback in the effective list but also noted a limitation by including the use of ability feedback alone in the ineffective list. Those who advocate the use of ability feedback highlight the impact that it has on the formation and development of students' self-concept (Craven, Marsh, & Debus, 1991). In addition, D. H. Schunk (1983) and B. Weiner (1986) noted that ability feedback produced higher expectations for future performance, greater skill acquisition, higher self-concept, enhanced satisfaction with performance, and further striving for achievement. Opposing the use of ability feedback in the classroom was C. M. Mueller and C. S. Dweck (1998) who argued against its use when they found that students who faced failure after receiving ability feedback showed low effort, poor persistence at a task and high frustration due to attributing their poor performance to lack of ability. Of further interest is the

fact that the use of effort feedback in the classroom has limitations. J. Henderlong and M. R. Lepper (2002) noted that the positive impact of effort feedback might be restricted if effort is overemphasised and the student perceives this as an indication that they lack ability and have to work hard to get anywhere. Furthermore, providing effort feedback may also be negative if hard work and effort result in failure.

DEVELOPMENTAL DIFFERENCES

Burnett (2001) investigated 747 elementary students' preferences for classroom praise. The students were in grades 3 to 7 and aged 8 to 12 years. Students reported that they wanted to be praised in classroom. Forty percent wanted to be praised often, 51% wanted to be praised sometimes, and only 9% never wanted to be praised. Interestingly, 84% wanted to be praised for trying hard and effort, while only 16% wanted to be praised for their ability and being smart. Most of students (52%) wanted to be praised quietly, while 31% wanted to be praised loudly in front of the class, leaving 17% who did not want to be praised publicly or quietly.

Developmental differences across the grades were noted. The need for praise increased from grade 3 to 5 and then declined over the next two grades levels. Students in grades 3 and 7 wanted to be praised at similar levels with the intermediate grades reporting that they wished to be praised more frequently. The students wanting the highest amount of praise were those in grades 4 to 6, suggesting that this is a developmental phase where students seek recognition and reassurance from their teachers. There were also developmental differences across the grades for effort and ability feedback. As students progressed through the grades they reported wanting more effort feedback and less ability feedback. Grade 3 students reported that they wanted about the same level of both effort and ability feedback, while grade 7 students reported wanting more effort feedback and less ability feedback. This suggests that younger students prefer to hear that they are smart and capable, but once this information is integrated into their self-concept they prefer to have their achievements attributed to their efforts.

Elwell and Tiberio (1994) investigated 620 high school students' preferences for the use of praise in their classrooms. Students in grades 9 and 10 wanted to be praised less frequently and less publicly than their younger and older counterparts in grades 7 and 8 and grades 11 and 12 respectively. The students in this study perceived the use of praise in the classroom as appropriate and expected to receive it for academic-related behaviors but not for socially appropriate behaviors. Nearly 60% of the students surveyed preferred quiet and private praise or no praise at all for academic success, while 41%

wanted to be praised loudly and publicly for their achievements. Elwell and Tiberio noted that students respond differently to praise, and teachers need to know about when, where, and under what circumstances praise should be delivered in the classroom.

USING PRAISE IN THE CLASSROOM

The research findings on the use of praise and feedback in the classroom have been integrated into guidelines for teachers. Burnett (2003) described a summary of what has been learned about praise and feedback in the classroom as a result of research.

Positive statements. Positive statements by teachers have a powerful impact and should be used in the classroom. Positive statements must be related to a behavior or performance. General praise that is not targeted or related to a specific behavior or performance has little impact on students and is not related to students' perceptions of the classroom environment or relationship with teacher. Thomas's 1991 descriptive reinforcement model (that is, name the student, use positive statements, describe the behavior) has merit.

Individual feedback. Praise and feedback should mostly be given individually. Only 31% of elementary students and 24% of high school students reported having a preference for public praise. Teachers should monitor a student's reaction to feedback as nearly one in five students reported not wanting to be praised at all, but this preference depends on circumstances and the student's grade level. Students should be praised for both effort and ability where warranted and appropriate for the grade level. Both types of feedback can be used despite having advantages and limitations.

Importance of grade level. The grade of the student is important. Students in grades 4 to 6 like to be praised more frequently and more publicly than students in grades 3 and 7, while students in grades 9 and 10 have a lower need for praise when compared with their older and younger high school peers. In the elementary school classroom students' preference for receiving effort feedback increases with grade, while preference for receiving ability feedback declines with grade.

SEE ALSO *Teacher Expectations.*

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Paul Burnett

PRESSLEY, G. MICHAEL 1951–2006

On May 23, 2006, the academic community lost one of its most brilliant and influential scholars in the fields of psychology and education. Michael Pressley, esteemed researcher and academic, died from complications associated with his fourth battle with cancer.

During his career, Pressley published more than 350 articles and book chapters and edited more than 25 books on psychology, literacy, and education. He especially was recognized for his senior authorship of the McGraw-Hill/SRA Open Course K-6 literacy program (also known as Open Court). He served as editor and board member for many prominent journals including *Journal of Educational Psychology* and the *Journal of Reading Behaviour*.

Pressley's dedication as a researcher was matched by his commitment to junior scholars. Pressley served as an advisor and mentor to dozens of doctoral and master's students throughout the United States and Canada, involving them extensively in his research and publication activities. Pressley also held great passion for K-12 schooling and involved himself in teacher preparation programs and the daily functions of elementary classrooms across America.

Pressley's schooling experiences, in part, shaped his interests in the psychology of learning. A student in the post-Sputnik era, Pressley participated in a science-enriched curriculum that concluded in his senior year with an 8-week research psychology summer session at Western Michigan University. This experience was profound in that it provided him with foundational insights about the enormous potential of research psychology to inform the field of education—insights that would subsequently be transformed into a professional passion.

Pressley completed his undergraduate studies at Northwestern University and earned a doctoral degree from the Institute of Child Development at Minnesota, specializing in cognitive development. Over the course of his career Pressley held positions at nine esteemed institutions including the University of Maryland-College Park, State University of New York, and Michigan State University.

A vigorous scholar, his research interests ranged from explorations in basic memory development to reading instruction. Pressley's initial explorations were largely quantitative and deepened understanding of effective learning strategies and study techniques, as well as factors that affected the learning process (good strategy user model). Adopting a variety of qualitative and mixed-methods methodologies, Pressley extended his research attentions to transforming educational practice and defining the essence of exemplary classroom instruction. His later interests focused in the area of reading comprehension and in monitoring and shaping teacher-student interactions as they negotiated meaning from text. Whether in the laboratory or in the classroom, students' positive learning experiences formed the foundation of Pressley's research and quickly earned him recognition as one of the nation's foremost educational researchers.

Pressley was the recipient of several prestigious career awards honoring his outstanding overall contributions to the fields of psychology and education, as well as his specific contributions in reading research and remedial reading diagnosis and programming for students at risk for reading and writing failure. These honors include induction into the Reading Hall of Fame, the Oscar Causey Award from the National Reading Conference, the Sylvia Scriber Award from the American Educational Research Association, and the Thorndike Award from the American Psychological Association. Pressley was honored with the University Distinguished Professor Award from Michigan State University and recognized as one of the top 100 University of Minnesota Distinguished Alumni from the College of Education and Human Development.

Pressley's contributions to the social science and education fields were unprecedented, as was his commitment to the universities, programs, and individuals he

Primary Language Acquisition

served. His intellect and leadership were matched by his compassion and unselfishness. Pressley was an individual who truly made a difference in the lives of his students and colleagues and his legacy remains with those who serve in America's classrooms.

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Vera Ella Woloshyn

PRIMARY LANGUAGE ACQUISITION

SEE *First (Primary) Language Acquisition*.

PROBLEM-BASED LEARNING

SEE *Constructivism: Problem-Based Learning*.

PROBLEM SOLVING

A major goal of education is to help students learn in ways that enable them to use what they have learned to solve problems in new situations. In short, problem solving is fundamental to education because educators are interested in improving students' ability to solve problems. This entry defines key terms, types of problems, and processes in problem solving and then examines theories of problem solving, ways of teaching for problem solving transfer, and ways of teaching of problem solving skill.

DEFINITIONS

What is a Problem? A problem exists when a problem solver has a goal but does not know how to accomplish it.

Specifically, a problem occurs when a situation is in a given state, a problem solver wants the situation to be in a goal state, and the problem solver is not aware of an obvious way to transform the situation from the given state to the goal state. In his classic monograph, *On Problem Solving*, the Gestalt psychologist Karl Duncker defined a problem as follows:

A problem arises when a living creature has a goal but does not know how this goal is to be reached. Whenever one cannot go from the given situation to the desired situation simply by action, then there has to be recourse to thinking. Such thinking has the task of devising some action, which may mediate between the existing and desired situations. (1945, p. 1)

This definition includes high-level academic tasks for a typical middle school student such as writing a convincing essay, solving an unfamiliar algebra word problem, or figuring out how an electric motor works, but does not include low-level academic tasks such as pronouncing the sound of the printed word "cat," stating the answer to " $2 + 2 =$," or changing a word from singular to plural form.

What is Problem Solving? According to Mayer and Wittrock, problem solving is "cognitive processing directed at achieving a goal when no solution method is obvious to the problem solver" (2006, p. 287). This definition consists of four parts: (1) problem solving is cognitive, that is, problem solving occurs within the problem solver's cognitive system and can only be inferred from the problem solver's behavior, (2) problem solving is a process, that is, problem solving involves applying cognitive processes to cognitive representations in the problem solver's cognitive system, (3) problem solving is directed, that is, problem solving is guided by the problem solver's goals, and (4) problem solving is personal, that is, problem solving depends on the knowledge and skill of the problem solver. In sum, problem solving is cognitive processing directed at transforming a problem from the given state to the goal state when the problem solver is not immediately aware of a solution method. For example, problem solving occurs when a high school student writes a convincing essay on the causes of the American Civil War, understands how the heart works from reading a biology textbook, or solves a complex arithmetic word problem.

PROBLEM SOLVING AS A KIND OF THINKING

Problem solving is related to other terms such as thinking, reasoning, decision making, critical thinking, and creative thinking. Thinking refers to a problem solver's cognitive processing, but it includes both directed thinking (which is

problem solving) and undirected thinking (such as day-dreaming). Thus, thinking is a broader term that includes problem solving as a subset of thinking (i.e., a kind of thinking, i.e., directed thinking).

Reasoning, decision making, critical thinking, and creative thinking are subsets of problem solving, that is, kinds of problem solving. Reasoning refers to problem solving with a specific task in which the goal is to draw a conclusion from premises using logical rules based on deduction or induction. For example, if students know that all four-sided figures are quadrilaterals and that all squares have four sides, then by using deduction they can conclude that all squares are quadrilaterals. If they are given the sequence 2 4 6 8, then by induction they can conclude that the next number should be 10. Decision making refers to problem solving with a specific task in which the goal is to choose one of two or more alternatives based on some criteria. For example, a decision making task is to decide whether someone would rather have \$100 for sure or a 1% chance of getting \$100,000. Thus, both reasoning and decision-making are kinds of problem solving that are characterized by specific kinds of tasks.

Finally, creative thinking and critical thinking refer to specific aspects of problem solving, respectively. Creative thinking involves generating alternatives that meet some criteria, such as listing all the possible uses for a brick, whereas critical thinking involves evaluating how well various alternatives meet some criteria, such as determining which are the best answers for the brick problem. For example, in scientific problem solving situations, creative thinking is involved in generating hypotheses and critical thinking is involved in testing them. Creative thinking and critical thinking can be involved in reasoning and decision making.

TYPES OF PROBLEMS

Problems can be well-defined or ill-defined. A well-defined problem has a clearly specified given state, a clearly specified goal state, and a clearly specified set of allowable operations. For example, "Solve for x : $2x + 11 = 33$ " is a well-defined problem because there is clear given state (i.e., $2x + 11 = 33$), a clear goal state (i.e., $x =$) and a clear set of operations (i.e., the rules of algebra and arithmetic). An ill-defined problem lacks a clearly specified given state, goal state, and/or set of allowable operators. For example, "develop a research plan for a senior honors thesis" is an ill-defined problem for most students because the goal state is not clear (e.g., the requirements for the plan) and the allowable operators are not clear (e.g., the places where students may find information). What makes a problem well-defined or ill-defined depends on the characteristics of the problem. Although most important

and challenging problems in life are ill-defined, most problem solving in schools involves well-defined problems.

Moreover, it is also customary to distinguish between routine and non-routine problems. When a problem solver knows how to go about solving a problem, the problem is routine. For example, two-column multiplication problems, such as $25 \times 12 =$, are routine for most high school students because they know the procedure. When a problem solver does not initially know how to go about solving a problem, the problem is non-routine. For example, the following problem is non-routine for most high-school students: "If the area covered by water lilies in a lake doubles every 24 hours, and the entire lake is covered in 60 days, how long does it take to cover half the lake?" Robert Sternberg and Janet Davidson (1995) refer to this kind of problem as an *insight problem* because problem solvers need to invent a solution method (e.g., in this case the answer is 59 days). What makes problems either routine or non-routine depends on the knowledge of the problem solver because the same problem can be routine for one person and non-routine for another. Although the goal of education is to prepare students for solving non-routine problems, most of the problems that students are asked to solve in school are routine.

COGNITIVE PROCESSES IN PROBLEM SOLVING

Mayer and Wittrock (2006) distinguished among four major cognitive processes in problem solving: representing, in which the problem solver constructs a cognitive representation of the problem; planning, in which the problem solver devises a plan for solving the problem; executing, in which the problem solver carries out the plan; and self-regulating, in which the problem solver evaluates the effectiveness of cognitive processing during problem solving and adjusts accordingly. During representing, the problem solver seeks to understand the problem, including the given state, goal state, and allowable operators, and the problem solver may build a situation model that is, a concrete representation of the situation being described in the problem. Although solution execution is often emphasized in mathematics textbooks and in mathematics classrooms, successful mathematical problem solving also depends on representing, planning, and self-regulating. In a 2001 review, Jeremy Kilpatrick, Jane Swafford, and Bradford Findell concluded that mathematical proficiency depends on intertwining of procedural fluency (for executing) with conceptual understanding (for representing), strategic competence (for planning), adaptive reasoning, and productive disposition (for self-regulating).

According to Mayer and Wittrock (2006), students need to have five kinds of knowledge in order to be successful problem solvers:

facts: knowledge about characteristics of elements or events, such as “there are 100 cents in a dollar”;

concepts: knowledge of a categories, principles, or models, such as knowing what place value means in arithmetic or how hot air rises in science;

strategies: knowledge of general methods, such as how to break a problem into parts or how to find a related problem;

procedures: knowledge of specific procedures, such as how to carry out long division or how to change words from singular to plural form; and

beliefs: cognitions about one’s problem-solving competence (such as “I am not good in math”) or about the nature of problem solving (e.g., “If someone can’t solve a problem right away, the person never will be able to solve it”).

Facts and concepts are useful for representing a problem, strategies are needed for planning a solution, procedures are needed for carrying out the plan, and beliefs can influence the process of self-regulating.

THEORIES OF PROBLEM SOLVING

Many current views of problem solving, such as described in Keith Holyoak and Robert Morrison’s *Cambridge Handbook of Thinking and Reasoning* (2005) or Marsha Lovett’s 2002 review of research on problem solving, have their roots in Gestalt theory or information processing theory.

Gestalt Theory. The Gestalt theory of problem solving, described by Karl Duncker (1945) and Max Wertheimer (1959), holds that problem solving occurs with a flash of insight. Richard Mayer (1995) noted that insight occurs when a problem solver moves from a state of not knowing how to solve a problem to knowing how to solve a problem. During insight, problem solvers devise a way of representing the problem that enables solution. Gestalt psychologists offered several ways of conceptualizing what happens during insight: insight involves building a schema in which all the parts fit together, insight involves suddenly reorganizing the visual information so it fits together to solve the problem, insight involves restating a problem’s givens or problem goal in a new way that makes the problem easier to solve, insight involves removing mental blocks, and insight involves finding a problem analog (i.e., a similar problem that the problem solver already knows how to solve). Gestalt theory

informs educational programs aimed at teaching students how to represent problems.

Information Processing Theory. The information processing theory of problem solving, as described by Allen Newell and Herbert Simon (1972), is based on a human-computer metaphor in which problem solving involves carrying out a series of mental computations on mental representations. The key components in the theory are as follows: the idea that a problem can be represented as a problem space a representation of the initial state, goal state, and all possible intervening states and search heuristics a strategy for moving through the problem space from one state of the problem to the next. The problem begins in the given state, the problem solver applies an operator that generates a new state, and so on until the goal state is reached. For example, a common search heuristic is means-ends analysis, in which the problem solver seeks to apply an operator that will satisfy the problem-solver’s current goal; if there is a constraint that blocks the application of the operator, then a goal is set to remove the constraint, and so on. Information processing theory informs educational programs aimed at teaching strategies for solving problems.

TEACHING FOR PROBLEM SOLVING

Max Wertheimer (1959) made the classic distinction between learning by rote and learning by understanding. For example, in teaching students how to compute the area of a parallelogram by a rote method, students are shown how to measure the height, how to measure the base, and how to multiply height times base using the formula, $\text{area} = \text{height} \times \text{base}$. According to Wertheimer, this rote method of instruction leads to good performance on retention tests (i.e., solving similar problems) and poor performance on transfer tests (i.e., solving new problems). In contrast, learning by understanding involves helping students see that if they can cut off the triangle from one end of the parallelogram and place it on the other side to form a rectangle; then, they can put 1×1 squares over the surface of the rectangle to determine how many squares form the area. According to Wertheimer, this meaningful method of instruction leads to good retention and good transfer performance. Wertheimer claimed that rote instruction creates reproductive thinking applying already learned procedures to a problem whereas meaningful instruction leads to productive thinking adapting what was learned to new kinds of problems.

Mayer and Wittrock (2006) identified instructional methods that are intended to promote meaningful learning, such as providing advance organizers that prime appropriate prior knowledge during learning, asking learners to

explain aloud a text they are reading, presenting worked out examples along with commentary, or providing hints and guidance as students work on an example problem. A major goal of meaningful methods of instruction is to promote problem-solving transfer, that is, the ability to use what was learned in new situations. Wittrock (1974) referred to meaningful learning as a generative process because it requires active cognitive processing during learning.

TEACHING OF PROBLEM SOLVING

In the previous section, instructional methods were examined that are intended to promote problem-solving transfer. However, a more direct approach is to teach people the knowledge and skills they need to be better problem solvers. Mayer (2008) identified four issues that are involved in designing a problem-solving course.

What to Teach. Should problem-solving courses attempt to teach problem solving as a single, monolithic skill (e.g., a mental muscle that needs to be strengthened) or as a collection of smaller, component skills? Although conventional wisdom is that problem solving involves a single skill, research in cognitive science suggests that problem solving ability is a collection of small component skills.

How to Teach. Should problem-solving courses focus on the product of problem solving (i.e., getting the right answer) or the process of problem solving (i.e., figuring out how to solve the problem)? While it makes sense that students need practice in getting the right answer (i.e., the product of problem solving), research in cognitive science suggests that students benefit from training in describing and evaluating the methods used to solve problems (i.e., the process of problem solving). For example, one technique that emphasizes the process of problem solving is modeling, in which teachers and students demonstrate their problem-solving methods.

Where to Teach. Should problem solving be taught as a general, stand-alone course or within specific domains (such as problem solving in history, in science, in mathematics, ETC.)? Although conventional wisdom is that students should be taught general skills in stand-alone courses, there is sufficient cognitive science research to propose that it would be effective to teach problem solving within the context of specific subject domains.

When to Teach. Should problem solving be taught before or after students have mastered corresponding lower-levels? Although it seems to make sense that higher-order thinking skills should be taught only after lower-level skills have been mastered, there is sufficient

cognitive science research to propose that it would be effective to teach higher-order skills before lower-level skills are mastered.

In this section, three classic problem-solving courses are described that meet these four criteria and that have been subjected to rigorous research study: the Productive Thinking Program developed by Martin Covington, Richard Crutchfield, and Lillian Davies (1966), Instrumental Enrichment developed by Reuven Feuerstein (1980), and *Odyssey* described by Raymond Nickerson (1994). The Productive Thinking Program consisted of 15 cartoon-like booklets intended to teach thinking skills to elementary school children. Each booklet presented a detective-type story such a story about a bank robbery and students learned how to generate hypotheses such as who might have done it and evaluate hypotheses using information in the booklet. Child characters in the booklet modeled problem-solving methods, and adult characters offered commentary and hints. Overall, Richard Mansfield, Thomas Busse, and Ernest Krepelka (1978) reported that students who learned with the Productive Thinking Program showed greater improvements in their ability to solve similar detective-type problems as compared to students who had not received the training.

In Instrumental Enrichment, students who had been identified as mentally retarded based on a traditional intelligence test were given concentrated classroom instruction in how to solve traditional intelligence test items. In a typical lesson, the teacher introduces the class to an intelligence test item; then, the class breaks down into small groups to devise ways to solve the problem; next, each group reports on its solution method to the whole class; and finally, a teacher-led discussion ensues in which students focus on describing effective methods for solving the problem. Evaluation studies reported by Feuerstein (1980) show that students who received this training on a regular basis over several years showed greater gains in non-verbal intelligence than did non-trained students.

Finally, in *Odyssey*, middle-school students received training in how to solve intelligence test problems, using a procedure somewhat like Instrumental Enrichment, and with similar results. David Perkins and Tina Grotzer reported that the training “enhanced the magnitude of students’ intelligent behavior [on] authentic tasks at least in the short term” (2000, p. 496). Overall, each of these courses met the criteria for what to teach (i.e., a collection of small component skills), how to teach (i.e., using modeling to focus on the process of problem solving), where to teach (i.e., teaching specific skills), and when to

Project-Based Learning

teach (i.e., teaching before all lower-level skills were mastered). Although none of these programs is currently popular, courses based on these four criteria are likely to be successful.

SEE ALSO *Creativity; Critical Thinking; Decision Making; Learning and Teaching Mathematics; Reasoning.*

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PROJECT-BASED LEARNING

SEE *Constructivism: Project-Based Learning.*

PROSOCIAL BEHAVIOR

Prosocial behaviors are voluntary behaviors made with the intention of benefiting others (Eisenberg & Fabes, 1998). This definition carefully circumvents the potential benefits to the person performing the prosocial behavior. Prosocial behavior is often accompanied with psychological and social rewards for its performer. In the long run, individuals can benefit from living in a society where prosociality is common (which, in evolutionary terms, increases reproductive potential). It has therefore been difficult for researchers to identify purely altruistic behaviors, benefiting only the recipient and not the performer. Nevertheless, behaviors benefiting others, but whose main goal is self-advantageous (e.g. cooperative behaviors intended to obtain a common resource), typically are not considered prosocial. Typical examples include: volunteering; sharing toys, treats, or food with friends; instrumental help (e.g., helping a peer with school assignments); costly help (e.g. risking one's own life to save others); and emotionally supporting others in distress (e.g., comforting a peer following a disappointing experience or caring for a person who is ill).

DEVELOPMENTAL CHANGES

Prosocial behavior has roots in human evolutionary history as de Waal's comparison with other species shows. Nevertheless, Fehr and Fischbacher note that humans are unique in their degree of prosociality. Hoffman's theory proposes that prosocial behavior becomes increasingly other-oriented as children mature. Infants feel self-distress in reaction to the distress of others because they are incapable of differentiating their own experiences from those of others. Gradually, self-distress is replaced by other-oriented concern, requiring some understanding of others' mental states (Hoffman, 2000). Zahn-Waxler, Robinson, and Emde show that by age 4, many children can react empathically to others, including offering help to those in distress.

The 1998 Eisenberg and Fabes meta-analysis found that prosocial behavior increases with age, although increases varied in size, depending on the methodological aspects of each study. In one study by Benenson, Pascoe, and Radmore, about 60 percent of 4-year old children donated at least one of 10 stickers they received to a peer, and about 85 percent did so at age 9. This increase was markedly elevated for higher-SES children compared to lower-SES children. From childhood to adolescence

further increases are found in sharing, but not in helping or providing emotional support (Eisenberg & Fabes, 1998). The boost in prosocial behavior with age is attributed to developmental increases in cognitive abilities associated with detecting others' needs and determining ways to help, in empathy-related responding, and in the moral understanding of the importance of helping others (Eisenberg et al., 2006).

CONTEXTUAL AND INDIVIDUAL INFLUENCES

Many contextual factors are associated with prosocial behavior. For example, Cole and colleagues report short-term success for television programs designed to increase children's prosociality. Social psychological experiments consistently show that recognizing a situation as requiring assistance, involving personal responsibility, and enabling oneself to help, all increase helping behavior (Penner, Dovidio, Piliavin, & Schroeder, 2005). Individuals are more likely to provide support in situations that promote personal psychological and material rewards, or where the costs (e.g., guilt) associated with not helping are prominent. Finally, individuals are more likely to behave prosocially towards similar or likable others (Penner et al., 2005), and towards others considered to be close, especially kin (Graziano et al., 2007). This pattern may reflect an ultimate evolutionary goal of kin selection as described by Hamilton, although de Waal notes that helpers' psychological goals may be quite different. Genetic relatedness aside, prosocial behavior towards family members probably involves a sense of duty, reciprocity, and affective relationships.

Rushton describes moderate consistency in individuals' prosocial behavior across varying situations and contexts, demonstrating both stable individual differences in prosociality and the importance of contextual factors. Research following children from early childhood to adulthood supports the existence of the long-debated altruistic or prosocial personality (Eisenberg et al., 1999). Individual differences in prosociality are linked to sociability, low shyness, extroversion, and agreeableness, although specific prosocial behaviors may require a combination of additional traits, such as perceived self-efficacy in the case of helping (Penner et al., 2005). Researchers Bardi and Schwartz highlight the importance of individuals' specific prosocial values, including emphasizing the importance of the welfare of others, as an additional variable likely to influence prosocial behavior. Personality and contextual variables are likely to interact in determining prosocial behavior. For example, agreeable individuals were more likely to help an outgroup member than low-agreeableness

individuals, but agreeableness was not associated with helping an ingroup member (Graziano et al., 2007).

Environmental factors linked to individual differences in children's prosociality include parental modeling of helping behavior and use of inductive discipline (e.g., explaining to children the consequences of their behavior) as opposed to power-assertive discipline (e.g., punishment) (Eisenberg & Fabes, 1998). Beyond parental influence, siblings, peers, and schools also may affect prosociality. For example, as Wentzel, McNamara, and Caldwell point out, children's prosociality may be influenced by close friends. Furthermore, the better the affective quality of the friendship, the more influential friends are to each other's prosociality.

Genetics also contribute to individual variation in prosociality. Research on adults finds that prosociality is substantially heritable. Research on young children shows lower heritability, demonstrated by one longitudinal twin study showing increases in the heritability of parent-rated prosociality, from 30 percent at age 2 to 60 percent at age 7 (Knafo & Plomin, 2006).

Genetic and environmental effects are often intertwined. For example, parental reasoning may be more effective with highly attentive children, while external rewards may work better for other children. These gene-environment interactions, in which children's genetically influenced tendencies interact with environmental influences in determining behavior, are highly likely. Further investigation is necessary of gene-environment interactions with regard to prosociality. Gene-environment correlations can also shape individual differences in prosociality. For example, children's low prosociality is related to parents' use of negative discipline and affection. This relationship can be traced back to children's genetic tendencies, implying that the genetically influenced low prosociality can initiate a negative reaction from parents (Knafo & Plomin, 2006).

Gender and culture are additional predictors of prosocial behavior. A meta-analysis found small differences favoring girls in prosocial behavior, smaller than expected based on gender stereotypes and lower for instrumental help than for other prosocial behaviors (Eisenberg & Fabes, 1998). Some evidence suggests that children in Western societies are less prosocial than children in other cultures, but some studies find no differences along these lines (see review by Eisenberg et al., 2006). A field study by Levine, Norenzayan, and Philbrick found large cultural differences in spontaneously helping strangers. For example, the proportion of individuals helping a stranger with a hurt leg pick up dropped magazines ranged from 22 percent to 95 percent across 23 cultures. Although national wealth was negatively associated with helping rates, the closely related cultural value of

individualism-collectivism (individualism is on average higher in richer countries) was not related. A compelling cultural explanation for cross-national differences in prosocial behavior was still needed as of 2008. Perhaps, cultures differ substantially in what each promotes as prosocial behavior (Eisenberg et al., 2006).

RELATION TO OTHER ASPECTS OF SCHOOL FUNCTIONING

Clark and Ladd find that prosocial children are relatively well adjusted and have better peer relationships than less prosocial children. Highly prosocial children have more friends and report a better quality of friendship, relative to less prosocial children.

Caprara and colleagues find positive relationships between children's early prosocial behavior and later academic achievement, and positive peer relations (statistically controlling for earlier achievement). The exact nature of these relationships has yet to be determined. Possibly, prosocial children's superior social skills enable them to work better with peers and to get along better with teachers. Alternatively, earlier prosociality represents self-regulation abilities needed for later achievement. Similarly, a finding by Johnson and colleagues that volunteering adolescents have higher grade point averages and intrinsic motivation toward schoolwork may indicate that volunteering increases academic self-esteem. Furthermore, adolescents who volunteer may receive preferential treatment from teachers, increasing their achievement.

HOW TEACHERS AND SCHOOLS CAN PROMOTE PROSOCIAL BEHAVIOR

Although observational studies suggest that preschool teachers usually do little to encourage prosocial behavior, teachers' behavior and school policies can promote prosociality. Positive, warm, and secure teacher-student relationships are associated with children's prosociality (Eisenberg et al., 2006).

To overrule the possibility that highly adjusted children are both prosocial and elicit positive reactions from teachers, intervention studies are essential. A five-year longitudinal study by Solomon and colleagues finds that training teachers to promote children's prosociality and developmental discipline increases children's prosocial values and behaviors. The program provided children with an opportunity to work collaboratively in small groups and participate in activities designed to promote social understanding. It emphasized prosocial values through the use of relevant media and highlighting children's positive behaviors and provided opportunities for active helping such as a buddy program that assigned older children to help younger peers.

In another school intervention reported by Fraser and colleagues, children received training designed to teach social problem-solving skills and to reduce peer rejection. Simultaneously, parents participated in home lessons designed to improve parenting skills (e.g., child development, parent-child communication, problem-solving, and discipline). Intervention children increased in prosocial behavior in comparison to the control group. Another experimental school program reported by Flannery and colleagues shows longitudinal gains in children's prosocial behavior by altering school climate by teaching students and staff five simple rules and activities: (a) praise people, (b) avoid put-downs, (c) seek wise people as advisers and friends, (d) notice and correct hurts one causes, and (e) right wrongs.

McMahon and Washburn point out that effective interventions often work to address students' empathy and problem-solving skills and are often tailored to the cultural, developmental, and behavioral characteristics of students. Research by Kazdin, Bass, Siegel, and Thomas reveals the effectiveness of cognitive-behavioral therapy in increasing prosociality in children with severe antisocial behavior. Another violence prevention program reported by DeCarlo and Hockman improves male urban African American students' prosocial skills through analysis of relevant RAP music lyrics. Furthermore, Lakes and Hoyt show the effectiveness of tae-kwon-do training at primary school to improve self-regulation and prosocial behavior among boys and, to a lesser extent, girls. Attention/play interventions by school psychologists with highly aggressive boys (modeling, role-playing, coaching, feedback, and discussion of play strategies), by Dubow and colleagues longitudinally decrease aggression and increase prosocial behavior. These studies demonstrate the usefulness of non-preaching approaches to prosocial development.

SEE ALSO *Moral Development; Social Skills.*

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PROVIDING EXPLANATIONS

Written explanations in classrooms have the goal of teaching a new understanding to students. According to genre theory, writers build a set of characteristics into explanations that readers use to learn from their reading. Cognitive load theory and educational psychology specify how the set of characteristics in an explanation could be designed to teach new domain understandings to students who do not yet have expertise. A synthesis of these separate areas of scholarship suggests guidelines for providing explanations that effectively teach important content to particular students.

EXPLANATION AS A GENRE

Genre theory specifies the characteristics of different genres and proposes a mechanism for how genres have developed. According to the theory, the identifiable patterns of structure and content that characterize any genre result from the work of communities of people completing recurring tasks and fulfilling shared purposes. A writer with a particular purpose in mind composes a text

with content, structure, and style characteristics that a prospective audience also knows and can use to fulfill a purpose, which may or may not match the goal intended by the author. The author who would write an explanation chooses characteristics with the purpose of communicating a new understanding to potential readers. Well-designed explanations present information, examples, analogies, diagrams, pictures, and models as subexplanations. These subexplanations follow a logical order to form a bridge between readers' current understandings and the new understanding. The goal for the reader is to construct a new understanding by attending to the subexplanations and following the text's logical order.

For example, the British physicist and astronomer, Sir James Jeans (1877–1946), wrote a short explanation titled “Why the Sky Is Blue” based on a series of radio talks for an audience with no formal knowledge of science. Jeans began by asking the reader to imagine standing on an ocean pier watching the waves roll in and strike the columns supporting the pier. This first subexplanation contrasted what happened to short and long ocean waves with the purpose of reminding the reader of an experience that the reader could readily imagine. The second subexplanation chronicled the movement of light waves through the atmosphere, a series of events that cannot be directly perceived. The third subexplanation mapped the model of water waves onto the model of light. The explanation ended with an explicit description of light waves moving through the atmosphere and ended with the two short sentences, “Consequently the blue waves of the sunlight enter our eyes from all directions. And that is why the sky looks blue.” This explanation presents four subexplanations logically ordered to juxtapose a readily perceivable and imaginable phenomenon that readers may have actually seen with a scientific model to bridge the knowledge of a novice and the understanding of an expert.

Explanations with these features appear in science textbooks in the United States, in science and social studies textbooks internationally, in science and social studies trade books, and in magazine articles and books written for the general public. They also appear in composition books prepared to teach important genres to novice writers (e.g. the anthology that includes Jeans's explanation). The educational community seems to have developed this genre to help learners gain new understanding.

COGNITIVE LOAD THEORY

Whereas rhetoricians have proposed a theory to explain the characteristics and development of genres, Cognitive load theory, developed by cognitive psychologists, explains how learning occurs and suggests constraints on the design of successful explanations. According to

the theory, the mind is composed of a limited working memory through which information enters the mind and a limitless long-term memory, which stores information that has successfully been processed in working memory as organized schemas. The schemas are abstract structures that store large amounts of information. Working memory can hold only a small number of discrete “bits” of information, and thus can be something of a bottleneck. Learning cannot occur if incoming information overloads working memory capacity; if the cognitive load is too great. But a schema is processed as a single bit. Schemas effectively reduce cognitive load.

Cognitive load can be intrinsic, germane, or extraneous. Intrinsic cognitive load depends on the complexity of the information and whether the learner already has at least one relevant schema. If intrinsic load is not too great, the learner may have the capacity in working memory to engage in processes that are germane to learning, including constructing new schemas. Instruction is effective to the extent that it enhances germane cognitive load. In contrast, instruction may actually impede schema acquisition by enhancing extraneous cognitive load, such as requiring readers to search for or organize information within instructional materials rather than presenting information coherently.

Cognitive load theory provides a framework for understanding how well-designed explanations enhance learning. Psychologically, domain understandings, such as understandings about light developed by physicists, are stored in long-term memory as schemas. The purpose of classroom explanation is to reduce intrinsic and extrinsic cognitive load so that the reader has the working memory capacity to construct a new schema. The design of the subexplanations and how they are ordered must meet this goal in order for learning to occur.

REDUCING INTRINSIC COGNITIVE LOAD

Originally the theory specified that instruction could not modify intrinsic cognitive load. However, research by psychologists John Sweller and Richard Catrambone and others using explanations of chemistry models and written mathematics tasks suggests that presenting instruction as a series of simplified tasks can reduce intrinsic cognitive load. Young adolescent boys following instructions to build molecular models completed the tasks more quickly for 10 simple models with only two related elements each than for 2 complex models with several related elements. Other work using written mathematics tasks suggests that presenting instruction as a series of simplified versions of a complex task can reduce intrinsic cognitive load. Intrinsic cognitive load can be reduced by restricting the number of related elements

that the learner must consider at a single point in time. Choosing incoming information that matches a known schema also reduces intrinsic cognitive load. The adolescents were faster for the complex models if the instructions were diagrammatic rather than text, matching the structure of a common graphic organizer used in school. Apparently, they had a schema that they could use to reduce the intrinsic cognitive load for even complex models. “Why the Sky Is Blue” offers an example of this process. It presents a sequence of subexplanations, each of which has a smaller number of related elements than is true for the explanation as a whole. It also begins with the ocean wave example, for which readers may well have a schema. Both of these features could reduce intrinsic load and thereby allow readers to understand the subexplanations about light waves.

REDUCING EXTRANEOUS COGNITIVE LOAD

In an explanation, any example, diagram, information, analogy and so on that does not relate directly to the schema to be acquired would increase extraneous cognitive load. Eliminating unnecessary input would reduce cognitive load and facilitate comprehension. For example, research by psychologist Richard Mayer and others has shown that learners reading a text with only a qualitative description of a model of ocean waves learned more than learners reading a text with quantitative data interspersed within the qualitative description. In the “Why the Sky Is Blue” example, this criterion is met, as each subexplanation relates to the light wave schema.

Texts that require the reader to expend working memory resources figuring out how to process the input also increase extraneous cognitive load. Designing a text to minimize processing unrelated to schema acquisition reduces this load. Research has shown that learners reading a text with captions that point out the relevant features in a diagram or highlighting that signals important relations in a text learn more than learners reading texts without these features. Reducing extraneous cognitive load is particularly important if intrinsic cognitive load is high. Reading diagrams that depicted the relations among chemical elements facilitated how quickly adolescents constructed complex models over reading prose explanations. Prose explanations would not directly represent the relations among elements in the model and might well require learners to create in working memory their own images, adding to the overall cognitive load.

Local coherence also reduces extraneous cognitive load. Readers reading texts with clear pronoun referents, paragraphs organized around a single idea, and paragraph topic sentences learn more than readers reading texts without local coherence, who must dedicate working

memory capacity to creating the local coherence themselves. Topic sentences from “Why the Sky Is Blue” such as, “We have been watching a sort of working model of the way in which sunlight struggles through the earth’s atmosphere”; (p. 703) and “The waves of the sea represent the sunlight” (p. 704), draw the reader’s attention to important relations in the text and also could help readers connect the subexplanations, therefore decreasing extraneous cognitive load.

Eliminating redundancy can decrease cognitive load as well. If an explanation only has content that relates to the expert schema, provides enough support so that the learner does not have to figure out how to process the input, and is coherent, adding additional explanatory support is redundant. Processing this redundancy increases extraneous cognitive load. Learners who read more concise explanations without additional, less central explanatory content learned more than learners who read elaborated versions with additional explanatory content. Redundancy only exists when an explanation has been designed well enough to lead to schema acquisition without the additional content. “Why the Sky Is Blue” is short, and it is likely that this explanation would have redundant content only for readers who already have the light wave schema.

ENHANCING GERMANE COGNITIVE LOAD

Germane cognitive load results from input that can stimulate the higher cognitive processes necessary for schema acquisition. The same features that decrease intrinsic and extrinsic cognitive load can also contribute to germane cognitive load if they enhance schema acquisition. For example, if all subexplanations are related to the schema, readers have the input to compare and contrast the subexplanations, abstract general similarities, and construct a schema that incorporates the separate subexplanations. If the explanation signals the similarities explicitly through captions on diagrams, explicitly noting the relationships between analogs, or worked out mathematical examples, readers’ attention will be further directed away from extraneous content and toward the similarities.

Research has suggested that providing subexplanations with different surface features can encourage learners to abstract the general similarities and construct a schema. The subexplanations in “Why the Sky Is Blue” present an analogy, the light wave model, a mapping of the analogy onto the model, and the sequence that results in the perception of the color blue. These multiple subexplanations could be expected to enhance germane cognitive load and learning because they all exemplify the underlying relationships in the schema and are not so numerous as to become redundant. Learners would be

thus more likely to focus cognitive effort on the relevant parts of the subexplanations.

The order in which an explanation presents subexplanations can also enhance germane cognitive load. Research on the development of expertise suggests that novices begin with simple schemas, and through practice, construct progressively more complex and useful schemas that ultimately are so well known that they are automatic and bypass working memory altogether. An explanation that begins with a simple, known schema followed by subexplanations that present progressively more complex schemas, could provide the input that a novice would be able to use to construct an expert schema. The subexplanations for “Why the Sky Is Blue” follow this simple to complex order.

EXPLANATIONS TO PROMOTE DOMAIN LEARNING

The challenge in providing explanations to promote domain learning is that typically students either lack obvious schemas upon which to construct new understanding or the schemas that they do have are misleading and interfere with domain learning. First, learners may lack schemas for letter-sound correspondences and grammatical patterns in English. Consequently, they may require so much working memory capacity to process the symbols on the page that no capacity is left for schema construction. Second, students may not have a schema for the generic characteristics of explanation and therefore be unable to take advantage of the subexplanations and logical order in the text. Rather than processing the text as a single unit in working memory, they may instead be overwhelmed by the individual pieces of information in the explanation. Third, students may either have no schemas for the content in the text, or the schemas that they do have may be based on everyday experiences that interfere with their construction of counterintuitive domain-based understandings. Naïve understandings most obviously interfere with new understandings in science, but they can also occur for formalistic vocabulary in mathematics and stereotypes in social studies and English.

LACKING DECODING SCHEMAS

Students who lack letter-sound and sentence grammar schemas struggle with almost all reading tasks. Because their struggles to decode and maintain fluency take up so much working memory capacity, it is of utmost importance that intrinsic load be minimal and other types of extrinsic load be eliminated. Intrinsic load can be minimized by providing explanations that rely heavily on pictures and familiar types of diagrams accompanied by a limited amount of text. Presenting the content in diagrams and pictures will eliminate the need for large

amounts of decoding; accompanying these features with a limited amount of text will give the readers practice in decoding successfully and thereby constructing the decoding schemas that they are lacking. “Why the Sky Is Blue” has no features that would support readers who lack decoding schemas. It was written for adults who presumably have these schemas.

Firmly established content schemas can also minimize intrinsic cognitive load. Students who struggle to decode otherwise can at times read content about which they have well-established schemas quite fluently. The problem, of course, is that the purpose of explanations is to lead to new understanding. The optimal balance between known and new for readers who struggle to decode is an important area for future research.

LACKING TEXT SCHEMAS

Explanations can be designed to build on text schemas that students typically have and compensate for text schemas that they lack. The most firmly established text schema for most students is narrative. Educational psychologists Linda Kucan and Isabel Beck, for example, have demonstrated that fourth graders seem to be able to follow the logic in narratives and fail to follow the logic in expositions. Asked to recall after reading, children up through fifth grade and beyond tend to recall the gist of stories and unconnected bits and pieces of expository texts what educational psychologist Bonnie Meyer has called the default list. Overall, explanation is exposition. It is structured as a series of subexplanations, not as a plot with characters. It might be expected that many students would lack a schema for explanation. However, subexplanations within explanations can be narrative. “Why the Sky Is Blue” starts with a narrative-like example with the reader as the main character, the waves and the pier as the setting, and what happens to the waves as the plot. It is possible that readers could use a narrative schema to process the remaining subexplanations even though the explanation as a whole is exposition.

Readers lacking a text schema can begin to construct one through signaling. Across a number of studies, research has demonstrated that introductions that synopsize the text structure; paragraph topic sentences and words such as “first,” “then,” and “however” that signal the structure of the text; and conclusions that summarize direct a reader’s attention to the generic patterns in a text. Explanations with these features would prompt readers to process an explanation within working memory as a single unit rather than a succession of unrelated bits of information. “Why the Sky Is Blue” has no signals that would help readers process it as an explanation.

HAVING WELL ESTABLISHED NAÏVE UNDERSTANDINGS

A challenge in most scholarly domains is to help students use expert models to explain everyday experience. In economics, models of supply and demand can explain fluctuations in price. In history, models of limited resources can explain why one country would invade another. In science, scholars have proposed and demonstrated causal models that can be used to explain and predict a wide range of phenomena. These models reduce phenomena to a set of core theoretical ideas that are often very different from the realm of everyday knowing. Indeed, a challenge in all domains, but particularly science, is to help students use expert models to explain everyday phenomena. Unfortunately, the schemas that students have, rather than guiding their understanding, can actually interfere with their construction of a new schema. Often texts for use in classrooms begin with the target model to be taught and do not address students' naïve models, typically failing to prompt students to construct a new schema. "Why the Sky Is Blue" fits this pattern, in that it does not directly address students' prior ideas about light.

A type of explanation called *refutational text* has proven to be an effective way to help readers adopt scientific models that may even be at odds with their naïve experience-based schemas. Refutational texts begin with a subexplanation that presents the naïve model based on everyday experiences, and follow with subexplanations that are logically ordered to demonstrate the limitations of the naïve model, present the scientific model, and point out how it addresses the limitations. Students who demonstrated naïve understandings before reading were more likely to demonstrate expert understanding after reading refutational texts than other students who conducted experiments, discussed in small groups, or read typical textbook material that did not "refute" their naïve understandings.

IMPLICATIONS FOR TEACHERS

The most important implication for teachers is to choose and compose explanations carefully. The well-designed explanation begins with a schema that the teacher could expect students in the class to have. If the children's schema contrasts with the expert understanding, the explanation is designed as a refutational text. The effective explanation has no extraneous content and is locally coherent. Subexplanations are varied, including diagrams and pictures to highlight the relationships in the schema where appropriate, as well as narrative examples. The explanation is as explicit as possible, drawing connections among each successive subexplanation, highlighting important relationships and including informative dia-

gram captions. Subexplanations follow a logical order, from part to whole, from simple to complex, from familiar to unfamiliar. Knowing the students well, the teacher chooses or develops an explanation with the optimal relationship between known and new to maximize germane cognitive load and student learning.

Most explanations will not match this set of characteristics perfectly. For example, "Why the Sky Is Blue" does not include diagrams and pictures, nor does it address possible naïve understandings. For less than perfect explanations, classroom instruction would need to provide what the explanation lacks. Students could draw missing diagrams or write captions for diagrams that are in the text, brainstorm before reading to access relevant schemas, and create graphic representations of the ideas in the explanation to highlight relevant content. Students could process more than one explanation, each of which could make up for lacks in the other. Even though research suggests that reading print may lead to learning more effectively than watching or listening to other types of media, students who lack decoding or relevant content schemas can learn better from a combination of print and other media than either by itself.

SEE ALSO *Cognitive Load Theory*.

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Punishment

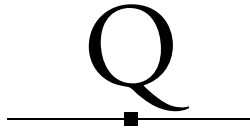
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PUNISHMENT

SEE *Classroom Management: Punishment.*



QUALITATIVE RESEARCH

A doctoral student collecting data for her dissertation visits a third grade classroom where two children labeled autistic are regular members. She goes there several days per week staying approximately four hours each time. She tries to remain as unobtrusive as possible observing the natural class environment and activities as they occur. When she leaves each day she goes to her home computer and writes detailed notes of everything she has seen and heard. In addition, she keeps a diary of her personal reactions and evolving thoughts. After she has been there six weeks, she begins conducting recorded interviews with the teacher and other school staff. She even interviews some of the parents of children in the classroom. Rather than using a questionnaire she asks general questions, leaving room for the respondents to raise issues and to freely express themselves. In conjunction with this interview information she gathers various official documents, student evaluations, and other information related to the class.

This researcher is interested in social relationships and learning in the room especially the experiences of the children labeled disabled. She wants to understand the classroom both from the teacher's point of view and that of other people involved. Although these are her general interests she did not state specific hypotheses or questions before she started. When she finishes the data collection she reads, rereads, and codes her descriptive data. She relies on one of the computer software programs available to help organize and analyze her qualitative data. Then she writes a dissertation about what she has learned.

DEFINITION OF QUALITATIVE RESEARCH

The researcher is engaging in qualitative research in the classroom. Her comprehensive data collection approach is not the only one qualitative researchers use to study classrooms. Some rely solely on in-depth interviews, others limit their data collection to intense observation, others on first person document analysis. Other techniques exist as well but what those who practice qualitative research in education have in common are the following:

1. Their data is descriptive (e.g. field notes, interview transcripts).
2. Their analysis is inductive (the questions and focus are not predetermined but evolve as the data are collected).
3. Their data are typically collected in natural settings, in classrooms, and in other places teachers and students spend their time. They try to conduct interviews on location and in a conversational style.
4. Their data are not reduced to numbers and they do not employ advanced statistical procedures. During data analysis some qualitative researchers use frequency counts and other simple quantitative procedures, but, for the most part, their reports are descriptive and conceptual.
5. Their goal is to understand basic social processes (e.g. how children play and learn in a group) and in developing insights in the form of sensitizing concepts. In addition they try to grasp the view of the world from the point of view of the participants (the

teachers, students and others related to the classroom). Their concern is not with prediction and the relationship between discrete variables.

IS IT A QUALITATIVE STUDY?

The example of the doctoral student collecting data for her dissertation is an exemplar of qualitative research of classroom learning. Her study contains all of the elements of this kind of research. Not all studies that people refer to as qualitative research incorporate all of these characteristics however. For example, some researchers might start with stated questions, others may emphasize interviews with teachers thereby straying from observations in the classroom. Whether a particular study is called qualitative is a judgment regarding the degree it contains the above elements rather than whether it meets all the criteria. As discussed below, researchers have different ideas about where to draw the line. Thus some researchers call what they do qualitative research, whereas others would not.

Terms previously used and currently associated with this form of research include: fieldwork, naturalistic, ethnographic, symbolic interaction, inner perspective, Chicago School, phenomenological, case study, interpretive, ethnomethodological, ecological and descriptive. These terms are not synonymous with qualitative research. Rather qualitative research is an umbrella for them all. The exact definition of each varies within particular research traditions and from user to user and from time to time. But each refers to approaches with many of the elements that are part of qualitative research as defined above.

EARLY HISTORY

Researchers employing the general approach described above have existed since the systematic inquiry began. Academic anthropologists and sociologists have used it since the late 1890s. Typically the former conducted studies in cultures other than their own, in so-called less developed or unindustrialized societies. Sociologists did similar work in Western countries. Although the approach was widely employed, the term *qualitative research* was not coined until the late 1960s. In 1967 scholars Barney Glaser and Anselm Strauss first used the phrase in the title of a book, *The Discovery of Grounded Theory: Strategies for Qualitative Research*. William Filstead followed in 1970 with his edited collection, *Qualitative Methodology*. In the late 1960s and early 70s some researchers, including those in education, began a dialogue about the approach outside the academic boundaries of anthropology and sociology.

HISTORY OF QUALITATIVE RESEARCH IN EDUCATION

Two of the earliest researchers to apply qualitative approaches to education in the United States were Mar-

garet Mead and Willard Waller. In the 1940s Mead, an anthropologist, used her fieldwork in less technically developed societies to reflect on the rapidly changing education system in the United States. She examined how what she called little red schoolhouses, city schools, and academies required particular kinds of interaction between teacher and student. She advocated that teachers use first-hand observation to study changes in schools and pupils as a way for them to become better teachers.

When Willard Waller published his work in the 1930s sociology was dominated by quantitative approaches. His book *Sociology of Teaching* (1932) relied on various kinds of descriptive data to analyze the social world of teachers and their students. He saw schools as people tied together in a complex maze of social interconnections. His book was designed to help teachers develop insight into the social nature of school life as a way of facilitating learning in the classroom.

In 1951 Howard Becker, a sociologist who would become very influential in the development of qualitative approaches to research, wrote his dissertation on the careers of Chicago school teacher and social-class variation in teacher-pupil relations. He used qualitative interviews to collect his data. Becker went on to launch a series of qualitative research studies on various aspects of education and encouraged a number of graduate students to follow his lead.

COMING OF AGE

Few important qualitative studies in education appeared prior to the 1960s. Quantitative methods continued to dominate research about schools and classrooms. Change began in the sixties as qualitative research began finding a small but enthusiastic following. During this decade the nation began focusing on educational problems, especially de facto segregation and the underachievement of minority students in the classroom. Civil rights leaders and other concerned citizens demanded that people take into account what teaching and learning was actually like in the classroom. Popular journalistic accounts of school life and autobiographical writings by teachers which documented the lack of learning in ghetto schools grabbed the attention of the public. In 1968 Jonathan Kozol's *Death at an Early Age: The Destruction of the Hearts and Minds of Negro Children in the Boston Public Schools*, his poignant account of his first year of teaching in a ghetto school in Boston, won a National Book Award. People wanted to know more about what was actually going on in schools.

Educational researchers began practicing qualitative strategies themselves in the 1960s rather than depending upon sociologists and anthropologists. Federal agencies began to see the promise in this research approach and

started to fund qualitative research. A number of these studies addressed inequality in schools. In 1963 Project True at Hunter College in New York City relied on interviews to examine the experiences of new teachers in urban schools and school integration (Eddy, 1967; Fuchs, 1969). Other researchers recognized that education had failed poor children and that this chronic problem needed to be studied in new ways. Eleanor Leacock focused her influential inquiry on the effect of school authorities on student behavior and learning. Jules Henry studied racism in elementary schools in St. Louis. It was through this project that Ray Rist, an important practitioner of qualitative research, started his career. His book, *Urban School: Factory for Failure*, a systematic observational study of learning in one classroom, was widely read by policymakers and researchers alike.

EMERGENCE OF THE FIELD OF QUALITATIVE RESEARCH

The 1960s were both the launching period of qualitative studies and the time that qualitative research emerged as a field. Prior to the 1960s courses in qualitative research were uncommon. Instruction in the method was mainly in anthropology and sociology through apprenticeships with professors engaged in research projects. A well-developed literature on the theories underlying the method and how to do it had not developed. In the late 1960s and early 1970s such a literature began to emerge and courses began to be offered. In 1966 Severyn Bruyn published *The Human Perspective in Sociology*, a comprehensive theoretical methodological treatise on the qualitative tradition. His book was followed by Glaser and Strauss's *Discovery of Grounded Theory: Strategies for Qualitative Research*, which for the first time presented the logic behind qualitative analysis. In 1971 Rosalie Wax published one of the first qualitative methods books, *Doing Fieldwork: Warning and Advice*. The literature grew. The early 1970s also saw courses in the approach being offered for the first time. Additionally, a literature began appearing in education and in other professional schools that addressed the research dilemmas inherent in classrooms and in other places where human service professionals practiced their trade.

The 1970s and 1980s saw qualitative research flower in education. Not only did well established educational research journals start regularly publishing articles that employed qualitative research, but also new journals favoring the approach first appeared. Book publishers welcomed titles on qualitative research and special sessions at meetings of professional educational researchers were devoted to the subject. Organizations emphasizing the qualitative approach arose and conferences devoted

to the approach became regular features of educational researchers' calendars.

CONFLICT AND DEBATE

Not all educational researchers embraced qualitative research during the 1970s and 1980s, however. Some professors and other researchers who were trained in quantitative approaches applied their method's criteria for good research to the encroaching approach and found it wanting. They resisted the movement, opposed its widespread use, and were skeptical about its contribution. The 1970s and 1980s became a time at least at some universities and within some professional groups of debate and conflict. Although a number of researchers trained in the quantitative tradition began integrating the qualitative approach into their work, others regarded the different methods as competing and in some universities became identified as being in one camp or another qualitative verses quantitative. By the end of the 1980s, doctoral students trained with broader ideas about research began entering the field of educational research and staunch detractors of the qualitative approach began to mellow. By this time there was an armistice of sorts with some researchers preferring one approach over the other and others attempting to integrate the two. Still others switched back and forth, choosing to adjust their approaches to the problems at hand.

ADDITIONAL ISSUES AND DEBATES

Although by the late 1980s and early 1990s the qualitative/quantitative debate had subsided, the qualitative researcher faced other issues and changes that continued being reformulated each decade. Some researchers trained in quantitative approaches who became practitioners of qualitative research as well as qualitative researchers responding to critics who wanted more structure in their research developed more rigid research designs. Authors such as Miles and Huberman advocated formal data collection protocols and standardized data analysis procedures in their work. They championed the development and use of computer software programs to do more thorough and systematic data analysis. Not all qualitative researchers were comfortable with these efforts and charged that such formalization of the method robbed it of its strengths, the discovery of new ways of thinking.

While some qualitative researchers moved toward more structure and accountability another group of scholars went in the opposite direction. People traditionally associated with the humanities (i.e., historical, literary, and philosophical scholars) began to embrace the label of qualitative research. A number of influential books such as James Clifford and George Marcus's *Writing Culture: The Poetics and Politics of Ethnography* and

J. Van Maanen's *Tales of the Field: On Writing Ethnography*, discussed the interpretive nature of qualitative research and how its writing was a product of the author's predispositions and characteristics. Rather than trying to control the author's predilections, a new brand of scholars embraced their own point of view and abandoned the goal of objectivity. They tended to de-emphasize rigorous data collection and concerned themselves less with the empirical world than did more traditional qualitative researchers. In addition to welcoming the humanities into the realm of qualitative research, some qualitative researchers embraced feminist, post-structural, conflict, and critical theory for the underpinnings of their work. Some more traditional qualitative researchers joined their ranks. This group of researchers became much more theory driven than traditional qualitative researchers had been. They also became less data based.

Thus starting in the early 1990s and continuing into the 21st century, qualitative research was pulled in many directions, some of them antagonistic. These movements led some to question whether the term qualitative research had expanded so much that the phrase had lost its meaning. While some cheered the expansion of the field, others thought that qualitative research should return to the basics, to just the elements included in the definition provided above in this entry.

STRENGTHS AND WEAKNESSES

Although general acceptance of qualitative research as defined here exists, some in the field of education continued to express concerns about its use. Qualitative researchers and skeptics would agree that one drawback of the approach is the time it takes to do a good study. Qualitative research is labor intensive; it takes hundreds of hours in the field to collect the data, and data analysis is complex and vexing.

More serious concerns among critics involve the topics of researcher bias and the generalizability of qualitative findings. Qualitative researchers use less standardized instruments and codified procedures than do quantitative researchers. The former approach resembles a craft in which the outcomes are dependent on the skills of the researcher to establish rapport, collect, and then analyze descriptive data. Researchers vary considerably in their talent, interests, points of view, and political disposition. In addition, few external checks on the researcher's data collection and analysis procedures exist. The descriptive data do not readily lend themselves to outside review. Because the data are filtered through the human instrument critics argue that the approach is wrought with observer effect and so its integrity is undermined.

Since most qualitative research involves small samples or studies of one particular classroom or school,

critics question whether what is found can be generalized. They point out, for example, that third grade classes vary so much from place to place and time to time, what is found in a case study of one class tells people little about other classrooms. They point to the danger of thinking that because a person knows one third grade well that person understands third grade classes in general.

Sufficient room is not present here to detail how advocates of qualitative research respond to questions of researcher bias and generalizability. Qualitative researchers acknowledge the unstructured nature of the inquiry and the influence the researcher might have on the outcome. In addressing bias, some point to the careful procedures they have built into the various stages of their research projects. As already indicated, some qualitative researchers, to the consternation of others, have attempted to become even more systematic and formal in their approach, thereby abandoning the evolving design that is characteristic of traditional qualitative studies. Others say the bias that critics are concerned with is overstated. After all, they say, just because other forms of research use instruments and more formal procedures does not mean that the researcher's point of view is not built into the researcher's studies. Further, they point out, in most qualitative studies the researcher carefully states his or her perspective and the concerns that drove the project, a practice that quantitative researchers do not follow.

How do qualitative researchers address the criticism that their findings are idiosyncratic and cannot be generalized? They take the position that critics do not understand the basic premise and logic of the approach. Rather than carrying out rigorous sampling, testing hypotheses, and coming up with a precise list of facts and findings that can be applied across settings and populations, qualitative researchers concern themselves with the dynamics of basic social processes and are interested in developing sensitizing concepts and grounded theory. They believe that behavior is not random and idiosyncratic. If they discover a process or develop a concept in one setting it has to exist in other places. They do not assume that it occurs in all places, for example, called third grade classrooms. Part of the analysis is speculating about other settings in which their findings might apply. Further, they say that if people are interested in generalizability as traditionally defined, it can be checked by additional studies.

Qualitative research comes in many forms and is widely practiced as a part of educational research. Once new and controversial, it has become a regular part of the curriculum for those studying for advanced degrees in education. While it will never replace quantitative approaches, it contributes a different kind of information and understanding to what researchers know about learning in the classroom.

SEE ALSO *Research Methods: An Overview*.

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Robert Bogdan

QUASIEXPERIMENTAL RESEARCH

There are two general categories of experimental research—true experimental design and quasiexperimental design (Gribbons & Herman, 1997). The word “quasi” in Latin means *as if* or *almost*. Considering this, quasiexperimental research could be described as a best attempt at an experiment when it is impossible, or not reasonable, to meet all the criteria of a true experiment. This type of research is typically identified as being void of randomization of either subjects or treatment and/or the lack of comparison groups. Yet, there is still an attempt to isolate the treatment. As an overarching

goal, the body of quasiexperimental research attempts to answer questions such as: “Does a treatment or intervention have an impact?” and “What is the relationship between program practices and outcomes?” (Dimsdale and Kutner, 2004).

True experiments are ideal when it comes to being able to isolate any type of statistical relationship, with the potential to infer causality. Even so, prior to designing an experiment, it is necessary to consider a few key elements. Can the individuals and/or other elements in your study be precisely classified? Can you select random individuals or other elements in your study? Is the process of randomization fair to all involved in the study? Should the answer be “no” to any of these questions, quasiexperimental designs then surface. Educational research, and the techniques or interventions that are introduced, seem relatively harmless to the general eye; thus, many researchers continue to emphasize true experiments (Kidder, 1981). It is never so simple; however, as effectiveness, efficiency, and feasibility also need to be considered. There are other ethical considerations as well. If there is any risk of harm from delivering or withholding services to someone in the sample, then an experimental design cannot be employed. For these reasons, in fields such as education, psychology, and criminal justice, quasiexperimental research is often utilized. As a whole, the research community tends to support the use of and recognize the utility of quasiexperimental research (Campbell & Stanley, 1963; Cook & Campbell, 1979).

A COMPARISON TO EXPERIMENTAL RESEARCH

Quasiexperimental research and experimental research both attempt to create a design scheme in which the concluded results can be thought of as the best, most logical solution to the question at hand. Quasiexperimental designs tend to do this through a comparison of existing groups. Experimental designs accomplish the same goal through random assignment of individuals to interventions or treatments (Michigan State University, College of Education, 2004).

Experiments, especially large-scale, are designed to control for the influences of extraneous variables. The goal is to allow for a maximum level of certainty regarding the impact of an intervention. Specifically, experimental designs must have random selection of subject, use of control groups, random assignments of individuals to the control and experimental groups, and random assignment of groups to the intervention (Henrichsen, Smith & Baker, 1997). The strongest comparisons are made through the ability to conduct a true experiment (Gribbons & Herman, 1997). To this extent, quasiexperimental designs attempt to rule out unrelated explanations so that

the outcome can be attributed only to the experimental intervention. The task is not as straightforward, but through efforts such as matching subjects and statistical analysis, the true experiment is mimicked (Morgan, Gliner & Harmon, 2000; SERVE Center, 2007). Specifically, *trend* replaces the word *cause* in quasiexperimental research. The goal of quasiexperimental research is to discover the one trend that is a result of the treatment or intervention. Clearly, this is not a simple or direct task and error exists in that process.

The data collection and analyses are a point of overlap and a point of distinction between experimental and quasiexperimental research. While standardized assessments are utilized in both approaches, they are the singular mechanism to the experimental design. In contrast, quasiexperimental design also utilizes such means as surveys, interviews, and observations. The statistical techniques also have the same appearance, clean and simple. In contrast, quasiexperimental research uses an array of analysis techniques including the t-test, but also extending to correlation, regression, and factor analysis (Dimsdale & Kutner, 2004).

Quasiexperimental designs are typically employed if random assignment is not practical, or even impossible. Without randomization, typical issues surface. Even with a comparison group, the concern surfaces of how alike the groups are from the onset. Also, with the loss of control in quasiexperimental designs, it is of concern whether both groups are in some manner exposed to the intervention, intentionally or not. Nonetheless, the biggest weakness of quasiexperimental designs may also indicate the greatest strength—a broader scope of the research design. The controlled, randomized design of true experiments typically lends itself to a very limited, narrow view of the topic of interest (Gribbons & Herman, 1997). In all cases, when human subjects are involved, there is never a 100% guarantee that the results of an intervention can be completely attributed to the intervention itself, with no regard for the opinions and practice of the individuals involved. Simply stated, true experiments work well in laboratory settings. Quasiexperiments work well in natural settings (Schoenfeld, 2006).

EXAMPLES OF QUASIEXPERIMENTAL RESEARCH

Quasiexperimental research is designed with the intent to be as much like a true experiment as possible. The two traditional platforms are: (1) matching studies, in which participants are compared with individuals that are comparable on variables of interest that do not receive the intervention; and (2) interrupted time series, in which observations made prior to an intervention are compared

again and additional observations are made after the intervention has happened. These types of studies present themselves in various formats (Prater, 1983).

The general goal of quasiexperimental research is to investigate cause and effect relationships. This approach to research allows for greater understanding of program features and practices. Because there is a loss of control in the quasiexperimental design, it is necessary for the researcher to decide what and when to measure (Dawson, 1997). What follows is a sample outline of designs. An *X* represents the group being exposed to a treatment or intervention. An *O* represents an observation or measurement. Temporal order of events is designated from left to right. The dotted line in each design is an indication of the lack of random assignment of subjects to the groups (Prater, 1983).

One-group posttest design

X O

The One-Group Posttest Design is a one-shot case study. It simply has a treatment, *X*, and posttest, *O* with no control group. This design is best implemented as an evaluation model. It should be used only when there is no available comparison group or pretest data.

Static-group comparison design

X O

 O

In the Static-Group Comparison Design, a pre-test, *X*, is given to only one group, while the post-test, *O*, is given to both the control and experimental group. This design is comparable to the One-Group Posttest Design, with the addition of a control group for comparison purposes. No randomization is present, instead two groups are arbitrarily selected, and one is labeled as experimental and the other control.

Nonequivalent control-group design

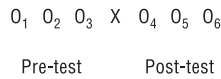
O₁ X O₂

O₂ O₂

The most common quasiexperimental design is the Nonequivalent Control-Group Design, illustrated above. The design includes at least an experimental and control group. It mirrors the Pretest-Posttest control group experimental design, but instead of randomization,

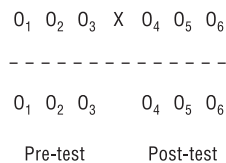
naturally occurring comparison groups are selected to be as alike as possible (Gribbons & Herman, 1997).

Time series design



With a Time Series Design, observations are taken (in this case three) to establish a baseline; a treatment then occurs, X , followed by additional observations being made. From this, an estimate of the impact the treatment made is computed (Gribbons & Herman, 1997; Morgan, Gliner & Harmon, 2000). The design can be employed to establish a baseline measure, describe a change over time or to keep track of trends. Data are almost always presented in a graph.

Multiple time series design



The Multiple Time Series Design is simply an extension of the Time Series Design with the addition of a comparison group. It attempts to model what would have happened to the experimental group if the treatment or intervention had not taken place. The addition of the control adds credibility, even without randomization.

Equivalent materials design



In the Equivalent Materials Design, different, equivalent materials are represented throughout with $M_{a,b,c,d}$. The treatments and repeats of treatments, $X_{0,1}$, are applied and then observed. In addition to the aforementioned designs, there are elaborate extensions, such as the Latin-square Design (Fortune & Hutson, 1984).

ROLE OF QUASIEXPERIMENTAL RESEARCH IN EDUCATIONAL RESEARCH

It was not until the late 1900s that educational reform gave credence to research. Prior to that, untested interventions and innovations were commonplace. The U.S. government has come to demand a research base, as demonstrated by the Comprehensive School Reform Demonstration legislation of 1997 and the No Child Left Behind Act. In both

cases, the emphasis is in the application of experimental or quasiexperimental research (Slavin, 2003).

Campbell and Stanley (1963) speak to traditional experimental and quasiexperimental methods. Cook and Campbell (1979) continued to explore these methods, building upon early investigations of validity. In 1993 Parker reviewed and synthesized both the works and further added to the mound of threats to validity. At the turn of the century, various authors were continuing to write about the issue of what constitutes an experimental design and the issues associated with a less than perfect experiment. The presence of true experimental designs in educational research has not been prevalent over time largely due to methodological constraints and on some accounts, more logistical issues like money and time. It is frequently not practical to randomly assign individuals to control and experimental groups, like in a clinical setting where groups are already intact (Dimsdale & Kutner, 2004; Heppner, Kivlighan & Wampold, 1992). Quasiexperimental designs offer a plausible solution to these dilemmas.

Other issues that typically surface in educational research include, but are not limited to, confounding and the assumption of independence. Independence states that the measure for an individual is independent of the measures of other individuals. Randomization of subjects is the only way to insure this. Confounding is another concern. When a variable in a research design is not controlled, but should be, it is identified as a confounding factor. Given that confounding cannot be dealt with in terms of statistical notions alone, quasiexperimental designs, and for the most part educational research as a whole, always have this as a limitation (Pearl, 2000).

If evidence-based school reform continues to be the golden standard, quasiexperimental research will play an instrumental role. Quasiexperimental research, and the scientifically based results that go along with it, can provide the educational community with a variety of models that have been shown to be effective. Reading First and other similar initiatives have created evidence-based reform that can be sustained. Because of this, it is plausible that the rigor associated with quasiexperimental designs will become commonplace (Slavin, 2003; U.S. Department of Education, 1998; U.S. Department of Education, 2002).

ANALYTIC APPLICATIONS APPLIED IN QUASIEXPERIMENTAL RESEARCH

Valentin (1997) made a claim that with an understanding of eight statistical procedures, it is reasonable to have an understanding of 90% of quantitative research. Experimental designs lend themselves to straightforward, often simpler, statistical analysis than quasiexperimental designs. Advanced statistical procedures are typically

necessary in quasiexperimental research, largely due to the lack of randomization (Dimsdale & Kutner, 2004).

Two specific examples include multiple regression analysis and factor analysis. *Multiple regression analysis* is a statistical application that is utilized in studies in which impact is being measured. Using statistical methods, a control group is simulated, and multiple adjustments can be made for outside factors. Thus, the control that is in the design of an experiment is inserted through analytical techniques (SERVE Center, 2007). *Factor analysis* is a useful technique when a study has a large number of variables. This statistical application allows for a reduction in the number of variables while detecting possible relationships between those variables of interest (Dimsdale & Kutner, 2004). It is commonly applied when data is collected through a survey, especially when the survey contains a large number of items. *Analysis of covariance* (ANCOVA) is yet another analytical technique employed to increase the strength of the quasiexperimental design. By making compensating adjustments, ANCOVA reduces the effects of the initial differences between groups. This again is an attempt to respond to the lack of randomization.

STRENGTHS AND WEAKNESS OF QUASIEXPERIMENTAL RESEARCH

When considering what type of design to employ in a study, it is important to consider both validity and practicality. In general, quasiexperimental research is more feasible, given the typical time and logistical constraints. At the surface level, an easily identifiable weakness of employing quasiexperimental research, in contrast to a true experiment, is the lack of random assignment. Without random assignment, internal validity is reduced, and causal claims become quite difficult to make (Prater, 1983).

On the other side, quasiexperimental designs tend to present the situation under investigation in real-world conditions, increasing the external validity. Typically, quasiexperimental designs are pre-existing constructions. Because of this, fewer variables are able to be controlled; yet another factor limiting the ability to make causal claims (Henrichsen, Smith & Baker, 1997).

With the implementation of the No Child Left Behind statute, educational research put forth an agenda of scientifically based research. Shavelson and Towne (2002) outline criteria necessary for a scientific study, which include: direct, empirical investigation of an important question; consideration for the context in which the study took place; alignment with a conceptual framework; careful and thorough reasoning; and disclosure of results. Quasiexperimental research makes the

mark by meeting each criterion listed. While the controlled, experimental design is the ideal, at least statistically, when an experiment is not possible or practical, the best approach is to identify and eliminate threats to validity through the implementation of a quasiexperimental approach (Borg & Gall, 1989).

SEE ALSO *Research Methods: An Overview.*

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Kelly D. Bradley

QUESTIONING

Questioning consumes a considerable proportion of time in classrooms. It occurs most often within recitations, characterized by the initiate-respond-evaluate (IRE) pattern of discourse, as well as in more open-ended discussions. Interest in questioning as an instructional tool can be traced back to the fourth century BCE as evidenced in the Socratic dialogues recorded by Plato (424/423–348/347 BCE). In the 21st century, teachers use questions to manage student behavior and classroom activities, to promote students' inquiry and thinking, and to assess students' knowledge or understanding. The focus of this entry is predominantly on teachers and students' use of questions as a tool to promote inquiry, thinking, and ultimately learning.

RESEARCH STRANDS AND CURRENTS

The research on questioning is considerable both in volume and topics investigated. Research on questioning has investigated the incidence and types of questions teachers ask (e.g., Guszak, 1967); the sources of teacher questions (e.g., Shake & Allington, 1985); the effect of teacher questions as compared to other instructional methods (e.g., Gall, Ward, Berliner, Cahen, Winne, Elashoff, & Stanton, 1978); the effects of different types of questions (e.g., Wright & Nuthall, 1970); the effects of waiting for students to respond after asking questions (e.g., Rowe, 1986; see also Tobin, 1987); training teachers to use certain types of questions (e.g., Galassi, Gall, Dunning, & Banks, 1974); teaching students how to answer questions (e.g., Raphael & Wonnacott, 1985); teaching students to generate their own questions (e.g., Commeyras & Sumner, 1998), and the psychology of question asking and answering (e.g., Graesser & Black, 1985). Table 1 lists the major reviews of this research.

Two trends are apparent in the research. One is movement from a focus on questions as isolated events

to a focus on questions embedded within larger spatial and temporal contexts, including the contexts created by the ongoing classroom discourse. Up until the early 1980s, researchers classified and counted teacher questions and attempted to relate the frequencies of different types of questions to student achievement. Researchers employed correlational studies that capitalized on existing variation in teacher questioning behavior or experimental studies in which they manipulated teachers' use of questions (see Brophy & Good, 1986). In the late 1980s and 1990s, researchers examined questions as "sites of interaction" (Nystrand, 1997) and their relationship to student learning. These sites of interaction included the question asked, students' responses to the question, the teacher's valuation or follow-up to students' responses, and even the genre of the entire classroom discourse. Researchers also developed questioning routines to help students talk and think together in cooperative or collaborative learning environments. These routines included *Reciprocal Teaching* (Palincsar & Brown, 1984), *Questioning the Author* (Beck, McKeown, Hamilton, & Kucan, 1997), and various methods of structuring discourse to promote learning among peers (King, 1999).

This trend was motivated by research in sociolinguistics and language acquisition that highlighted the distinction between language form and communicative function, showing that the meaning of a question depended on its context of use. This context includes not only the situational context but also the contexts created by speakers in the give and take of discussion. From a sociolinguistic perspective, teacher questions are mutually constructed by teachers and students (Carlsen, 1991). Hence, the cognitive impact of questions depends on their placement within the larger discourse, the backgrounds of the students, relations among teachers and students, and other factors. (Cazden, 2001).

Another trend apparent in the research is movement from a focus on teacher-generated questions to a focus on student-generated questions. This trend is apparent in the research on questioning routines embedded in cooperative or collaborative learning environments mentioned earlier. It can also be seen in research on the K-W-L technique developed by Ogle (1986), a technique that requires students to ask themselves questions to promote comprehension of expository texts ("What do I Know about the text?" "What do I Want to learn from the text?" "What did I Learn from the text?"). It is also evident in research by Commeyras (1995; Commeyras & Sumner, 1998) on the benefits of giving students responsibility for posing their own questions for discussion in response to literature. Wong (1985) reviewed 27 studies of student question generating and found positive

Chronological list of major reviews of questioning research

Year	Review
1970	Gall, M.D.(1970).The use of questions in teaching. <i>Review of Educational Research</i> 40, 707-721.
1971	Rosenshine, B. (1971). <i>Teaching behaviors and student achievement</i> . Windsor: NFER/Nelson.
1974	Dunkin, M. J., & Biddle, B. J. (1974). <i>The study of teaching</i> . NY: Holt, Rinehart and Winston.
1976	Rosenshine, B. (1976). Classroom instruction. In N. L. Gage (Ed.), <i>The psychology of teaching methods</i> (The Seventy-Fifth Year book of the National Society for the Study of Education, Part I, pp.335-371). Chicago: University of Chicago Press.
1979	Winne, P. H. (1979). Experiments relating teachers' use of higher cognitive questions to student achievement. <i>Review of Educational Research</i> , 49, 13-49.
1981	Redfield, D. L., & Rousseau, E. W. (1981). A meta-analysis of experimental research on teacher questioning behavior. <i>Review of Educational Research</i> , 51, 237-245.
1982	Dillon, J. T. (1982). The multi disciplinary study of questioning. <i>Journal of Educational Psychology</i> 74(2), 147-165.
1984	Dillon, J. T. (1984). Research on questioning and discussion. <i>Educational Leadership</i> , 42, 50-56.
1984	Gall, M. (1984). Synthesis of research on teachers' questioning. <i>Educational Leadership</i> , 42, 40-47
1985	Wong, B. Y. (1985). Self-questioning instructional research: A review. <i>Review of Educational Research</i> , 55, 227-268.
1986	Brophy, J., & Good, T. L. (1986). Teacher behavior and student achievement. In M. C. Wittrock (Ed.), <i>Handbook of Research on Teaching</i> (3rd ed., pp. 328-375). New York: Macmillan.
1986	Wilén, W. W. & Clegg, A. A. (1986). Effective questions and questioning: A research review. <i>Theory and Research in Social Education</i> , 14, 153-161.
1987	Doenau, S. J. (1987). Soliciting. In M. J. Dunkin (Ed.), <i>The international encyclopedia of teaching and teacher education</i> (pp. 407-413). Oxford, England: Pergamon.
1987	Gall, M. D. & Rhody, T. (1987). Review of research on questioning techniques. In W. W. Wilén (Ed.), <i>Questions, questioning techniques, and effective teaching</i> . Washington, DC: National Education Association.
1987	Samson, G. E., Strykowski, B., Weinstein, T., & Walberg, H. J. (1987). The effects of teacher questioning levels on student achievement: A quantitative synthesis. <i>Journal of Educational Research</i> , 80, 290-295.
1988	Wong, B. (1988). Self-questioning strategy training: From theory to practice. <i>Australian Journal of Reading</i> , 11, 246-256.
1991	Carlsen, W. S. (1991). Questioning in classrooms: A sociolinguistic perspective. <i>Review of Educational Research</i> , 61, 157-178.
1991	Wilén, W. W. (1991). <i>Questioning skills for teachers: What research says to the teacher</i> . Washington, D. C., National Education Association.
1995	Gall, M. D., & Artero-Boname, M. (1995). Questioning. In L. W. Anderson (Ed.), <i>The international encyclopedia of teaching and teacher education</i> (pp. 242-248). Oxford, England: Pergamon.
1996	Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching students to generate questions: A review of the intervention studies. <i>Review of Educational Research</i> , 66, 181-221.
2006	Gayle, B. M., Preiss, R. W., & Allen, M. (2006). How effective are teacher-initiated classroom questions in enhancing student learning? In B. M. Gayle, R. W. Preiss, N. Burrell & M. Allen (Eds.). <i>Classroom communication and instructional processes: Advances through meta-analysis</i> (pp. 279-293). Mahwah, NJ: Erlbaum.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

effects on students' reading comprehension in the majority of studies. Rosenshine, Meister, and Chapman (1996) conducted a meta-analysis of 26 studies of student questioning and also found positive effects on students' comprehension.

QUESTIONS THAT VARY BY COGNITIVE DEMAND

Questions are typically classified by the nature of the cognitive demand they are presumed to make on students. Most classifications define cognitive demand in terms of Bloom's 1956 taxonomy of learning or some variant of it. Bloom defined learning in terms of six levels of increasingly complex requirements: knowledge, comprehension, application, analysis, synthesis, and evaluation. Lower-order questions are presumed to elicit a student's knowledge and comprehension of a topic or text; higher-order questions are presumed to elicit a student's application, analysis, synthesis, or evaluation of a topic or text.

A related framework often used in research in reading and the teaching of reading is Pearson and Johnson's

1978 taxonomy of questions or, more accurately, question-answer relations. This framework classifies questions according to source of information that must be used by the reader to generate a response: *textually explicit*, in which the information required for answering the question is stated explicitly in the text ("reading the lines"); *textually implicit*, in which the information required for answering the question is in the text but has to be inferred by integrating material from different parts of the text ("reading between the lines"); and *scriptally implicit*, in which the information required for answering the question involves the reader's store of prior knowledge ("reading beyond the lines").

Research in the United States as well as in other English-speaking countries has documented a higher incidence of lower-order than higher-order questions in classrooms for much of the 20th century. Stevens' 1912 study was possibly the first systematic study of teacher questioning in the United States. He observed teachers in 100 high-school classrooms in six subject areas and found that at least two-thirds of the questions teachers asked focused on recitation and memory of facts. Studies in

the 1970s and 1980s (e.g., Sirotnik, 1983) showed little change in the preponderance of lower-order over higher-order questions (see Klinzing & Klinzing-Eurich, 1988). Data collected by Nystrand in 1997 also suggest little change. Nystrand observed the instructional practices in 58 eighth-grade and 54 ninth-grade language arts and English classes in eight Midwestern communities in the United States. He reported that 64% of questions in the eighth-grade classes involved recitation and reporting of facts whereas only 36% involved high-level thinking (analysis, generalization, speculation). Results in the ninth-grade classes revealed a somewhat different picture with 54% of questions involving recitation and reporting.

Similar trends are evident in observational studies of reading instruction in elementary grades. Guszak's 1967 study examined the kinds of questions 12 teachers asked in selected second-, fourth-, and sixth-grade classrooms in Texas during reading group lessons. He found that 70% of questions were recognition or recall questions that focused on literal comprehension. O'Flahavan, Hartman, and Pearson (1988) conducted a replication and extension of Guszak's study, videotaping teacher-led reading groups and story discussions conducted by 15 teachers in grades 2, 4, and 6 in four schools in Illinois. Results showed a lower incidence of recognition and recall questions (43%). Overall, relative to Guszak's findings, they noted a shift from literal questions to more inferential questions. However, other studies conducted at the time continued to report a preponderance of lower-level, text-based questions in reading lessons (Gambrell, 1983; Shake & Allington, 1985; Weber & Shake, 1988). Observational studies by Taylor and Pearson (Taylor, Pearson, Clark, & Walpole, 1999, 2000; Taylor, Peterson, Pearson, & Rodriguez, 2002; Taylor, Pearson, Peterson, & Rodriguez, 2003, 2005) of reading instruction in grades 1 to 5 in a number of high-poverty schools in the United States have shown similar results. Across all grades, they observed a relatively small amount of higher-level questioning (e.g., only 16% of the teachers in grades 1 to 3 were frequently observed asking higher-level questions).

It is presumed that asking more higher-order questions contributes to greater gains in students' high-level thinking, learning, and achievement. This presumption has received only weak support. Rosenshine (1971, 1976) and Dunkin and Biddle (1974) conducted reviews of studies relating teacher questioning to student learning, many of which were correlational studies, and found that results were inconsistent (in some studies, even lower-order questions were found to be more effective). Winne (1979) reviewed 18 experimental and quasi-experimental studies on levels of teacher questioning and concluded that "whether teachers use predominantly higher cognitive

questions or predominantly fact questions makes little difference in student achievement" (p. 43). Redfield and Rousseau (1981) conducted a meta-analysis of 14 experiments, 13 of which overlapped with those reviewed by Winne, and found that a predominant use of higher cognitive questions had an overall positive effect on student achievement (mean effect size = 0.73). Samson, Strykowski, Weinstein, and Walberg (1987) conducted another meta-analysis of 14 experiments, most of which overlapped with those of the previous reviews, and obtained results more in tune with the earlier findings by Winne and others. Samson and colleagues reported only a small positive effects of higher cognitive questions on student achievement (median effects size = 0.13). Gall and Artero-Boname (1995) attributed the inconsistency in results to a number of factors, not the least of which was that the individual studies failed to take account of the larger instructional context in which questions occurred.

Other studies have attempted to examine the role of questions within the larger instructional context but have still not shown consistent results. Nystrand's 1997 large-scale correlational study showed no relationship between the cognitive level of questions and students' performance. Taylor and Pearson's series of correlational studies of reading instruction in high-poverty schools (Taylor et al., 1999, 2000; Taylor et al., 2002; Taylor et al., 2003, 2005) have shown more consistent relationships between higher-level questioning and students' growth in reading and writing. However, even in these studies, there were inconsistencies. In their 2005 study, they found that high-level questioning made a modest contribution to growth in students' reading fluency but had no relationship to growth in their comprehension or writing.

QUESTIONS THAT VARY BY EPISTEMIC ROLE

Another way of classifying questions is in terms of the epistemic role they afford students. Authenticity and "uptake" are key features in giving students a role in orchestrating their own learning. Questions that give students considerable control over their learning are "authentic questions" questions that the teacher is genuinely interested in exploring and that evoke a variety of responses from students (in other words, the answer is not prespecified). By contrast, questions that give students little to no control are known-answer questions (sometimes called "test questions") that allow only one possible right answer. Questions that incorporate responses from students, called uptake, offer another way of building on students' contributions and affording them a role in learning. This way of classifying questions

is not independent of the level of cognitive demand described earlier. Authentic questions are more likely to elicit application, analysis, synthesis, or evaluations of information; whereas known-answer questions are more likely to elicit recall or literal understanding.

Nystrand (1997) and Applebee, Langer, Nystrand, & Gamoran (2003) documented the incidence of authentic questions and uptake in large numbers of language arts and English classes in middle and high schools in various states in the United States. Nystrand's data showed that, in the eighth-grade classes, only 10% of teacher questions were authentic and only 11% exhibited uptake. In the ninth-grade classes, 27% of teacher questions were authentic and 26% exhibited uptake (Nystrand noted that much of the increase in the incidence of authentic questions in the ninth grade was due to the use of authentic questions about nonacademic topics). Applebee and colleagues' data for grades 7, 8, 10, and 11 showed that 19% of teacher questions were authentic and 31% exhibited uptake.

Nystrand's 1997 correlational analyses showed that, in eighth-grade classes, authentic questions and those exhibiting uptake were significantly related to students' learning. However, in ninth-grade classes, results showed that authentic questions were not related or were even negatively related to learning. Questions exhibiting uptake still showed a significant and positive contribution. Further analyses showed that authentic questions had a positive relation in high-track classes but a negative relation in low-track classes. This was because most of the authentic questions in high-track classes pertained to literature, whereas most in low-track questions were about topics not related to literature. Nystrand concluded that authentic questions do not invariably produce learning but they at least signal to students "that *their* ideas . . . are important and can provide opportunities for learning" (p. 90). The 2003 study by Applebee and colleagues largely confirmed the role of authentic questions and uptake, in combination with other discussion-based approaches to developing understanding, as contributors to student learning.

WHAT IS KNOWN AND NOT KNOWN ABOUT QUESTIONING

The considerable volume of research on questioning has shed light on a number of issues regarding questions as a tool for learning. It is known that the incidence of higher-order and authentic questions is low relative to lower-order and known-answer questions. It is known that waiting for students to respond to questions leads to enhanced quality of responses and improved student achievement. It is known that teachers can be taught to ask certain types of question, and that students can be

taught how to answer questions based on the relationship to the text. It is also known that promoting student-generated questions has positive effects on learning.

However, there are several enduring issues about which research is unclear. It is not known whether teacher questioning as an instructional tool is any better than other instructional methods. Indeed, there is research and argument that a number of alternatives to questioning (e.g., declarative statements) are associated with longer and more complex responses from students (Dillon, 1985; 1991). It is not known, with any reasonable surety, that asking higher-level questions contributes cognitive benefits for students. Asking higher-level questions seems to have at least a small positive effect on learning but the inconsistency in results on this issue remains an enigma. Asking authentic questions and questions that involve uptake has more reliable associations with student achievement, but only to the extent that they assign meaningful epistemic roles to students and little is known about the context and classroom culture that shape such conditions. These are questions about questions that are in need of exploring.

SEE ALSO *Bloom's Taxonomy; Discussion Methods.*

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R

READING, LEARNING AND TEACHING

SEE *Learning and Teaching Reading*.

REASONING

Reasoning has long been a topic of study in logic and philosophy. Logical philosophical approaches are typically concerned with formal and epistemic aspects of reasoning; describing normative models of sound or valid reasoning. However, philosopher David Hume (1711–1776), who produced some of the most influential work on inductive reasoning, recognized the limitations of purely logical accounts of reasoning and noted that psychological processes were vital to a full account of reasoning. Formal or logical approaches to reasoning specify the syntactic form of valid inferences (i.e., those that do not lead to logical contradictions). In contrast, psychological approaches to reasoning explain cognitive performance or how people actually reason. Inferences that are syntactically valid from a logical perspective may be practically uninformative. For example, given the premises (a) Jane is taller than Mary, and (b) Mary is taller than Jill, it would be logically valid to deduce the following inference: Jane is taller than Mary, and Mary is taller than Jill, and Jane is taller than Mary and Jill. However, people are unlikely to make this particular inference from the premises (a) and (b) because it is not parsimonious. Instead, people are far more likely to draw the logically valid and parsimonious conclusion that Jane is taller than Jill.

People's knowledge of the world places pragmatic constraints on how they reason (Brewer & Samarapungavan, 1991; Giere, 1988; Johnson-Laird, 2006; Cheng, 1997). Classical models of reasoning based on logic or the laws of statistics and probability assume an ideal reasoner, unconstrained by cognitive resources. However, Gigerenzer & Goldstein (1996) argue that people display bounded rationality. Their reasoning is constrained by a number of factors such as the limited capacity of working memory and their cognitive goals (they often reason to find an acceptable solution, not necessarily the “best” solution).

DEFINITION OF REASONING

From a psychological perspective, reasoning may be defined as the set of mental processes used to derive inferences or conclusions from premises. Reasoning helps to generate new knowledge and to organize existing knowledge, rendering it more usable for future mental work. Reasoning is therefore central to many forms of thought such as scientific, critical, and creative thinking, argumentation, problem solving, and decision making. Each of these more complex forms of thought can employ inductive, deductive, and abductive reasoning which are described below.

Induction. *Inductive reasoning* is ampliative; it generates new knowledge. Inductive reasoning supports inferences but does not guarantee that the inferences are true. Vickers (2006) characterizes inductive reasoning as “contingent” (i.e., dependent on past experiences and observations). There are many forms of inductive reasoning such as *enumerative induction* and *analogical reasoning*. The best known form is enumerative induction in which

the general properties of a class are inferred from a specific set of empirical observations. For example, upon observing that all the birds in the neighborhood have wings and fly, a person infers that all birds have wings and fly. Generalizations of this kind, though commonplace in human reasoning, are clearly fallible (ostriches and penguins are birds and have wings, but do not fly). The preceding example illustrates a general epistemic problem with inductive inferences, which philosophers refer to as the problem of underdetermination.

Analogical reasoning is another form of inductive reasoning that is important in generating new knowledge. Analogical reasoning involves the transfer of knowledge elements and relationships among knowledge elements (e.g., object properties and property relations such as correlated features) from a well-known domain, a “base,” to an unknown or partially known domain, a “target” (see Gentner, Holyoak, & Koikinov, 2001). For example, the analogy of a biological cell as a factory allows people to transfer knowledge about how a factory works (it has parts that are specialized to perform certain tasks and that operate together to maintain the functioning of the whole) to understand how a cell works. Analogical reasoning is often employed in instruction to help student understand new concepts by analogical transfer from more familiar concepts (Clement, 1993; Baker & Lawson, 2001; Thagard, 2006). Inductive reasoning presumes principles of regularity or continuity in the world that allow the drawing of inferences about new instances from past experience. Induction plays a role in concept formation and concept learning in every domain of knowledge from natural language to science.

Deduction. Deduction refers to processes of inference which guarantee logically valid conclusions from a set of premises. In other words, assuming that the premises are correct, the conclusions deduced from these premises must also be correct. Transitive inferences of the kind described earlier (Jane is taller than Mary; Mary is taller than Jill; therefore Jane is taller than Jill) are one form of deductive inference. Deduction is a constituent of many varieties of cognitive performance such as text comprehension, scientific and mathematical reasoning, and argumentation. Deduction also plays an important role in categorical reasoning. If, for example, scientists were to discover the remains of a hitherto unknown animal in permafrost, conduct DNA analysis on the remains and conclude that the animal was a mammal, they could then deduce that this previously unknown species had defining mammalian characteristics (e.g., it gave birth to its young and had body hair). One of the main cognitive functions of deductive reasoning is to organize knowledge in ways that allow one to derive parsimonious conclusions from sets of premises.

Abduction. The term *abduction* was coined by Charles Peirce (1839–1914) to refer to a third mode of inference that was distinct from induction and deduction and played a crucial role in scientific reasoning and discovery. Adductive reasoning is a form of reasoning in which individuals start by attending to a particular phenomenon and try to construct a hypothesis that best explains their observation. The process is often called inference to the best explanation (Lipton, 1961; Thagard & Shelley, 1997). Many causal inferences are abductive in nature.

An example of abductive reasoning would be an inquiry into a car crash in which investigators try to reconstruct what happened from forensic evidence (e.g., patterns of damage to a car and its surroundings, data from physiological and toxicological exams conducted on the driver and passengers). From the forensic data, they reconstruct the most plausible or likely explanation for the crash.

SCIENTIFIC REASONING

A classic model of scientific reasoning in philosophy is the hypothetico-deductive model developed by Karl Popper (1902–1994) (1959, 1972). This model posits that hypotheses are deduced from theory and empirically verified by conducting tests that attempt to falsify them. Hypotheses that withstand repeated attempts at falsification may be regarded as better corroborated by the existing evidence than those that do not. However, according to Popper (following Hume), no matter how often a hypothesis is corroborated by empirical evidence, there can be no certainty that it is true.

Post-Popperian scholarship suggests that scientific reasoning is multi-faceted and includes inductive, deductive, and abductive reasoning (Giere, 1988). It is perhaps most useful to think of scientific reasoning as an umbrella term that encompasses all forms of inference that further the generation, evaluation, and revision of scientific knowledge. One important source of scholarship on scientific reasoning comes from the area of science studies. Much of this research draws upon the methods and data of historical research to understand how science is done (Conant, 1957; Giere, 1988; Kuhn, 1962; Thagard, 1990). Such studies analyze archival data, including the laboratory notebooks, correspondence, and the publications of scientists. Dunbar, Giere, Knorr-Cetina, and Sahdra and Thagard have undertaken cognitive analyses of the research practices of working scientists. Naturalistic research has highlighted the role of interpretation in scientific reasoning. Laudan (1990) suggests that scientific judgments are often based on pragmatic criteria such as the compatibility of new ideas with those that are considered to be “well founded.”

VARIATIONS IN REASONING ACROSS DISCIPLINES

Naturalistic research suggests that reasoning within different disciplines and sub-disciplines is shaped by the specific conventions of disciplinary practice such as methodological conventions for collecting, analyzing, presenting, and evaluating data (Ericsson, Charness, Hoffman, & Feltovich, 2006; Giere, 1988; Thagard, 2003; Sahdra & Thagard, 2003). Deductive reasoning may play a greater role in disciplines or sub-disciplines with well-developed formal theories; for instance, certain areas of mathematics and physics. Inductive and abductive reasoning may play a greater role in contexts in which different causal patterns can result in similar outcomes (medical diagnosis) or where particular configurations of events are unique and unlikely to be repeated exactly (forensic science). For instance, Wineburg (1998, 1999) argues that history is a discipline with its own unique contextualized patterns of reasoning. It should be noted that most disciplines employ varied forms of reasoning. Although mathematics has historically been characterized as a deductive discipline (Kitcher, 1979; Netz, 2005; Russell, 1903), Kitcher (1985) and Lakatos (1976) suggest that inductive reasoning plays an important role in mathematical thinking.

DEVELOPMENT OF SCIENTIFIC REASONING

Research indicates that some aspects of reasoning develop early, even before the onset of formal schooling or instruction, and may be part of the basic cognitive machinery of humans. There is considerable evidence that people employ forms of inductive and abductive reasoning to construct concepts about the natural world spontaneously, even in the absence of formal instruction in science (Bailargeon, 2004; Carey, 1985; diSessa, 1993; Hatano & Inagaki, 2004; Vosniadou & Brewer, 1992). Young children can use prior knowledge of causal mechanisms to reason causally in new contexts and to make causal inferences. Brown's 1990 research shows that by the age of 3, children are able to use their causal knowledge about physical mechanisms to select tools of the right shape and material to help them retrieve a physical object. Given a set of tools of the same shape (rakes or hoes) but different materials, the children in Brown's experiments rejected non-rigid or "squishy" tools in favor of those that were made of rigid materials and would pick up the desired objects without bending or breaking.

Children can use category-based induction to infer new biological knowledge. Two-year-olds expect animals that belong to the same category or "kind" to have the same underlying properties (Gelman & Coley, 1991; Lawson & Kalish, 2006). Young children are also able

to use analogical reasoning to help them solve novel problems (Goswami, 1989; Holyoak, Junn, & Billman, 1984). Both adults and young children are able to induce causal structures from observed patterns of covariation in data (Cheng, 1997; Glymour, 2001; Sobel, Tenenbaum, & Gopnik, 2004). Preshcoolers can use Bayesian knowledge about causal patterns to infer causal structure from data in some circumstances. In experiments, children observe patterns of data in which an outcome *C* varies as two putative causes *A* and *B* are presented either individually or together. For example, they might observe that *A* alone is followed by *C*, and *A* and *B* together are followed by *C*, but *B* alone is not followed by *C*. Children ages 3 and 4 are able to infer from such patterns that only *A* and not *B* causes *C* (Sobel, Tenenbaum, & Gopnik, 2004; Schulz and Gopnik, 2004).

Certain aspects of reasoning develop late and may not be evident even in the thinking of college-educated adults in the absence of specific training. Research shows that complex forms of deductive reasoning such as syllogistic and conditional reasoning start to emerge in the late elementary school years and continue to develop through adolescence (Bara, Bucciarelli, & Johnson-Laird, 1995; Ward & Overton, 1990). One important psychological model of scientific reasoning is Klahr and Dunbar's model which characterizes scientific discovery as the search for hypotheses to account for patterns of relevant evidence. The model posits that during discovery, people simultaneously search in two related spaces, a "hypothesis space" and an "experiment space." When trying to account for patterns of data, people either invoke hypotheses from prior knowledge or induce them from the data. They then search for an experiment that can help them choose among rival hypotheses. The work of Klahr and his colleagues suggests that adolescents and adults have difficulty with the use of appropriate experimental design and evidence evaluation strategies. For instance, many people do not spontaneously employ a "control of variables" strategy in complex scientific discovery tasks where there are several potential causes that might influence an outcome (Chen & Klahr, 1999; Klahr, 2000).

On tasks that require the interpretation of covariation evidence (for instance, rates of illness among people who have eaten different combinations of foods) research shows that both children and adults often make unwarranted causal inferences from confounded experiments (Kuhn, 1989, 1991; Kuhn & Dean, 2004). Additionally, people reason differently about identical patterns of covariation evidence depending on whether the variables under consideration are believed to be causal or non-causal based on prior knowledge (Kuhn, 1991; Schauble, 1996). These findings parallel earlier work by Kahneman and Tversky (1979) on errors and biases in human reasoning which shows that given the same objective

probability data, people's reasoning about probable gains differed from their reasoning about probable losses. Kuhn & Dean (2004, 2005) argue that part of learning to reason scientifically is the ability to generate genuine scientific questions (ones to which the answer is not known) that can be fruitfully addressed by empirical evidence. They point out that in richer and more realistic knowledge building and evaluation contexts, there is considerable variability in reasoning both across individuals (for example, by age and expertise) and within individuals (for instance, across domains and tasks). Thus, one aspect of developing reasoning competence is the range of contexts to which different forms of reasoning can be successfully applied.

THE ROLE OF CONCEPTUAL KNOWLEDGE

As noted earlier, one factor that influences how people reason is the nature of the conceptual base from which they reason. People reason with and about concepts, and one problem in evaluating reasoning is that different individuals may interpret the same situation differently and bring different assumptions to bear in reasoning. Prior knowledge and belief facilitate reasoning in some contexts. The work of Brown (1990) shows that prior knowledge facilitates causal reasoning even in young children. Pragmatic knowledge improves deductive reasoning on conditional reasoning tasks (e.g., tasks of the logical form: If *P* then *Q*) for both children and adults (Cheng & Holyoak, 1985; Girotto, Light, & Colbourn, 1988). Samarapungavan (1992) has shown that elementary school children are able to reason scientifically in theory choice tasks if the competing theories are both plausible. For example, given two equally plausible theories, they prefer the theory that is consistent with the available empirical evidence. They also prefer theories that explain a wider range of data to narrower theories.

Prior knowledge and belief can also impede valid reasoning. For example, Kahneman and Tversky (1973) showed that people's predictions about the likelihood of future events were often based not on the actual (known) frequencies with which these events occurred in a target population (the "base rate") but on other heuristics such as how easily an example of the event came to mind (availability). In the context of scientific investigation tasks, differences in conceptual models lead people to adopt different strategies of investigation and evidence interpretation. When investigating electricity in a simulated microworld (a computer-based dynamic system that simulates how electricity works) called *Votlerville*, college students with more sophisticated initial causal models of electricity learned more than students with less sophisticated models because they used more fruitful investiga-

tive strategies and engaged in better reasoning (Schauble, Glaser, Raghavan, & Reiner, 1992).

SOCIOCULTURAL FACTORS IN REASONING

In contrast to traditional psychological approaches which focus on individual reasoning, sociocultural theories emphasize the socially shared or co-constructed aspects of reasoning (Boyd & Richerson, 2005; Bruner, 1966; Latour & Woolgar, 1986; Knorr-Cetina, 1999; Rogoff, 1990; Vygotsky, 1978). Jean Piaget (1896-1980) (1945) believed that encountering beliefs and opinions that countered one's own in the course of social interaction provided a powerful form of cognitive challenge which impelled a person to reason. The science studies research discussed above illustrates how sociocultural contexts and practices shape and support scientific reasoning in a variety of ways. Individuals learn prototypical forms or patterns of reasoning as they are acculturated into the practices of their discipline. For instance, social scientists become adept in the use of statistical models for reasoning about patterns of evidence. Giere (1988) and Knorr-Cetina (1989) have noted the role of peer discourse, both formal and informal (e.g., peer review, research group discussions), in shaping the reasoning and knowledge of scientists engaged in discovery. Expert reasoning is supported by cultural tools such as charts, laboratory notebooks, and computer programs for statistical analysis or data modeling (Latour, 1990). Such inscriptional tools allow users to externalize and share both the processes and products of reasoning and reduce cognitive load during complex tasks. For example, using computer programs such as SAS to perform multivariate regression reduces the computational burden of reasoning about covariation evidence with large data sets.

INSTRUCTIONAL STRATEGIES

Can good reasoning be developed through instruction? The research suggests that a variety of instructional approaches and strategies can support the development of reasoning in students. In some circumstances, explicit instruction and modeling can help students acquire patterns of reasoning that they are unfamiliar with (Nisbett, Fong, Lehman, & Cheng, 1987). Students who are explicitly taught to use a "control of variables" strategy on scientific reasoning and discovery tasks are more likely to transfer and use this strategy in novel reasoning contexts than students who receive no explicit instruction and are left to discover the strategy on their own (Klahr & Nigam, 2004).

Instructional scaffolding can be used to support and enhance students' reasoning. Adult support and guidance in the form of hints, questions, and prompts during classroom discourse can help students gain awareness and

control over their reasoning (Hogan, Nastasi, & Pressley, 2000; Gleason & Schauble, 1999). Cultural tools (especially computer technology) can be used to enhance student thinking and reasoning in the classroom (Polman & Pea, 2001; Roschelle, Pea, Hoadley, & Gordin, 2000).

In addition to specific strategies to foster reasoning, many educators have discussed the general characteristics of learning environments that support habits of thought and reasoning. These include the use of knowledge-rich, challenging, and open-ended instructional tasks, such as those used in project-based, problem-based, and inquiry learning, that provide the students with affordances to reason (Barron, Schwartz, Vye, & Moore, 1998; Chinn & Malhotra, 2001; Duschl, 2000; Haskill, 2001, Hammer & Elby, 2002; Magnusson, & Palinscar, 1995; Penner, Lehrer, & Schauble, 1998). More generally, fostering a culture of communication in which children are encouraged to talk to one another, argue about ideas, explain concepts, and share their discoveries supports the development of reasoning (Bruner, 1996; Polman & Pea, 2001; Roth, 2005).

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Ala Samarapungavan

RECIPROCAL TEACHING

Reciprocal teaching is one of the methods that are used to teach comprehension-fostering strategies to students. Reading scores have usually improved as a result of this instruction.

Until the 1980s, students were seldom provided with any help in reading comprehension. In a class study, Durkin (1979) observed 4,469 minutes of reading instruction in grade 4 and found that only 20 minutes of this time were spent in teaching students how to comprehend what they were reading. Durkin found that teachers spent almost all of the instructional time asking students questions, but they spent little time teaching students comprehension strategies they could use to answer the questions. Duffy, Lanier, and Roehler noted a similar lack of comprehension instruction in elementary classrooms: “There is little evidence of instruction of any kind . . . Seldom does one observe teaching in which a teacher presents a skill, a strategy, or a process to pupils, shows them how to do it, provides assistance as they initiate attempts to perform the task and assures that they can be successful” (1980, p. 514). As a result of these astonishing findings, investigators developed and taught students to use specific cognitive strategies that were designed to help them perform higher-level operations in reading. Palincsar and Brown (1984) referred to these strategies as “comprehension-fostering” activities.

Teaching students to ask questions about the material they are reading is an example of a comprehension-fostering activity. Asking questions, by itself, does not directly lead in a step-by-step manner to comprehension. Rather, in the process of generating questions, students need to search the text and combine information, and these processes serve to help students comprehend what they read. A cognitive strategy, then, is a guide or a scaffold that serves to support the learners as they develop the internal procedures that enable them to perform the higher level operations.

TWO MAJOR COGNITIVE STRATEGIES

Two of the major and most researched cognitive strategies have been teaching students to ask questions about material they were reading and teaching students to summarize passages.

The cognitive strategy of asking questions was usually taught by providing students with a list of signal words who, what, when, why, how that students could use to form questions. The strategy of summarizing was frequently taught using a *legs and table* procedure in which students first list the major details (the legs) and then use the legs to compose a summary sentence (the table).

TEACHING COGNITIVE STRATEGIES

In many of these studies the cognitive strategies were taught directly by the teacher. The teacher first presented a list of signal words and then modeled the use of these words to ask questions about the material in a story or a passage. Then the teacher guided the students as they began to generate questions about the material, and, finally, the students asked questions independently, without much supervision.

Students were taught to use the legs and table strategy the same way. First, the teacher modeled how to select the main points (the legs) and then use these points to develop a summary (the table). Then the teacher supervised the students as they practiced identifying the legs and the table. The teacher would guide the students as they practiced by first summarizing a paragraph, then several paragraphs, then a passage, and then a larger unit. Finally, the students worked on their own, with minimal supervision from the teacher.

Reciprocal teaching, a term and practice developed by Palincsar and Brown (1984), is a variation on the traditional teaching method. In reciprocal teaching the focus is also upon teaching students specific comprehension-fostering strategies. Palincsar and Brown taught students four strategies: asking questions about the text, summarizing what was read, predicting what might happen next, and attempting to clarify words and phrases that were not understood. But in reciprocal teaching, the practice of applying these strategies takes place primarily in the context of a dialogue between the teacher and the students.

In reciprocal teaching, students read a passage of expository material paragraph by paragraph. During the early stages of the lesson, the teacher assumes the major responsibility for instruction by explicitly modeling the process of using these strategies on a selected text. The students then practice the strategies on the next section of text and the teacher supports each student’s participation through specific feedback, additional modeling, coaching, hints, and explanations. The teacher adjusts the difficulty of the task according to the current level of the student. As Palincsar and Brown (1984) explained:

The teacher models and explains, relinquishing part of the task to novices only at the level each one is capable of negotiating at any one time.

Increasingly, as the novice becomes more competent, the teacher increases her demands, requiring participation at a slightly more challenging level. (p. 13)

During this guided practice the teacher invites students to initiate discussion and to react to other students' statements. Student participation can include (a) elaborating or commenting on another student's summary, (b) suggesting other questions, (c) commenting on another's predictions, (d) requesting clarification of material not understood, and (e) helping to resolve misunderstandings.

The teacher supports the students by rephrasing or elaborating on their answers, comments, or questions, and by providing hints and instruction when needed. In the course of this guided practice, there is a gradual shift in responsibility from the teacher doing much of the work to the student taking over the major thinking while the teacher observes and helps only when needed.

At this point, the practice becomes a dialogue: one student asks questions, another answers, and a third comments on the answer; one student identifies a difficult word, and the other students help to infer the meaning and give reasons for the inferences they made. The emphasis throughout is on a cooperative effort by the teacher and students to bring meaning to the ideas in the text, rather than merely restating the words. In addition, during the dialogue, students are provided instruction in when, why, and where these activities should be applied to the text.

Reciprocal teaching, then, has two major features: instruction and practice of the four comprehension-fostering strategies and the use of the reciprocal teaching dialogue as a vehicle for learning and practicing these four strategies.

The process of gradual introduction of a skill by a teacher who provides assistance to students as they practice is similar to the guided practice described by Hunter (1982), Good and Grouws (1979), and Rosenshine and Stevens (1986). In reciprocal teaching, however, much greater emphasis is placed on encouraging students to provide instructional support for each other.

RESULTS

Two different types of tests were used to study the effect of using reciprocal teaching methods. Some investigators developed their own tests while other investigators used standardized tests in reading. Some investigators used both their own tests and standardized tests.

When experimenter-developed tests were used in the reciprocal teaching studies, the results were usually statistically significant and the average effect size was .88. An effect size of .88 means that students who scored at the 50th percentile in the experimental group would have

scored at the 88th percentile if they had been in the control group (Rosenhine & Meister, 1994). When standardized tests were used the average effect size was .32. This result means that on the standardized tests, students who scored at the 50th percentile in the experimental group would have scored at the 63rd percentile if they had been in the control group. An effect size of .88 is considered to be very large.

As noted, asking questions has also been taught in traditional settings, without the reciprocal teaching addition. When experimenter-developed tests were used in these studies the results were also usually statistically significant and the average effect size was .89. When standardized tests were used the average effect size was .34 (Rosenhine, Meister and Chapman, 1996). This result means that the same statistically significant results were obtained for teacher-led instruction when only the question-asking strategy was taught as were obtained using the reciprocal teaching format when four cognitive strategies were taught. These results suggest that the teaching of cognitive strategies is a useful instructional procedure for raising student achievement, and these strategies can be successfully taught in both a traditional and a reciprocal teaching format.

Palincsar and Brown (1984) suggest that what the students learned was not simply how to ask questions and summarize. Rather, the new strategies enabled and required the students to perform deeper processing of what they read, to engage in making sense of what they read, to be aware of what they did not understand the material, and to engage in additional searching when they encountered comprehension difficulties, and it was the learning and practice of these processes that led to the improved comprehension.

SEE ALSO *Brown, Ann Leslie; Communities of Learners; Scaffolding; Tutoring.*

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Barak Rosenshine

REINFORCEMENT

Reinforcement is an event that increases behavior. In the classroom, reinforcement occurs as teachers manage the environmental events that follow students' desired ways of behaving so to increase the strength and future likelihood of that behavior.

Reinforcement comes in two types: positive and negative. Positive reinforcement occurs when desired behavior is strengthened by the presentation of a contingent stimulus. The attractive, behavior-increasing, contingent stimulus used during positive reinforcement is referred to as a positive reinforcer. A positive reinforcer is defined as any environmental event that, when given in response to the behavior, increases the strength and frequency of that behavior. Some commonly used positive reinforcers in the classroom are praise, attention, tokens, and stickers.

Negative reinforcement occurs when desired behavior is strengthened by the removal of a contingent stimulus. The aversive, behavior-increasing, contingent stimulus that is removed during negative reinforcement is referred to as a negative reinforcer. A negative reinforcer is defined as any environmental event that, when taken away in response to the behavior, increases the strength and frequency of that behavior. Some commonly used negative reinforcers in the classroom are taking away an aversive assignment (e.g., homework), withdrawing an intrusive stare, or canceling a chore.

Table 1 provides a sample of reinforcers commonly used in K-12 classrooms. The left side of the table lists a variety of positive reinforcers that teachers give to strengthen students' behavior, while the right side of the table lists a variety of negative reinforcers that teachers take away to strengthen students' behavior. What is common to all positive reinforcers in the list is the idea that after the student engages in a particular behavior, he or she receives an attractive consequence for doing so.

Examples of positive and negative reinforcers commonly-used in K-12 classrooms

Positive reinforcers	Negative reinforcers
Giving praise	Taking away a deadline
Giving stickers	Taking away surveillance
Giving privileges	Taking away an unattractive assignment
Giving tokens	Taking away a threat
Giving attention	Removing a negative evaluation
Giving good grades	Removing bad grades
Giving scholarships	Taking away criticism
Giving an honor	Stopping one's ridicule
Giving a trophy	Stopping one's teasing
Giving a prize	Stopping one's yelling or screaming
Giving an award	Stopping one's crying
Giving food	Stopping one's whining
Giving money	Stopping one's staring
Giving a smile	Stopping one's pleading or pouting
Giving positive feedback	Stopping laughing (at someone)

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

That is, when the student turns in her homework, the teacher then places a sticker on the paper. The sticker is given after the homework has been handed in and with the intention of strengthening the likelihood that future homework assignments will be forthcoming. What is common to all negative reinforcers in the list is the idea that when the student engages in a particular behavior, he or she gets a break from an unattractive or aversive consequence for doing so. That is, when the student turns in her homework, the teacher then exempts the student from an arduous assignment of long division problems. The arduous assignment is removed after the homework has been handed in and with the intention of strengthening the likelihood that future homework assignments will be forthcoming.

REINFORCERS AND REWARDS

Reinforcement is defined by its effect on behavior. Only environmental events that actually increase behavior are reinforcers. If an event such as a smile, candy bar, or break from chores does not increase the student's behavior, then the event is not actually a reinforcer. This qualification of which environmental events are reinforcers and which are not is an important point because teachers often implement consequences haphazardly (non-contingently) or inconsistently (Kauffman, 1996; Pullen, 2004). Praise represents a good example of commonly used attractive environmental event that is used for a dozen different reasons, only one of which is to reinforce (increase) students' behavior (Brophy, 1981). Further, teachers do not reinforce positive behavior as

Reinforcement

often as they could (Wehby, Symons, Canale, & Go, 1998). Instead of delivering contingent and strategic consequences for desired behavior (i.e., reinforcers), what teachers more typically offer to students are promises of reward.

A reward is the offering of an environmental event in exchange for the student's participation, service, or achievement (Craighead, Kazdin, & Mahoney, 1981). When a teacher promises an award if the student will complete an assignment or when a teacher promises a prize to acknowledge a successful performance, she introduces a reward into the learning environment. Adding a discussion of rewards to a discussion of reinforcement highlights the instructional practice of soliciting students' behavior or acknowledging their achievement, regardless of whether those rewards actually reinforce behavior. The discrepancy between reinforcers and rewards is that a reward functions as a reinforcer only when the student values it enough to affect a change in his or her behavior. Sometimes teachers use rewards that students do not value (e.g., public recognition), and unappealing rewards do not increase the frequency of the desired behavior. If the student is embarrassed, rather than gratified by, the public recognition then it will not reinforce (i.e., strengthen) the behavior, and it might even act as a punisher to some students. The important point is that teachers offer rewards in hopes of soliciting behavior, while they deliver contingent reinforcers to increase desired behavior which has already occurred.

ASSUMPTIONS THAT RELATE REINFORCEMENT TO LEARNING

Reinforcement is an educational concept rooted in behavioral learning theory (Baldwin & Baldwin, 1986). Behavioral learning theory does not focus on mental knowledge, such as learning information. Neither does it focus on cognitive and sociocultural concepts, such as creating meaning, understanding concepts, using memory, and the experience of conceptual change. Instead, behavioral learning theory focuses on behavior. Specifically, it focuses on voluntary, intentional, and situationally appropriate behavior. So, the learning highlighted by behavioral learning theory is learning how to adapt successfully to one's environment (e.g., raise one's hand before speaking, wait one's turn in the lunch line). Reinforcers play the important role they do in helping students learn how to adapt to the classroom (and school) environment by signaling which behaviors are desirable (those that are reinforced) and which are not (those that are not reinforced). Students learn which behaviors are desirable and adaptive by learning which behaviors are associated with reinforcers. The assumption that relates reinforcement to learning is that the presence of a rein-

forcer signals that a particular behavior is desirable, and this signaling process, therefore, helps students learn how to adapt more successfully to the classroom environment.

ASSUMPTIONS THAT RELATE REINFORCEMENT TO MOTIVATION

Reinforcing students' desirable behaviors with positive and negative contingencies is an extrinsic motivational strategy. Motivation researchers outside behavioral learning theory find that extrinsic rewards often undermine students' intrinsic motivation and capacity for autonomous self-regulation (Deci & Ryan, 1985; Deci, Koestner, & Ryan, 1999; Kohn, 1993). That is, reinforcers and rewards produce complicated, and often undesirable, motivational side-effects. The undermining effect that extrinsic rewards often have on intrinsic motivation and autonomous self-regulation is important for two reasons. First, many teachers incorrectly assume that adding extrinsic rewards on top of students' intrinsic motivation will create a supermotivation in which the two types of motivation (extrinsic and intrinsic) will combine and complement one another. Instead, extrinsic rewards typically interfere with and undermine intrinsic motivation and autonomous self-regulation. Second, teachers often offer students extrinsic rewards when introducing uninteresting activities in the hope that the reward will be able to generate the motivation to engage in the task that the task itself cannot generate (because it is uninteresting). From a motivational point of view, teachers therefore use positive reinforcers, negative reinforcers, and extrinsic rewards to bolster students' otherwise low motivation (Boggiano, Barrett, Weiher, McClelland, & Lusk, 1987). In doing so, teachers are essentially trying to set up (manage) conditions that make desired target behaviors, such as engaging in uninteresting (but educationally important) lessons, more likely.

CLASSROOM MANAGEMENT TO PROMOTE EDUCATIONAL OUTCOMES

Many positive educational outcomes can be framed in terms of desirable behavior. Teachers, administrators, and parents all consider behaviors such as attending school regularly and promptly, being actively engaged during classroom lessons, showing respect for others, making good grades, and graduating from school as desirable ways to behave. Because educators value these ways of behaving and because they would like to see students engage in these ways of behaving more frequently, they find merit in classroom management practices, the most popular and the most effective of which involves the strategic use of positive reinforcers, negative reinforcers, and extrinsic rewards (Landrum & Kauffman, 2006).

The fundamental task of classroom management is to create a caring, supportive, inclusive, and engaging

community in which students frequently engage in desirable, constructive, and prosocial behavior (Weinstein, Curran, & Tomlinson-Clarke, 2003). When practiced effectively, classroom management is a proactive strategy that creates a classroom environment in which desirable behavior is expected, supported, and reinforced. From this point of view, reinforcement plays only one part in the teacher's larger effect to manage the classrooms. In addition to reinforcing desirable behavior after it occurs and in addition to offering extrinsic rewards to solicit students' desired behavior, teachers can further support students' desirable ways of behaving by adding additional classroom management strategies such as modeling and observational learning (Ozur & Bandura, 1990), scaffolding and tutoring (Chi, Siler, Jeong, Yamauchi, & Jausmann, 2001), behavioral supports (Casteel, Isom, & Jordan, 2000), and promoting students' effective self-management (Bohn, Roehrig, & Pressley, 2004).

SEE ALSO *Behaviorism; Rewards; Thorndike, E(dward) L(ee)*.

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RELEVANCE OF SELF-EVALUATIONS TO CLASSROOM LEARNING

There has been controversy in the psychological and educational literature about the role of self-concept and global self-esteem in the classroom. How are these constructs best defined, and distinguished from each other, as well as from self-efficacy? Is an understanding of students' perceptions of their scholastic ability related to their motivation to perform in the classroom room? How does the accuracy of students' perceptions of their academic performance impact their preference for intellectual challenge? What are the implications for educators, in terms of possible interventions in the classroom? Here there is also controversy. Should educators focus on the enhancement of scholastic skills themselves or should attention be directed toward impacting self-concept as the primary target? How is global self-esteem relevant to students in the classroom, as well as to interventions?

DEFINITIONAL ISSUES

Before addressing these substantive issues, it is important to untangle the often confusing terminology. For example, among the many terms are *self-concept*, *self-efficacy*, and *self-esteem*, to name three that are a source of confusion. The definitions offered here are those that appear to be the most useful, in terms of clarity. Self-concept refers to one's perceptions of competence or adequacy across specific domains, for example, scholastic competence, athletic competence, and social competence, as well as feelings of adequacy in such domains as perceptions of appearance and the evaluations of one's behavioral conduct or morality (see Harter, 1999). Thus, the concept of domain-specific self-concepts is particularly

useful in discriminating differences between the various arenas in which one has self-perceptions of competence and/or adequacy.

This approach is particularly useful in identifying a profile of self-perceptions across the various domains that are included on any given instrument adopting this framework. That is, the vast majority of children and adolescents do not feel equally competent and/or adequate in every domain assessed. Their scores on domain-specific measures vary across domains, leading to different profiles for individuals. Summing or averaging such scores can mask the incredible differences that individuals report across domains. From an educator's perspective, perceptions of competence in the domain of scholastics may be particularly critical to discriminate from other domains, although the latter may also be of interest.

Another term that represents a source of confusion is self-efficacy, a construct identified by Bandura (1977). Self-efficacy refers to the belief that one can or will be efficacious in a particular arena. It has a futuristic connotation. For example, a student may feel that "when I am faced with new academic challenges, I will be successful." Domain-specific self-concept, in contrast, refers to self-evaluations in the present, for example, "I am very good at my schoolwork (right now)." While the two constructs, self-concept and self-efficacy, may be correlated with one another, they are not the same and therefore there can be discrepancies between the two. For example, students could feel competent in the present about their specific ability, if facing new challenges, associated with movement to a new grade, a new teacher, a new school, but not necessarily possess self-efficacy about their future ability to perform. Conversely, students may feel that they can be efficacious in the future, if a change favors their abilities, but may not experience domain-specific competence in their present educational environment. (In this entry, the focus will be on domain-specific competence, emphasizing the scholastic or academic domain, and will not address self-efficacy, although it is important to distinguish clearly between the two constructs.)

APPLICATIONS OF DOMAIN SPECIFIC SCHOLASTIC COMPETENCE

Before addressing the third construct, self-esteem, which is not domain-specific but rather an overall evaluation of one's worth as a person, two classroom applications of domain-specific scholastic competence will be considered: (a) how perceptions of scholastic competence impact intrinsic versus extrinsic motivation in the classroom, and (b) whether the accuracy of perceptions of scholastic competence is predictive of preference for scholastic challenge, one motivational component.

An important motivational dimension critical to educators is whether children are *intrinsically* or *extrinsically* motivated in the classroom. Three dimensions of motivation have been identified (Harter, 1981): First, are the students intrinsically motivated by curiosity and the love of learning or are they merely extrinsically motivated to do the schoolwork assigned? Second do the students prefer academic challenge or do they merely want easy work that they are sure they can accomplish? Third, do the students prefer to approach schoolwork independently or are they dependent on the teacher and need help and/or to be given the correct answer? These dimensions are highly correlated with one another and thus can be combined into a single score representing a student's average motivation along a dimension from intrinsic (highest score = 4) to extrinsic (lowest score = 1).

There is considerable variability in students' motivational level, across grade levels as well as within a given grade level. Developmentally, across grades 3 through 9, there is a systematic decline representing a gradual shift from intrinsic motivation in the third grade to extrinsic motivation during adolescence (Harter, 1981). Eccles, Midgley, and Adler (1984) have suggested that grade-related changes in educational practices are responsible. A focus on academic grades and test performance, including public posting of scores, social comparison, a shift from an emphasis on effort to ability, ability grouping, and a shift from an emphasis on the product of one's performance to the process of learning could all adaptively contribute to a decline in intrinsic motivation and an increase in extrinsic motivation.

Not all students show this unilateral shift. A longitudinal study by Riddle and Harter (reported in Harter, 1990) studied motivational patterns in children making the transition from a sixth grade elementary school to a middle school (seventh and eighth grades). Some showed the decline to extrinsic motivation over this transition, some reported no change, and yet a third group actually showed increases toward greater intrinsic motivation.

What might explain these three different patterns? The researchers found that the patterns were directly predicted by students' perceived scholastic competence. Students whose perceived scholastic competence increased across the transition from sixth to seventh grades, reported a shift toward greater intrinsic motivation, those reporting no changes in scholastic competence reported no changes in level of motivation, and those reporting a decrease in perceived scholastic competence reported a shift to more extrinsic motivation.

Why should children's perceived scholastic competence change as a function of the transition to a new school? In this study, students from three elementary feeder schools made the shift to one junior high school.

This means that two-thirds of the students were undoubtedly new to each individual. Social comparison processes would lead to the conclusion that the hierarchy of perceived competence would shift for many, leading to different perceptions of their perceived scholastic competence (see Harter, 1996). These, in turn, impacted the level of intrinsic vs. extrinsic motivation. Thus, the more students feel scholastically competent, the more they will be drawn to an intrinsic motivational orientation. Conversely, if students report a decline in scholastic competence, they will shift toward an extrinsic motivational style in which they may feel more assured of some success and less failure.

The second application of domain-specific competence concerns the accuracy of perceptions of scholastic competence and preference for challenge. Do the accuracy of self-perceptions have an impact? In one study of the component of preference for challenge, the researchers first established accuracy by comparing teachers' ratings of students' scholastic competence to the students' own perceptions of scholastic competence. Students were divided into "over-raters," those whose scores significantly exceeded the rating of the teacher, "under-raters," those whose scores were significantly lower than the teacher's ratings, and "accurate" raters, those whose scores were congruent with the teachers' (see Harter, 1999).

Next, students were brought into a university classroom in which research assistants acted as teachers. Students were given a booklet that contained anagrams of different levels of challenge, three-letter to seven-letter anagrams, to be unscrambled to make legitimate words. They were given a choice of which they wanted to attempt (see Harter, 1999, for details). Results revealed that the under-raters selected the easier anagrams, presumably because they did not feel scholastically competent. Surprisingly, perhaps, the over-raters who reported high perceived scholastic competence also selected the easiest anagrams. Accurate raters chose the most challenging anagrams.

Why should those reporting high levels of perceived competence select easier anagrams? It should be recalled that this group, the over-raters, were so designated because teachers were not in agreement with their perceptions, viewing them as less competent than the students themselves. The researchers interpreted these findings to reflect the fact that these over-raters, at some level, consciously or perhaps defensively, knew that they were not as competent as their ratings implied. Thus, rather than risk failure, they selected the easiest anagrams. This is an important finding because if over-raters select easier tasks in a simulated classroom, they are likely to select easier tasks in other arenas of their life. By avoiding challenges, they will limit their learning ability. Thus, it is not only the level of perceived scholastic competence that is relevant to the

prediction of certain forms of motivation but the accuracy of those judgments. The issue of why unrealistic evaluations can ultimately be psychologically debilitating will be further discussed below.

SELF ESTEEM

Another term that is critical to define is self-esteem. Self-esteem, in this entry, refers to a *global* perception of one's overall worth as a person, such as "liking who one is as a person," "being satisfied, overall with who one is." (Negative content is also included.) It should be noted that in the framework of Harter (1999) and Rosenberg (1979) global self-esteem is *not* the sum or average of domain-specific scores. It is its own construct, assessed by its own set of items.

From a developmental perspective, the ability to construct a global view of one's esteem does not appear until about age 8. Younger children (ages 4 to 7) do not have the cognitive skills to integrate information about the self into an overall self-evaluation of their worth (see Harter, 1985, 1999). Rather, they can only make judgments about domain-specific self-concepts such as cognitive competence, social acceptance, and physical competence. This does not mean that young children do not have some sense of their overall worth. Rather, they do not have a verbalizable concept of their global self-esteem, as a cognitive construct that can be expressed through language. However, it has been demonstrated that young children exude or manifest a sense of self-esteem in their *behavior*.

An empirical effort to identify the relevant behaviors by Haltiwanter and Harter has been described in Harter (1985). The researchers first asked teachers to sort behavioral descriptors into groups, those describing high- and low-self-esteem children, ages 4 to 7. Those defining the high self-esteem child included curiosity, exploration, pride in their "work" (e.g., drawings), and confidence, to name the primary descriptors. Those identified with low self-esteem displayed the lack of these attributes. Agreement among teachers was extremely high. The researchers then cast these items in a behavioral rating scale such that teachers or relevant adults could evaluate children on a four-point scale in which they rated each item separately. These could then be averaged to arrive at a score that represented young children's behaviorally manifest self-esteem.

To return to older children and adolescents, separate self-report measures of both domain-specific self-concepts and global self-esteem are needed because global self-esteem is highly related to depression, which, in turn, is predictive of suicidal thinking and behavior (Harter, 1999). These are major mental health concerns, particularly in contemporary society. In fact, reports indicate that

depression and suicide are on the rise among preadolescents, adolescents, and young adults. Thus, it is important to understand the causes of depression and suicide, namely lack of global self-esteem, as well as to understand the causes of different levels of global self-esteem. Often these factors are difficult for teachers to observe, and observing them is not the primary task of the educator. Thus, self-report measures that may be administered by school counselors, social workers, or mental health professionals, can aid in the identification of children at risk.

In understanding the causes of global self-esteem and the relevance of domain-specific self-concepts, it is critical to assess domain-specific self-concepts because they can contribute to global self-esteem, as was pointed out by an historical scholar of the self, William James (1842–1910) (1892). James argued that global self-esteem was the product of those domain-specific successes that individuals viewed as particularly important to their well-being (see Harter, 1985, 1999). For example, if scholastic competence is important to students and they are doing well academically, that may be one contributor to high global self-esteem. Conversely, if scholastic competence is important but the students are doing poorly at schoolwork, then they will experience low global self-esteem. The same logic applies to other domains. An example involves the domain of perceived physical attractiveness. In fact, this domain bears the highest correlation with global self-esteem (see Harter, 1985; 1999). The correlation between scholastic competence and self-esteem is the second highest correlation. Thus, to understand one's level of global self-esteem, it is critical to examine domain-specific self-concepts and the relationship they bear to how much one likes oneself as a person, overall.

Another influential theory of the causes of global self-esteem was put forth by Charles Horton Cooley (1864–1929) (1902), another historical scholar of the self. Unlike James, Cooley contended that the opinions of significant others were the key to understanding one's level of self-esteem. Cooley proposed the metaphor of the "looking glass self." Other people are social mirrors into which individuals psychologically gaze in order to divine how they are being perceived. If people feel that others hold them in esteem and approve of them as worthy individuals, then they will incorporate their view into their self-evaluation of their own overall self-esteem. Conversely, if they feel that significant others do not value them, they will report low self-esteem.

Harter (1985, 1999) consistently discovered that approval from classmates is the best predictor of global self-esteem. Classmates are the public significant others who can scrutinize the self and whose resulting opinions are critical to one's self-esteem. The opinions of classmates, expressed directly (e.g., through comments that

may communicate negative evaluations of the self) or more indirectly (e.g., avoidance, conveying social rejection), are internalized in the form of low self-esteem. In contrast, the perceived positive acceptance by classmates will lead to positive acceptance of the self, in the form of high self-esteem. Thus, processes that occur within the classroom, namely, perceptions of domain-specific scholastic competence and perceptions of classmate approval are each critical to global self-esteem.

IMPLICATIONS FOR INTERVENTION

A comprehensive coverage of the implications for intervention can be found in Harter (1999). A few of these principles will be summarized here. One issue is whether the goal of interventions should be the enhancement of domain-specific self-evaluations, for example, scholastic competence, or efforts to promote the accuracy of self-evaluations. Some scholars advocate enhancement as the primary goal, such that students will feel good about themselves. However, others point to the dangers of promoting unrealistically high domain-specific evaluations and urge that interventions promote more realistic self-perceptions. The negative effects of over-rating one's scholastic competence were described above.

A similar controversy applies to the construct of global self-esteem. While "feel-good" approaches aimed at encouraging students to value themselves as individuals may give students a temporary psychological lift, in the long run they can have detrimental effects. Damon (1995) views such efforts as misguided, in that they lead to an inflated sense of self-esteem. He argues that they divert educators from teaching skills and deprive students the thrill of actual accomplishment. Damon contends that the importance of self-esteem as a commodity has been greatly exaggerated and that the effusive praise that parents or teachers heap on children to make them feel good is often met with suspicion by children. Moreover, it interferes with the goal of building specific skills in the service of genuine achievement.

Other strategies apply to interventions to influence social self-evaluations. For those reporting low social support from parents, one should determine whether they are withholding support because their children are not meeting parents' highly demanding and often unrealistic expectations. Encouraging parents to accept their children for who they are and for domains in which the child has talents is one goal. For example, parents of a child who has legitimate academic limitations (low intelligence, learning disabilities) but who is musically talented should reward musical accomplishments rather than critically hound the child for lack of academic success. If these strategies are unworkable, then providing some type of compensatory support, in the form of a

special adult who can provide support, for example, an extended family member or those in programs like Big Sisters and Big Brothers.

Other students may lack peer support, contributing to low self-esteem. To the extent that they are realistic, attempts should focus on understanding the particular causes of their lack of acceptance. Do such children lack attributes that are valued by peers, for example, attractiveness, athletic ability, or interpersonal qualities that make them likable? Intervention efforts may be directed toward improving the child's skills in the relevant area(s), realizing that there will be natural limits on the extent to which the child may be able to improve. Another strategy may involve removing such children from an unsupportive peer-group situation and placing them with individuals who are likely to provide more support. Social skills programs may also be an option. Increasing social support from either parents or peers, in turn, enhance children's global self-esteem.

The present entry has focused on two critical constructs, students' domain-specific self-concepts and global self-esteem, and how they are relevant to the classroom. Research by Harter has revealed that students' motivation shifts from intrinsic to extrinsic motivation as a function of grade-level. Moreover, students' perceived scholastic competence is a powerful predictor of the level of intrinsic versus extrinsic motivation. In addition, Harter's research has demonstrated that those who over-rate and under-rate their scholastic competence are more likely to report low preference for challenge, which in turn can hamper efforts to approach challenging situations in the classroom as well as in other arenas of their life that can provide learning experiences.

SEE ALSO *Self-Esteem*.

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RELIABILITY

Reliability is the consistency of a measure. In educational testing, reliability refers to the confidence that the test score will be the same across repeated administrations of the test. There is a close relation between the construct of reliability and the construct of validity. Many sources discuss how a test can have reliability without validity and that a test cannot have validity without reliability. In the theoretical sense, these statements are true but not in any practical sense. A test is designed to be reliable and valid, consistent, and accurate. Practical conceptualizations of reliability cannot be discussed separately from examples with validity.

RELIABILITY AND VALIDITY

Reliability without validity would be similar to an archer consistently hitting the target in the same place but missing the bull's eye by a foot. The archer's aim is reliable because it is predictable but it is not accurate. The archer's aim never hits what it is expected to hit. In this analogy, validity without reliability would be the arrows hitting the target in a haphazard manner but close to the bull's eye and centering around the bull's eye. In this second example, it can be seen that the validity is evidence that the archer is aiming at the right place. However, it also demonstrates that, even though the reliability is low, there is still some degree of reliability. That is, at least the arrows are consistently hitting the target. In addition, if the arrows are centered around the bull's eye, the error of one aim leading too far to the right is balanced by another aim leading too far to the left. Looking at the unpainted backside of the target's canvas, someone would be able to identify where the bull's eye was by averaging the distance of all the shots from the bull's eye.

Reliability of a test is an important selling point for publishers of standardized test, especially in high-stakes testing. If an institute asserts that its instrument can

identify children who qualify for a special education program, the users of that test would hope that it has a high reliability. Otherwise, some children requiring the special education may not be identified, whereas others who do not require the special education may be unnecessarily assigned to the special education program.

Even in situations perceived as low-stakes testing, such as classroom testing, reliability and validity are serious concerns. Classroom teachers are concerned that the tests they administer are truly reflective of their students' abilities. If a teacher administered a test that was reliable but not valid, it would not have much practical use. An example would be a teacher in a grade-school history class administering, as a midterm exam, a standardized test from a reputable publisher. If that exam was suggested by the test developer as the final exam, the results would most likely be reliable but not valid. The test results would be reliable because they would most likely reflect the students' rank order in class performance. However, the test would not be valid as most students would not be ready for half of the material being tested. If the grade-school history teacher administered as a midterm exam a standardized test recommended by the test developer as a midterm exam for the appropriate grade level, the test could be considered valid. However, if the students (for some strange reason) did not receive uniform instruction in grade-appropriate history, the test would most likely not be reliable.

From these examples, it is clear that it is easier to increase the validity of a reliable measure than to increase the reliability of an otherwise valid measure. The reliable archer could be trained, little by little, to move the aim in the direction of the bull's eye. However, the target could be moved over one foot, so that the bull's eye is at the spot on the target that the archer usually hits. The teacher could take the time necessary (half a school year) to teach the students what they need to know to pass the valid final exam. (This is similar to training the archer to shoot in the right direction.) Another solution for the classroom situation would be for the teacher to adapt the test items in the exam, so that it is more appropriate as a midterm exam, instead of as a final exam. (This is similar to moving the target so that the archer's aim hits the bull's eye.)

In the test publishing world, the reliability of a draft test instrument is often quickly established. However, after the test is used many times, its validity might be questioned. A test designed as a verbal reasoning test may rely heavily on the test-taker's knowledge of music, art, and history. Because the test is reliable, the publishers might redefine what construct it is measuring; in this case, it is a better measure of the students' knowledge of the humanities than of verbal reasoning. The publisher would recall all copies of the Verbal Reasoning test; then,

with little change to the test, the publisher could offer it again as the Humanities Achievement test.

Test reliability is explained through the true score theory and the theory of reliability. True score theory states that the observed score on a test is the result of a true score plus some error in measurement. The theory of reliability compares the reliability of a test of human characteristics with the reliability of measuring instruments in the physical sciences.

RELIABILITY IN TRUE SCORE THEORY

True score is the exact measure of the test taker's true ability in the area being tested. With a perfect test, the observed score would be equal to the true score. However, there is no perfect test. As one example of where the error may occur, the wording of test items may not be detailed enough for some test takers yet be too detailed for others. The examples of test errors are innumerable. According to true score theory, no one can know what the reliability of the test is unless one knows how much random error exists in the test. One cannot know how much error exists in the test unless one knows what the true score is. As a theoretical concept, the true score cannot be known. Therefore, what the reliability is can never be known with certainty. However, one can still estimate what the reliability is through repeated measures. As the error is assumed to be random, it should be balanced out over many administrations of the same test. If the test-taker's ability measured by the test is unchanging, when the error inflates the observed score one time it can be expected to deflate the observed score to the same degree at another time.

THE THEORY OF RELIABILITY

According to the theory of reliability, when a test is administered to a group of individuals, the observed variance in the distribution of scores should be due only to the true variance in the ability levels of the test takers. The degree that the two variances match is the reliability evaluation.

Another principle of the theory of reliability is that the reliability of a test is the ratio of the true score over the observed score. This relates to the true score theory because if the true score equals the observed score, then the error term must equal zero and the ratio of the true score to the observed score will be a perfect 1. Any deviation from this perfect ratio is caused by the strength of the error term (whether a positive or negative value). Therefore, expressing reliability as the ratio of the true score to observed score is in agreement with true score theory.

Reliability can also be expressed as the ratio of the variance of the true score to the variance of the observed score. Still, as noted above, one cannot know what the true score is, so one cannot know what the variance of the true

score is. One way to estimate the variance of the true score is to calculate the covariance of two observed scores from the same test with the same test takers with unchanging ability.

The covariance of two measures is the variance that the two measures share. It is the numerator in the calculation of the correlation of the two measures. The denominator of the correlation is the standard deviation of one measure times the standard deviation of the second. Because the measures are assumed to be the same, their standard deviations should be the same. Therefore, the product of the two standard deviations should equal the square of the standard deviation of the one measure. Statistically, this is the same as the variance of the observed score. The conclusion is that the estimation of reliability is the same as the correlation of two distributions of matching scores from the same test.

In summary, according to reliability theory, reliability is equal to the ratio of the variance of the true score to the variance of the observed score. Calculating the ratio of the estimated variance of the true score to the variance of the observed score is the same as calculating the correlation between two observed scores. Therefore, the correlation of two repeated measures of the same test is accepted as an appropriate estimate of the reliability of the test.

TYPES OF RELIABILITY

Inter-rater (or inter-observer) reliability is an important consideration in the social sciences because there are many conditions for which the best means of measurement is the report of trained observers. Some classes such as gymnastics can only be assessed through the ratings of expert judges. As another example, external observers may be brought into a classroom to assess a student's inappropriate behavior. The observations of only one observer can be challenged from so many points of view. A lone observer may have some personal expectancies of what is supposed to occur. The lone observer may get tired and bored, so that earlier observations are more precise than later ones. It is less likely that the reports of two or more observers would be challenged. Particularly, the acceptability of the reports of two or more observers increases when their observations are similar. The measure of the similarities of the observations coming from two or more sources is the inter-rater reliability.

One method to establish inter-rater reliability is to calculate the proportion of agreement between or among the observers. This is appropriate if the ratings or observations are in mutually exclusive categories. The two observers recording the behavior of the student with the

inappropriate behavior would do well to have a common checklist of the likely behaviors. If they agree on the occurrence of 16 out of 20 behaviors, their inter-rater reliability would be 80 percent.

Another method is to calculate the correlation between the ratings of the two or more observers. This is possible if the ratings or observations are two or more sets of interval numbers. The gymnastic judges would have different ratings. Some may be consistently rating high while others consistently rating low. However, there should be some general agreement on the ranking of the different performers. The strength of this agreement would be reflected in the correlation of their ratings.

Inter-rater reliability is increased if the observers have appropriate training. The training should focus on what exactly is meant to be observed. The raters need to be given a clear description of the event to be observed. The classroom observers would need to know what is and is not appropriate behavior. The raters also need concrete examples of what constitutes an occurrence or what constitutes achievement at each criterion level. The gymnastic judges need to know the standards for each element of the gymnastic routine. Training is best when it includes much practice with feedback.

Test-retest reliability is appropriate for tests that measure a construct that is not likely to change. The construct that intelligence tests measure is not expected to change. Another well-known test with an expectedly unchanging construct is the Scholastic Aptitude Test (SAT). Although a test taker is allowed to take the SAT up to three times, the developers claim that the score on repeated administrations will not change. The construct that the SAT is measuring is the predicted adaptability to college. By the time students take the SAT, they are as prepared for college as they are going to be.

Test-retest reliability is described as the correlation between the distribution of scores on one administration and the distribution of scores on a subsequent administration. Test-retest reliability is also an important factor in some experimental designs in which the treatment group is administered a pretest and posttest with treatment in between and the control group only receives the pretest and the posttest. Any analysis of the difference noted in the results of the posttest (compared to the pretest) of the treatment group is confounded unless there is a strong reliability between the pretest and posttest of the control group.

Parallel-forms reliability evaluates the consistency of the results of two tests constructed in the same manner from the same content domain. For every item on the test, a similar item is developed with the same difficulty level. The items from each pair are then randomly assigned to one form of the test or the other. The resulting two tests

are the same in content and difficulty but not expression. The reliability is described as the correlation of the two distributions of scores. This type of reliability is important in the development of standardized tests.

Split half reliability is similar to parallel forms except that the two forms are both incorporated into one test. After the test is administered, the scores are divided into the two forms and the correlation between the two distributions of scores is calculated. Like parallel forms it is important in the development of standardized tests. However, it could have classroom applications if the classroom teacher was willing to make the effort to develop a test with twice as many items as an ordinary test. In the classroom, split-half reliability could detect the effect of students' guessing on the test.

Inter-item reliability is another means of evaluating the reliability of one administration of one test. Most tests are made up of items that are related to one another because they are measuring similar concepts. Because the items are similar in design, there should be a measurable correlation between the items in any pair of items. The evaluation of inter-item reliability begins with predicting all correlations between all pairs of items. The inter-item reliability is expressed as the proportion of correct predictions. A classroom teacher might want to use inter-item reliability to identify the items that were not related to any other items or to identify the effects of students' guessing.

Cronbach's Alpha and the Kuder-Richardson methods are systems of reporting internal consistency of a test. The essential results of the internal consistency methods are comparable to the average of all correlations between all pairs of items. These methods can estimate reliability using the results of only one administration of the test. The main difference between the two approaches is how the items are scored. Cronbach's Alpha can be used on items with a range of responses such as a Likert scale. The Kuder-Richardson methods require that all items be scored dichotomously right or wrong (Borg and Gall, 1983).

PROCEDURES TO INCREASE RELIABILITY

The general goal to increase reliability of a measure is to increase the variance while reducing the variance error. Three recommended procedures to accomplish this are: 1) decrease the ambiguity of the test items; 2) increase the number of items per objective; and 3) provide clear test-taking instructions (Kerlinger, 1986).

If an item is ambiguous, it can be interpreted in more than one way. Two test takers of equal ability could conceivably interpret an ambiguous item two different ways, one getting it right and the other getting it wrong.

Their score would differ based on their interpretation of the item and not based on their differences in true ability.

Where there is error in a test item, it will have less effect if that item is one among many for the same objective than if that item is one among few. A test taker whose ability is mismeasured by a faulty item will need to balance the effect of that item with the effect of the items that are measuring more accurately.

Clear test-taking instructions help test takers to interpret the test items correctly and to indicate their chosen answers properly. Test instructions might remind the test takers of the types of items that require special attention. In addition, if there is a special procedure for answering such as using an answering sheet, test instructions can remind test takers how to respond correctly.

SEE ALSO *Standards for Educational and Psychological Testing; Validity.*

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Ray Brogan

RESEARCH METHODS: AN OVERVIEW

There are many different methodologies that can be used to conduct educational research. The type of methodology selected by a researcher emanates directly from the research question that is being asked. In addition, some of the differing techniques for conducting educational research reflect different paradigms in scientific thought. In this entry, a review of the most commonly used methodologies is presented; in addition, the strengths and weaknesses of various methods are compared and contrasted.

OVERVIEW OF RESEARCH METHODS IN EDUCATION

Research methodologies can be classified in many different ways. For example, some researchers distinguish between quantitative and qualitative studies; others distinguish between experimental and non-experimental research; still others distinguish between research that is

Examples of strengths and weaknesses of various research methodologies		
Methodology	Major strength	Major weakness
Correlational	Can be used to examine complex relations among many variables.	Can't draw conclusions about causality.
Experimental	Can draw conclusions about causality.	Often does not represent true learning environments in real classrooms.
Quasi-experimental	Can simulate an experiment in a true classroom setting.	More difficult to justify causal conclusions than in true experiments.
Qualitative	Can provide detailed, in-depth analyses of the contexts of learning environments.	Very time-consuming, both in terms of data collection and analysis.
Longitudinal	Can examine changes in variables over time.	Very costly, and subjects may drop out over the course of the study.
Cross-sectional	Efficient and rapid way to examine developmental differences.	Not nearly as accurate as longitudinal designs; cohorts may differ, and these differences may be mistaken for true developmental differences.
Design experiments	Occur in actual classrooms; experiments are constantly altered based on actual occurrences in the classrooms.	Very time-consuming; sometimes quite difficult to examine causality.
Microgenetic research	Allows for in-depth analyses of development in strategy usage over time.	Very time consuming; often uses very small samples.
Single-subjects	Provides detailed data about changes in a specific variable in one individual learner at a time; can be particularly useful in developing interventions for learners with special needs.	Difficult to generalize to larger populations.
Action research	Involves real classroom teachers investigating questions that are directly important to practicing educators.	Often does not meet the stringent criteria of other designs, and results may not be acceptable to the scientific community.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

conducted in laboratories versus in the field (i.e., in classrooms). Obviously, there are many ways to categorize research methods. However, there also is much overlap in such categorizations. For example, a “non-experimental” study can be either quantitative or qualitative; an experimental study can include some qualitative components. This entry does not attempt to classify these methodologies; rather, the various methods are first briefly described and then compared and contrasted.

Correlational Research. *Correlational research* involves quantitatively studying the relations between and among variables. One of the hallmarks of correlational research is that cause and effect relations cannot be determined.

Researchers who engage in correlational research do not manipulate variables; rather, they collect data on existing variables and examine relations between those variables. A number of different statistical techniques can be used to analyze correlational data. An example of a correlational research would be an examination of the statistical relations between middle school students’ standardized examination scores in mathematics, and the students’ demographic characteristics (e.g., gender, ethnicity, socioeconomic status, etc.).

Experimental Research. In an experiment, participants are randomly assigned to one of several treatments. One

of the most basic experimental designs involves random assignment to either an experimental group (which receives some kind of treatment), or a control group (which does not receive the treatment). If the differences in treatment between the experimental and the control group are tightly controlled, and if subsequent to the experiment there are measurable differences between the two groups that were not present before the experiment, then researchers often conclude that the experimental manipulation “caused” the differences to occur.

Many researchers and government agencies consider true experiments to represent the gold standard in research; however, it is extraordinarily difficult to conduct true experiments in actual educational settings (i.e., schools). The primary reason for this difficulty is the fact that students can rarely be randomly assigned to conditions or classrooms in school settings. It is also important to distinguish between small-scale experiments and larger-scale clinical trials. Small-scale experiments can occur in settings such as laboratories or classrooms, whereas larger-scale clinical trials often occur across many classrooms or schools.

An example of an experiment would be a study examining the effects of a video presentation on learning multiplication skills. Students in a classroom where all students are learning about multiplication could be randomly assigned to either watch a video that demonstrates

multiplication skills, or to watch another video (i.e., a video about how to make ice cream sundaes); the students would probably be asked to view the videos in a highly controlled environment, where the experimental and control conditions could be as similar as possible (except for the video presentation). If on a post-test the students who watched the multiplication video outperformed the other students, then a researcher could conclude that the video “caused” the improved performance.

Quasi-Experimental Research. In quasi-experimental studies, researchers do not randomly assign participants to groups (Cook & Campbell, 1979). Quasi-experimentation is used often in educational research, because it is often impossible and sometimes unethical to randomly assign students to settings.

In quasi-experimental studies, researchers attempt to control for differences between non-randomly assigned groups in a number of ways. Two of the most common methods include (a) matching, and (b) statistical control. The following example explains the concept. A researcher is interested in comparing the effects of a traditional third-grade reading curriculum with the effects of an enhanced version of the curriculum that includes extra homework assignments. If the two versions of the curricula are being administered in different classrooms, the researcher can try to “match” similar classrooms on certain variables. For example, the researcher might decide to match classrooms on years of experience of the teacher, wherein teachers with much experience (e.g., 20 or more years of teaching experience) might be paired, so that for each pair of highly experienced teachers, one is assigned to each condition.

In addition, the researcher can statistically control for variables that are related to the outcome. If the researcher knows that variables such as socioeconomic status and prior reading ability are related to reading achievement, then the researcher can statistically control for these variables, in order to better assess the unique effects of the new curriculum.

Qualitative Research. Qualitative research represents a broad framework for conducting educational studies. Whereas *quantitative* research focuses on measurable variations between and among variables, *qualitative* studies focus on holistic descriptions of learners and teachers in naturalistic settings.

Fraenkel and Wallen (1996) describe five general characteristics of qualitative research studies. These include:

1. Researchers collect their data in naturalistic settings (e.g., classrooms), by observing and participating in regular activities.

2. Data are collected via words or pictures (not via numerical or quantifiable indicators).
3. Processes (i.e., how individuals communicate with each other about a lesson) are as important as products (i.e., whether or not students obtain the correct answers to a problem).
4. Most qualitative researchers do not start out with specific hypotheses; rather, they use inductive methods to generate conclusions regarding their observations.
5. Qualitative researchers care about participants’ perceptions; investigators are likely to question participants in depth about their beliefs, attitudes, and thought processes.

A variety of methods can be used to conduct qualitative studies. For example, qualitative researchers can collect their data from direct observations, from analyses of video or audio recordings, from interviews, or from long-term ethnographic studies.

There are a variety of different ways of analyzing qualitative data. Generally, researchers carefully examine their data and discover themes that emerge from the data. Sometimes several researchers will analyze the same sources of data and then compare their conclusions and examine the extent to which they agree or disagree (inter-rater reliability); in other studies, one researcher will conduct all of the analyses, and will also critically examine how his or her own biases may affect interpretations. Software packages have been developed to assist qualitative researchers with data analysis. Two of the most commonly used packages are Envivo and NUDIST.

Longitudinal and Cross-sectional Research. Many research studies in education focus on developmental issues (i.e., how individuals change over time). For example, it is known that the reading strategies that young children use are different from the reading strategies adopted by older children (Pressley & Harris, 2006). There are several different methods that can be used to examine such developmental phenomena.

In a *longitudinal* study, researchers collect data on the same individuals over a number of different time periods or “waves.” Thus the same group of students might complete study assessments at the end of first grade, second grade, third grade, and fourth grade. Researchers can then examine changes in student data across those four years.

In a *cross-sectional* study, researchers collect data on individuals of differing ages or developmental levels, at the same time. Thus data are collected for many students, at one time interval only. For example, a researcher might give assessments to 200 first graders, 200 second graders,

200 third graders, and 200 fourth graders all at the same time. Then the researcher can compare the results of students in these four different grades and try to draw some conclusions about developmental differences.

Most researchers agree that when possible, longitudinal studies provide better developmental data than cross-sectional studies. The primary advantage of longitudinal studies is that the same individuals are assessed at different time points; therefore, it is easier to make inferences about true development over time, since the distinct data points represent the same individuals across different time periods. However, longitudinal research is often difficult to conduct, because it is very expensive, and it is often difficult to track individuals over time; many of the students who participate in the first wave of data collection may have moved or may not want to participate in later waves of the study.

Design Experiments. When researchers conduct design experiments, they examine the effects of educational interventions in actual classrooms while the interventions are being implemented. As results are obtained and analyzed, the intervention is changed and continuously re-evaluated (Brown, 1992).

Cobb, Confrey, diSessa, Lehrer, and Schauble (2003) identified five overarching features of design experiments:

1. The purpose of design experiments is to develop theories about learning (including how learning is supported).
2. Design experiments involve an intervention, or the introduction of a new instructional technique.
3. In design experiments, researchers attempt to develop new theoretical perspectives, but also must test and refine their theories along the way.
4. Design experiments have iterative designs; as theories change during the study, the design of the study must be revised and altered accordingly.
5. The theories that are developed in design experiments should affect future instruction.

An example of a design experiment might be a study of a new curriculum designed to teach adolescents about HIV and pregnancy prevention. The curriculum might be introduced into the classroom setting; then, after initial presentation of the first few units, the researchers might collect data and then make some alterations to the next units, based on those data. This process can continue until the curriculum is substantially improved.

It is important to note that in design experiments, the changes in instruction that occur across iterations are often confounded with greater teacher familiarity with the

approach as a whole. This can be problematic, because it hinders researchers' abilities to make causal inferences.

Microgenetic Research. In microgenetic research studies, the same individual is observed intensively over a long period of time; this could be for many weeks or even months. Data are collected in order to examine both large-scale and small-scale changes in learners' use of strategies over time (Kuhn, 1995). Data can be analyzed via either quantitative or qualitative methods, depending on the types of data that are collected.

As noted by Chinn (2006), most educational research using a microgenetic approach has examined learners' usage of cognitive strategies (e.g., problem solving). Microgenetic studies are time consuming and be expensive, but they also can provide researchers with rich and detailed information concerning cognitive processes in learners. An example of a microgenetic study would be an examination of a kindergartner's strategy usage in solving simple addition problems over a three-month period.

Single-Subject Research. In a single-subject study, there is only one participant. Researchers generally examine a variable at a baseline stage (prior to the start of an intervention), and then later examine how this variable changes at different time intervals, as an intervention is introduced. In single-subject research, control or comparison groups are not used. Researchers are particularly interested in whether or not patterns replicate over time within the same subject; in addition, researchers also examine whether or not similar patterns can be generated in new subjects.

Single-subject studies are particularly common in the special education literature, although this methodology can be used in other areas of educational research as well. An example of a single-subject study would be an examination of the effect of classical music on the ability of a learning-disabled child to solve single-digit addition problems. First, the child's baseline addition skills would be assessed; then, the student's skills in the presence of music would be measured. The music might then be alternately started and stopped several times, while the student's problem-solving skills are continuously assessed.

Action Research. Action research is research that is conducted by classroom teachers, examining their own practices. The goal of action research is to examine one's practices critically and then to make changes to those practices based on the results of the research. Action research can be conducted by a single teacher, or by a group of educators working together.

Ferrance (2000) summarizes five steps in action research. These include:

1. Identify the problem or question that is going to be investigated.
2. Gather data to help answer the driving question. Data can be collected in many forms (e.g., interviews with students, surveys, journals, video or audio tapes, samples of student work, etc.).
3. Interpret the data by critically examining all data sources, and identifying major themes.
4. Evaluate results; in particular, examine whether or not the research question has been answered.
5. Take next steps—develop additional research questions, or make changes to instructional methods.

Action research can improve instruction for students; in addition, it can empower teachers, since it is a tool that allows them to judge their own efforts and evaluate the outcomes of their practices.

STRENGTHS AND WEAKNESSES OF RESEARCH DESIGNS

Each of the aforementioned research designs has both strengths and weaknesses. Some of these differences are obvious but others are not. Table 1 presents some examples of the key strengths and weaknesses of the various research methodologies discussed in this entry. This is not an exhaustive list; rather, it is provided to demonstrate that each methodology is complex and has both pros and cons.

When researchers and consumers of research evaluate the strengths and weaknesses of various designs, there are many issues to consider. Specifically, there are several key questions that can serve as a framework for evaluating research designs. The main questions are discussed below.

The Research Question. The research question is by far the most important question to consider when selecting and evaluating a research design. In all educational studies, the major research question should be articulated before the methodology is selected; the appropriate methodology should then be chosen based on that question. Most social scientists agree that a preferred methodology should not be used as a framework to guide research.

For example, a large school district might want to know if high school students' foreign language pronunciation is better after two years of studying Spanish or two years of studying French. The research question might be: What is the relation between studying French versus studying Spanish, and foreign language pronunciation after two years of study?

The researcher then must decide which research design is the most appropriate to answer the specific research question. In this example, the researcher can easily eliminate several options. For example, an experiment would be

impossible, since students cannot be randomly assigned to Spanish or French classes. In addition, the researcher might decide that qualitative and microgenetic studies are inappropriate, since the researcher is not interested in the processes or developmental trends that occur over time. There are several other questions that the researcher must also address that will help to finalize the decision.

The Sample Being Studied. Researchers must consider the nature of their samples when selecting a methodology. This is an important question because some methodologies are challenging to implement with certain populations.

For example, most studies that use survey-based methodologies require the participants to be able to read the survey items. If the sample included young children, or individuals with impaired visual abilities, then this might preclude the use of a self-administered survey. In addition, if the researcher is studying a large sample, with more than 1000 participants, in many cases this would prohibit the investigator from implementing single-subject designs, since the sample is so large.

Resources Available to Do the Research. Many resources are needed to complete research studies. Novice researchers often do not realize the cost involved with educational studies. A college student doing a small study for a research methods course will certainly not have the same resources available as an experienced investigator with a multimillion dollar grant.

Resources involve more than money. Another important consideration is personnel. Some research methodologies require more personnel than others. For example, a microgenetic study might be carried out by one investigator who can focus on the progress of a few subjects. In contrast, a large experimental study that requires collection of large amounts of data from many participants will require many more personnel. Thus if fewer resources are available, a researcher might not be able to use the ideal methodology to conduct a study.

Time is another important resource that often affects the type of methodology that is chosen for a particular study. A design experiment that involves continuous evaluation of progress and setting of goals might be ideal if a researcher has enough time to devote to a long-term study. Some studies (e.g., longitudinal studies) take a long time to complete. Thus a researcher who is interested in examining developmental issues, but who does not have a lot of time and funding, might select a cross-sectional methodology instead.

The Intended Audience for the Research. Different audiences will benefit from different kinds of research studies. If the audience is practitioners, then action

research might be highly appropriate. First, teachers can be directly involved in action research studies; second, other educators might be more willing to accept the results obtained from one of their peers via action research than from unknown researchers.

Certain funding agencies might be interested in only funding some types of studies. For example, there is much debate among educational researchers about the advantages and disadvantages of using experimental designs in educational research; whereas many funding agencies encourage experimental studies, many educational researchers argue that sometimes, true experiments are difficult to implement in actual classroom settings.

Using Mixed Methods. Many educational issues are multifaceted and complex; consequently, often one single methodology will not yield all of the essential information that researchers desire. Given the strengths and weaknesses of the various designs, and the many decisions that researchers must make before choosing a methodology, a number of scholars in recent years have begun to use mixed methods in educational research. When researcher use mixed methods, they use a variety of different methodologies within the same study.

A mixed methods study is usually challenging; the researchers must be able to utilize multiple designs appropriately. Some mixed methods studies involve two or more methodologies being carried out simultaneously, whereas others involve a succession of different studies, all designed to answer one general research question.

An example is a study conducted by Turner and her colleagues (Turner et al., 2002). In that study, the researchers were interested in examining the relations between early adolescents' perceptions of the classroom environment and the students' use of avoidance strategies (e.g., avoidance of asking for help from the teacher) in math classrooms. The researchers realized that the use of multiple methods would help them to best answer their research question. Therefore, they conducted a study in which longitudinal survey data were collected from a sample of more than 1,000 students. The researchers also randomly selected nine classrooms in which they conducted observations. The final analysis of data included quantitative results from the surveys as well as qualitative results from detailed discourse analyses from the classrooms. Each source of data provided different types of information, which allowed the researchers to examine a variety of indicators of the use of avoidance strategies by students. The quantitative survey data allowed the researchers to examine the relations of both student characteristics (e.g., gender) and students' perceptions of classroom environments to the use of avoidance strategies; the observational data allowed the researchers to

examine the discourse patterns in classrooms with different types of learning environments.

In summary, research methodology is a complex topic. This entry has described some of the most basic issues in the research enterprise, some of the methods that educational researchers use in their work, and some of the complexities involved in deciding upon an appropriate methodology. Ultimately, the methodology that is chosen will be determined by the specific research question and by the resources that are available.

Most research studies have limitations, which often are related to the design of the study. Research can always be improved, and it is important for scholars engaged in educational research critically to evaluate their designs and to acknowledge the limitations of their studies. As new researchers replicate previous studies, they often will attempt to eliminate the design problems encountered by previous researchers. This is one of the most important ways in which educational researchers can continue to improve and enhance knowledge about teaching and learning.

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Eric M. Anderman

RESISTANCE THEORY

School classrooms involve complex human and environmental interactions. The classroom-based cultural landscapes hold unique teacher-student and student-student interrelationships that can mirror socioeconomic experiences of the larger community. In all these relationships, human agency permeates teachers' and students' interactions. Students' interpretation of and their responses to classroom culture can have profound effects on their achievement. Belonging, cultural relatedness, and autonomy are some of many issues that play key roles in determining students' motivation to approach or resist participation in learning activities. Resistance theories, in particular, provide a unique description of the classroom culture by examining how students or teachers perceive and respond to cultural dominance. Generally, resistance involves actions that passively or actively oppose the dominant culture. These actions serve to preserve students' or teachers' (as the case may be) sense of autonomy and identity.

CULTURAL OPPOSITIONAL THEORY

John Ogbu and Signithia Fordham (Fordham, 1996; Fordham & Ogbu, 1986; Ogbu, 1991; Ogbu, 2003) propose a resistance theory that explores minority students' reactions to cultural dominance. Originating with John Ogbu, this theory explores how different ethnic groups respond to different cultural landscapes. Ogbu suggests that ethnic-minority groups in the United States fall into one of two categories: voluntary minorities or involuntary minorities. These categories matter in the interpretation of mainstream cultures. Voluntary minorities are those who came or whose ancestors came to the United States out of their own free will (e.g., Vietnamese, Irish). Involuntary minorities are those whose ancestors were brought to the United States by force (e.g., African Americans) or whose ancestors were forced into ethnic minority status by military force (e.g., Native Americans).

Ogbu posits that voluntary minorities hold positive beliefs about the dominant society and, as a result, are more likely to adopt the attitudes and practices of the dominant group. In contrast, involuntary minorities hold less positive beliefs about the dominant society. These groups, such as the African Americans and Native Americans, see the United States as taking away or compromising their civil liberties. Ogbu suggests that, for many involuntary minorities, adopting dominant attitudes or behaviors is perceived as supporting their oppression. These beliefs for involuntary minorities have been substantially investigated by Ogbu and Fordham (Fordham, 1996; Fordham & Ogbu, 1986; Ogbu, 1991; Ogbu, 2003). In school context, Ogbu's 1991 findings suggest that voluntary minorities have more positive attitudes toward schooling, teachers, and the curriculum. Whereas

Southeast Asian and Chinese students accepted greater responsibility for academic underachievement, involuntary minorities avoided responsibility and asserted blame on teachers and school administrators.

In addition to attitudes, Ogbu and Fordham argue that perspectives of involuntary minorities manifest themselves in "oppositional behavior." That is, involuntary minorities react according to their beliefs about the dominant culture by engaging in behaviors that is in opposition to it. To support this notion, Ogbu (2003) reports that, in school contexts, involuntary minorities are more likely to disengage in academic activities than voluntary minorities. Ogbu called such behavior the "norm of minimal effort." Ogbu also found that these behavioral norms to disengage from academic activities were reinforced by African Americans who label other African American students who pursue academic achievement as "acting white." Such labels reinforce the notion that participating in dominant institutions by involuntary minorities contributes to the power of the dominant culture. In other words, if one succumbs to participating in the institutions of the dominant culture, then one becomes a member of that culture.

Furthermore, it is common to hear the expression, "talking white," a similar label to "acting white," applied to African Americans who use standard English. Limiting standard English in school is an important oppositional behavior that resists the dominant school culture. Similarly, a study by Bryan Brown (2003) explored how minority students in a science class avoided using scientific terms during classroom discourse, thus continuing to oppose the standard curriculum and pedagogy. These oppositional behaviors can have significant negative results on students' achievement. Ogbu (2003) observed an interesting phenomenon among students who resisted succumbing to the dominant academic culture: These students, while believing that education can lead them to economic stability, also held beliefs that athletics and entertainment could also serve as pathways to similar, if not better economic outcome.

Finn (1999), while using Ogbu's notions to describe reasons for students' resistance, brings together research of other scholars to expand sociological reasons for students' resistance beyond resistance of involuntary minority communities. Finn synthesizes a body of research on resistance of students from working-class families (Anyon, 1981; Weis, 1990; Willis, 1977) to suggest that the mismatch between working-class students' goals and their teachers' goals creates a social environment that is reminiscent of the relationship between management and workers within a factory. Within such a relationship, the management's goals have to do with meeting production quotas whereas the workers' goals have to do with managing and lowering

the amount of work that is required while maintaining salaries that can support their families. Finn reports that in such work environments, workers often develop systems that slow down the productivity. Likewise, Finn makes the connection to working-class students who challenge their teachers, sometimes subversively, by developing mechanisms to lower the amount of required work. An example of such a mechanism is students' asking a series of relevant and irrelevant questions to waste class time.

Finn, then, makes an explicit connection between Ogbu's work on resistance of involuntary minorities and that of scholars who describe resistance of working-class students by describing the relationship between unions and management. Union members who are seen as not cooperating with the union and collaborating with management are often harassed by other union members. For example, workers who beat their quota are often called derogatory names, reminiscent of the "acting white" term that is described by Ogbu. Likewise, working-class students who are seen to increase the amount of work in the classroom are also alienated by their classmates. Such oppositional social structures are natural spawning grounds for oppositional identities that enable resistance to school work.

CRITIQUE OF OPPOSITIONAL THEORY

While Ogbu's notions are well known in the education research community, his ideas are not without critics. The first set of criticism comes from Solorzano and Dolores Delgado-Bernal (2001), who challenge Ogbu's theory by suggesting that Ogbu focuses on "self-defeating" resistance. They, instead, posit that resistance can also have transformative effects. In their reconceptualization of Ogbu's work, they argue that there are four main types of students' resistance. The first type of resistance focuses on opposition with no orientation or awareness of social justice or the dominant culture. During such resistance, students exhibit poor classroom behavior for the sake of disrupting classroom instructional activities. Another type of resistance is self-defeating resistance. As a part of this type of resistance, students engage in oppositional behaviors with no real goal for bringing about social justice, although they may have some notion about societal inequities. This is most similar to Ogbu's notions of oppositional behavior. The third type of resistance is labeled as the conformist resistance. These students are very much aware of social injustice but do not respond to these beliefs by their actions. These students adopt dominant behaviors, in spite of their knowledge about society and school contexts. Finally, Solorzano and Delgado-Bernal describe the final type of resistance, transformative resistance. These students see the world as unjust and engage in oppositional behavior to bring out social

justice. These behaviors may include students' working harder to disprove negative expectations about their academic abilities or to challenge poor and racist classroom curricula or pedagogy.

Interestingly, in addition to describing development of oppositional identities of working-class students, Finn (1999) also identifies transformative people who have the power to create educational environments. While he describes resistance from the perspective of differentiated goals for education between students and teachers, he also describes societal leaders as having the option to be transformative. Finn does not believe that education in which students unconditionally do the work that teachers assign is "powerful." He believes that students must participate in their own education and that educators should establish educational environments in which students have access to empower themselves. To this end, Finn draws on the work of Aronowitz and Giroux (1993) to describe three types of educators: hegemonic, critical, and transformative. Hegemonic educators work to maintain the status quo by recreating an educational environment that, in its own right, recreates the social classes of students. In such classrooms, working-class students attempt to lower their workload while middle-class students do all their assigned work and learn how to glean information from textbooks. Critical educators believe themselves to be free of bias and think that they provide the same education to all students, regardless of students' backgrounds, including ethnicity and socio-economic class. Nonetheless, critical educators maintain the status quo by not actively challenging it by empowering students to take control of their education. Transformative educators help their students actively resist societal hegemony and take the power of education into their control. This, of course, fits directly into Solorzano and Delgado-Bernal's 2001 notion of transformative resistance.

Research on resilience highlights this notion of transformative resistance. Researchers such as Hassinger and Plourde (2005) suggest that students adopt adaptive behaviors to disprove prevailing expectations or stereotypes. Solorzano and Delgado-Bernal (2001) describe how students engaged in resistance behavior in order to announce their opposition to California state policy limiting bilingual education. Their resistance was aimed at promoting, in their mind, social justice.

The work of Horvat and Lewis (2003) counters Ogbu's notions about the significance of the "acting white" label by suggesting two counter examples. First, they review literature that suggests that the behaviors associated with negatively labeling students who participate in academic pursuits reflect students' in-group/outgroup school hierarchies that are typical of teen-agers, regardless of ethnicity, similar to the description above of

working-class students resisting schoolwork. Second, Horvat and Lewis describe their own research in which they found that “acting white” was not a dominant force in African American female students’ academic decisions. They report that African American females who participated in their research navigated among diverse set of African American peers from various socioeconomic strata of society. This challenge to Fordham and Ogbu’s notions does not negate the phenomena of resistance, but it certainly complicates the occurrence of resistance among involuntary minorities.

IMPLICATIONS FOR CLASSROOMS AND TEACHERS

Research on resistance theory highlights the need for some students to actively engage in oppositional behaviors. This is a choice that they make and this choice may be based on awareness of the dominant culture and social injustice. The reasons for students’ resistance may be difficult for teachers to assess. Oppositional behaviors may be the result of peer cultural norms (Horvat & Lewis, 2003), disparate goals of students and teachers (Finn, 1999), or awareness of social injustice (Solorzano & Delgado-Bernal, 2001). In light of the latter two reasons, the teacher needs to facilitate students’ autonomy by allowing students to critique the curriculum and classroom pedagogy. Some researchers suggest that autonomy-supportive behaviors, such as permitting students’ opportunities to voice opinions and oppositions to classroom activities, promote engagement in and positive attitudes about the classroom (Assor et al., 2002).

Students who engage in oppositional behavior as a result of cultural norms, however, require a different set of responses from teachers. One solution comes from Freire’s 1993 notions regarding the pedagogy of the oppressed. While some students may resist standard curriculum as a tool designed to oppress them, teachers can use strategies that raise students’ awareness about societal inequities and provide tools by which students may combat social injustice.

Another task for teachers is to carefully examine what activities, behaviors, and artifacts are valued by the class culture and school administration. Oakes and Lipton (2003) suggests that some schools and teachers show what is important in schools by way of rewarding key behaviors or attitudes. For example, schools show that they value high grades by posting names of students with excellent academic achievement. For many schools, these students may be racially identifiable. Other talents or abilities that reflect more student diversity may not be highly valued by a school. Teachers and school communities should take a critical examination of what gets praised and rewarded, determine whether these values

favor one ethnicity over another, and search for activities that value and convey social justice.

Finally, Gloria Ladson Billings (1997; 1998; 2000) and Geneva Gay (2002; 2004; 2005) write extensively about teachers’ making their curriculum culturally relevant. They suggest that classrooms should be spaces in which students find a sense of belonging, in which students believe that their teachers understand them, and in which instructional activities reflect students’ experiences by building on their prior knowledge. In these classrooms, students should work with and not in opposition to the teachers because their experiences are a part of the classroom culture; there is a symbiotic relationship that supports and promotes positive learning experiences for students as well as teachers.

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REWARDS

Every teacher in every classroom throughout the United States uses strategies to acknowledge and encourage appropriate social and academic behavior by their students. These strategies take many forms, some overt and dramatic (presentation of tokens or recognition at an assembly), others more subtle and embedded in natural activities (a smile, the organization of a successful academic effort). This process of encouraging appropriate behavior and how best to incorporate this process in education has been a major focus of both research and professional controversy. As a result, understanding the role and function of rewards is in the early 2000s a central concern for many educators.

Since 1898, when E. L. Thorndike (1874-1949) described the law of effect, educators and psychologists have noted that when a behavior is successful it is more likely to occur again in similar circumstances. The success of a behavior lies in the result, effect, or consequence that behavior has on the environment. The simple message is that the consequences of a behavior affect future performance of that behavior. If, following the contingent delivery of a consequence, a behavior becomes more likely in the future, then that consequence was reinforcing or rewarding. This basic idea has been among the most intensely studied and validated phenomena associated with human behavior. The use of rewards in education remains a controversy, not over the principles governing its function, but in part due to two issues: (a)

the precise definition of rewards, and (b) the perceived effect of rewards on intrinsic motivation.

DEFINING REWARDS

Rewards (or the more technical term, reinforcers) are defined as any contingently delivered consequence (e.g., event, activity, object) associated with an increase in the future likelihood of a behavior in similar situations. This definition presents many problems when used in natural contexts such as homes, schools, and communities. When applied in a rigorous and precise manner, the definition allows an object or event to be classified as a reward, or reinforcer, only after demonstration that (a) the object/event was delivered contingent upon the performance of a behavior, and (b) the behavior became more likely to occur under similar conditions in the future. In practice, teachers and parents seldom wait to see the effect of a consequence on future occurrences of the behavior. It is far more likely that a teacher will simply presume that she or he has provided rewards when praise is delivered following sharing or points are assigned for correct problem completion, or access to preferred toys follows work completion.

An important distinction here is that the technical definition of a reward (reinforcer) always adopts the perspective of the learner, not the intentions of the person delivering the reward. If the contingent delivery of a consequence resulted in increased likelihood of that behavior, then the consequence was a reward. If the consequence was a piece of preferred fruit, and the behavior increased, then the fruit was a reward; if the consequence was a sticker, and the behavior increased, then the sticker was a reward; if the consequence was a reprimand (which included adult attention), and the behavior increased, then the reprimand was a reward. It is the effect of the consequence on future behavior that determines if that consequence is a reward (reinforcer).

If a consequence does not lead to increased likelihood of the behavior, then it was not a reward, even if the person delivering the consequence had the best of intentions. If a teacher's praise for on-task working is followed by a reduction in level of being on-task, then the teacher's praise was not a functional reward (reinforcer). If the delivery of tokens for sharing on the playground does not lead to increased sharing, then the tokens were not a reward. From a technical perspective, rewards are defined by the effect they have on behavior, not on their intended desirability. In this way, an event, activity, or object can never be defined as a reward without connecting it to the behavior that was affected by contingent access to that event, activity, or object. Practically, teachers will deliver feedback and consequences that they presume are rewards. Those teachers with

technical knowledge, however, will always check the effect of that presumed reward on student behavior.

Understanding rewards is of special importance because teachers not only want desirable behavior to be rewarded, but they also want to avoid rewarding undesirable behavior. A reprimand, for example, may not have been intended to be a reward, but may still function in that capacity. One of the more common findings in schools is that teachers inadvertently reward inappropriate child behavior by attending to talking out or disruptive acts. Similarly being sent to the office may be rewarding to some students if it involves escaping from aversive or difficult work. If a behavior is contingently followed by (a) obtaining a desirable event/activity/object or (b) avoiding an aversive event/activity/object, then the behavior will become more likely to occur in similar situations in the future. Said differently, the behavior has been rewarded.

Rewards are important for both encouraging appropriate behavior and preventing the encouragement of inappropriate behavior. What the science of human behavior teaches, is that teachers should adopt the perspective of the learner when they plan how to select and deliver rewards. The following are some basic guidelines:

- Reward behavior not people. When rewards are provided be clear about the specific behavior that led to the reward.
- Include the learner in identification of possible rewards. Use consequences that are likely to be rewarding to the students.
- Use small rewards frequently, rather than large rewards infrequently.
- Embed rewards in the activity/behavior that is to be encouraged.
- Ensure that rewards closely follow the behavior that is to be encouraged.
- Try to reward quickly because doing so tends to be more effective than delaying the reward.
- Use rewards that are natural to the context, appropriate to the developmental age of the learner, and easy to administer.
- Use many different kinds of rewards (objects, activities, privileges, attention, natural consequences) rather than relying on one strategy or pattern.
- Use rewards more often than negative consequences. Students should experience at least five times the number of rewards as they do corrections or punishers.
- Avoid delivering rewards (even inadvertently) for problem behaviors.

THE IMPACT OF REWARDS ON INTRINSIC MOTIVATION

Some people wonder if the formal use of rewards in schools may result in children failing to develop intrinsic, or self-managed, motivation. Reading should be a behavior that becomes more frequent because the content of what is read is rewarding, not because a token or play period will follow reading. Sharing on the playground should occur because a child experiences personal satisfaction from behaving well, not because the child receives candy if she shares. Similarly, some people wonder if a teacher provides a reward to Child A for excellent math work, it will be a negative, or punishing, experience for Child B who did not receive a reward, tried just as hard, but did not get as many problems correct. These concerns were substantiated in research conducted in the 1970s (Deci, 1971; 1975; Lepper, Greene & Nisbett, 1973) and have led to strong recommendations against the formal use of praise and extrinsic rewards (e.g., tokens, food, activities, privileges) in schools (Deci, Koestner, & Ryan, 2001; Kohn, 1993; 1996). There is evidence that rewards can be used poorly. The primary errors involve (a) providing rewards without being clear about the behavior being rewarded, (b) inadvertently providing rewards for problem behavior, (c) providing large rewards and then suddenly (rather than gradually) withdrawing the rewards, and (d) providing rewards so infrequently that a child never builds the skill fluency needed to attain the natural benefit of a skill (e.g., does not learn to read fast enough or well enough to enjoy reading). These errors are worth considering and avoiding.

The concern that rewards damage the intrinsic motivation of students is less well supported by research. Most educators will agree that academic and social skills learned in schools should be maintained by natural consequence, not artificial rewards. Reading, math and play skills should not end when a teacher is no longer present to offer verbal praise, toys, or stickers. The rewards provided for the behavior of one student should not function as a punisher for all others. There is less agreement (and much less evidence) that the use of rewards in schools leads to these ill effects.

To address these concerns several scholars examined the full body of research literature and concluded that schools successfully employed the use of external rewards for decades (Slavin, 1997) and the use of rewards following appropriate behavior is directly related to both initial and durable academic and social success. Rewards are an effective, important, and functional part of any educational context and need not be detrimental to intrinsic motivation (Akin-Little, Eckert, Lovett, & Little, 2004; Cameron, Banko, & Pierce, 2001). Rewards are especially important for helping motivate a child to build early

competence (fluency) with reading, math, or social skills. Encouragement, guidance, and reward of appropriate approximations of successful behavior are helpful for students in building the skills that can then be sustained by the natural consequences from reading well, joining games with peers, or playing a musical instrument. Rewards also are important for building a predictable, positive social culture in a school. Schools with clearly defined behavioral expectations and formal strategies for acknowledging (rewarding) appropriate behavior are perceived as safer, more effective learning environments. The delivery of rewards is one overt way in which children learn that adults are serious about the social and academic goals they are teaching.

Understanding and using rewards is an essential skill for any educator. Selecting the right type, level, and form of rewards to encourage student behavior is a competence developed over time and is a hallmark of effective teaching.

SEE ALSO *Feedback in Learning*.

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ROGOFF, BARBARA

1950–

Born in 1950, Barbara Rogoff received her B.A. in psychology with honors from Pomona College in 1971.

From 1971 to 1972 she attended the École de Psychologie et Sciences de l'Éducation at the University of Geneva, where she studied with Barbel Inhelder. In 1977 Rogoff received her Ph.D. in developmental psychology from Harvard University, where she was mentored by Sheldon H. White, Jerome Kagan, and Beatrice Whiting. During her graduate training, she spent a year in Guatemala as a field psychologist at the Institute of Nutrition of Central America and Panama, which began a decades long involvement with the Tz'utujil Mayan community of San Pedro, Guatemala. There she collaborated with the anthropologists Benjamin and Lois Paul. From 1977 to 1992 she was a member of the Department of Psychology at the University of Utah. In 1992 she joined the faculty at the University of California at Santa Cruz, where as of 2008 she was the UCSC Foundation Professor of Psychology. She is a Fellow of the American Psychological Association, the American Psychological Society, and the California Academy of Science, as well as a member of the National Academy of Education. She has been a Fellow at the Center for Advanced Study in the Behavioral Sciences and a Kellogg Fellow.

Rogoff has advanced theory and research on the cultural and social bases of human development. In 1975 she collaborated in a landmark study that examined the ethnographies of 50 cultural communities and documented a shift between 5 and 7 years of age in children's roles and responsibilities across these settings. This research contains two themes that came to be central to Rogoff's research: the cultural variability of child development and the developmental processes in these culturally diverse paths. In 1981 Rogoff drew on a wide range of anthropological and psychological research to describe how the cultural institution of formal schooling relates to cognitive development. She concluded that contemporary understanding of cognitive development is deeply entwined with children's experiences with formal schooling and, thus, limited in its ability to account for the range of human intellectual development.

From the 1970s into the early 2000s, Rogoff pursued these ideas in empirical research on memory, problem solving, planning, communication, and attention. She examined cultural contributions to development as well as how cultural ways of thinking are fostered in children through social interaction. This research, coupled with her ethnographic work in Guatemala, led to the concept of guided participation, a concept that pointed out that children's learning is based on their own participation in cultural activities, at the same time that other people and the community also provide them with varying forms of guidance. In one form of guided participation, learning through intent community participation, Rogoff described learning as children participate in the range of everyday activities of their community, in

Rules and Procedures

the company of more experienced cultural members. Although these activities are sometimes instructional, they often occur in the midst of adult activities in which the primary purpose is not to instruct the child but to carry out the activity. An important component of her approach is the idea that children are participants in cultural activities from the outset of development, in one form or another. For Rogoff (2003), intent community participation, in which children seek opportunities to observe, initiate, and engage in the activities that are important in their community, is one of the most prevalent forms of children's learning.

Rogoff's approach redefines development in a fundamental way with her view that the proper level of developmental analysis is not the solitary child but rather the child's changing participation in socially and culturally organized activity. This approach, integrating the social and cognitive processes of human development is described in her 2003 book, *The Cultural Nature of Human Development*, which was awarded the APA William James Award for advancing the field of psychology.

SEE ALSO *Guided Participation*.

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Mary Gauvain

RULES AND PROCEDURES

SEE *Classroom Management: Rules and Procedures*.

S

SCAFFOLDING

Scaffolding is an often-used construct to describe the ongoing support provided to a learner by an expert. In this entry, the original notion of scaffolding and its key tenets are discussed, followed by a description of the use of the construct in classrooms and in computer-based systems. The challenges of providing scaffolding to students in a classroom are also discussed.

Scaffolding has been defined by Wood, Bruner, and Ross (1976) as an “adult controlling those elements of the task that are essentially beyond the learner’s capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence.” The notion of scaffolding has been linked to the work of Soviet psychologist Lev Vygotsky (1896–1934). However, Vygotsky never used the term *scaffolding* (Stone, 1998), but emphasized the role of social interaction as being crucial to cognitive development, so that learning first occurs at the social or interindividual level. Thus, when a child (or a novice) learns with an adult or a more capable peer, the learning occurs within the child’s *zone of proximal development* (ZPD). ZPD is defined as the “distance between the child’s actual developmental level as determined by independent problem solving and the higher level of potential development as determined through problem solving under adult guidance and in collaboration with more capable peers” (Vygotsky, 1978, p. 86). Enabling the learner to bridge this gap between the actual and the potential depends on the resources or the kind of support that is provided.

KEY FEATURES OF SCAFFOLDING

The original notion of scaffolding assumed that a single more knowledgeable person, such as a parent or a teacher, helps individual learners, providing them with exactly the support they need to move forward (e.g., Bruner, 1975; Wood et al., 1976). One of the most critical aspects of scaffolding is the role of the adult or the expert. The expert is knowledgeable about the content of instruction as well as a facilitator with the skills, strategies and processes required for teaching. The expert not only helps motivate learners by providing just enough support to enable them to accomplish the goal, but also provides support in the form of modeling, highlighting the critical features of the task, and providing hints and questions that might help learners to reflect (Wood et al., 1976). In this conception then, the adult’s role has perceptual and cognitive as well as affective components (Stone, 1998).

Although the role of the adult is crucial, descriptions of the notion of scaffolding (Langer & Applebee, 1986; Palincsar, 1998; Reid, 1998; Stone, 1998) point to several other key elements of scaffolded instruction:

1. *Common goal.* Shared understanding, described as *intersubjectivity* (Rogoff, 1990), is of critical importance in scaffolded instruction. Intersubjectivity refers to the combined ownership of the task between the adult and the child, and setting a common goal.
2. *Ongoing diagnosis and adaptive support.* Perhaps the most important feature of scaffolding is the fact that the adult is constantly evaluating the child’s progress and providing support that is appropriate for “*this*

tutee, in *this task at this point in task mastering*” (Wood et al., 1976, p. 97). This results in interactions that are different in “content and form from individual to individual” (Hogan & Tudge, 1999), and for the same individual at different times. As Wood and colleagues (1976) described, scaffolded interactions comprise of a theory of the task and a theory of the tutee. The adult needs to have a thorough knowledge of the task and its components, the subgoals that need to be accomplished, as well as knowledge of the child’s capabilities as they change throughout the instruction.

3. *Dialogues and interactions.* A critical factor in the ongoing diagnosis and calibrated support is the dialogic nature of scaffolding interactions, so that the learner is an active participant and a partner in deciding the direction of the interaction, and not a passive recipient. The dialogic nature of scaffolding is best illustrated in the reciprocal teaching studies of reading (Brown & Palinscar, 1985; Palinscar & Brown, 1984), in which students took turns leading the group discussion, engaging in comprehension monitoring strategies.
4. *Fading and transfer of responsibility.* The final feature of scaffolding is reducing the support provided to learners so that they are in control and take responsibility for their learning. The best scaffolding will eventually lead learners to internalize the processes they are being helped to accomplish (Rogoff, 1990). In the original description by Wood and colleagues (1976), the important aspect of the transfer of responsibility is that the child has not only learned how to complete a specific task, but has also abstracted the process of completing the particular task.

EXAMPLES OF SCAFFOLDING

The early studies that described scaffolding, be they descriptions of parent-child interactions (Greenfield, 1999) or classroom interactions (Langer and Applebee, 1986), were observational rather than interventionist studies. One of the earliest accounts of an interventionist study of scaffolding is Wood, Bruner and Ross’s 1976 study in which 3-, 4-, and 5-year-olds engaged in a task of building a pyramid from interlocking blocks, with guidance from a tutor. Each child was tutored individually and the tutor followed a set of guidelines for her tutoring. But the tutor did not always follow pre-set rules in her interactions; instead she provided just enough assistance to help the child move forward—assistance that was sensitive to, and adapted based on, the child’s progress. Wood and colleagues documented six types of support that an adult can provide: recruiting the child’s interest, reducing the degrees of freedom by simplifying the task, maintaining

direction, highlighting the critical task features, controlling frustration, and demonstrating ideal solution paths.

Perhaps the most well-known example of the notion of scaffolding in the classroom is the work on reciprocal teaching (Palinscar & Brown, 1984; Brown & Palinscar, 1985). In this study, groups of students were supported in the process of reading by strategies such as self-directed summarizing (review), questioning, clarifying, and predicting. A teacher or a more capable peer took the lead in modeling the strategies until students in the group could apply them on their own. The teacher or the peer modeled the strategies and used prompts and questions to enable students to apply the four strategies. As described by Palinscar and Brown (1984), the teacher used strategies such as prompting (“What question did you think a teacher might ask?”); instruction (“Remember, a summary is a shortened version, it doesn’t include detail”); and modifying the activity (“If you’re having a hard time thinking of a question, why don’t you summarize first?”) (Palinscar & Brown, 1984, p. 131). Both the Wood, Bruner, and Ross study and the reciprocal teaching studies highlight how the key features—intersubjectivity, ongoing diagnosis, tailored assistance, and fading—were attained in the dynamic, interactive environment. Whereas the study by Wood and colleagues illustrates the tutorial interventions in a one-on-one situation, the reciprocal teaching studies were conducted with small groups of learners. In addition, both the quality and the quantity of support were varied, based on the needs of a particular learner. As the learners attained competence, the scaffolding was faded, giving them more control.

SCAFFOLDING IN CLASSROOM SITUATIONS

The notion of scaffolding is increasingly being used to describe the support provided for students to learn successfully in classrooms, especially the use of project- or design-based activities to teach math and science (e.g., Kafai, 1994; Kolodner et al., 2003; Krajcik et al., 1998). Many of these approaches are based on a socioconstructivist model (Vygotsky, 1978; Wertsch, McNamee, McLare, & Budwig, 1980) emphasizing that learning occurs in a rich social context, marked by interaction, negotiation, articulation, and collaboration. The original notion of scaffolding, as used in the initial studies of parent-child interactions (Bruner, 1975) or in teacher-student interactions, focused on situations that allowed for one-on-one interactions between the adult or the expert and the learner. The one-on-one nature of the tutoring allowed the adult/teacher to provide “titrated support” (Stone, 1998) that changed based on the progress made by the learner. However, classroom situations involving many students do not allow for the fine-tuned, sensitive, personalized exchange that occurs in one-on-

one or small-group scaffolding (Rogoff, 1990). Therefore, instead of one teacher working with each student, support is provided in a paper or software tool that individuals interact with, or classroom activities are redefined so that peers can help each other (e.g., Bell & Davis, 2000; Jackson, Krajcik, & Soloway, 1998; Puntambekar & Kolodner, 2002; Reiser et al., 2001).

SOFTWARE TOOLS IN THE CLASSROOM

Software environments that provide support have been developed with the goal of supporting students in the processes that they might find difficult in a complex task when it is not possible for a teacher to attend to each student in a class. Several software tools have been developed to prompt students to reflect, articulate, and complete the steps of a complex task. Examples of such software include ThinkerTools (White & Fredrickson, 1998), Knowledge Integration Environment or KIE (Bell & Davis, 2000), Progress Portfolio (Loh et al., 1998), BGuILE (Reiser et al., 2001) and Model-It (Jackson, Krajcik, & Soloway, 1998).

Quintana and colleagues (2004) have put forth a comprehensive scaffolding design framework for building software tools to help students learn from inquiry-based science activities. Their framework is based on the difficulties that students have during science inquiry and focuses on such aspects of the inquiry process as process management, i.e., the ability to engage in processes and activities required for inquiry; sense making, which they describe as difficulties that learners experience in making sense of their work and finding a direction; and data recording and analysis and articulation.

Reiser (2004) proposed two mechanisms as being essential to software tools that scaffold complex learning: structuring and problematizing. Structuring is believed to scaffold students by decomposing the task and guiding them through the steps of a complex task. Structuring can be provided by using prompts that help students with reflection and articulation, helping them move forward in a complex task. For example, in the software tool Explanation Constructor (Reiser et al., 2001) is an electronic journal that helps students construct their science explanations. In this tool, structuring is provided for articulation and reflection by having students record their research questions, construct explanations, and articulate their findings. In other words, structuring breaks down a complex task into constituent steps to make it more manageable to students. Problematizing, as Reiser described it, "is the flip side of structuring" (p. 287). It involves having learners confront the complexity of the task by helping them focus on aspects of the task that need to be resolved. For example, having students analyze

their findings based on a theoretical framework forces students to think about the theoretical constructs that they should use in their explanations, supporting the notion of problematizing.

Software tools and frameworks are based on the difficulties that students have and help students with complex tasks and several strategies that they need. They provide an important first step in the design of scaffolding; however, if the tools do not fade the support, and do not vary the support for different users, they lack the most critical elements of scaffolding, that of ongoing diagnosis and calibrated support.

PEER INTERACTIONS

In addition to software tools, peer interactions have also been considered important for scaffolding in classrooms. In contrast to the adult being the expert in the traditional notion of scaffolding, in peer interactions students support one another through their interactions. Brown and colleagues (1993) emphasized the multidimensional nature of the interactions in a classroom embodying the communities of learners approach. In this environment, the researchers note:

[learners] of all ages and levels of expertise and interests seed the environment with ideas and knowledge that are appropriated by different learners at different rates, according to their needs and to the current states of the zones of proximal development in which they are engaged.

For example, a modified version of the jigsaw method is used in this approach in which a research theme is divided into subtopics and students in each research group are assigned different topics. Thus every group has a member who is working on a subtopic and every member in a group works on a different subtopic. All the students work on their subtopic and then students come together in reciprocal teaching groups to put their information together and complete the jigsaw. Expertise is therefore distributed amongst all participants, who are engaged in supporting and critiquing one another, justifying views and opinions, and offering suggestions and explanations. The teacher's role changes from that of being a knowledge giver to a facilitator of a community in which students engage in reasoning and justification, eventually helping them to adopt these crucial skills.

DISTRIBUTED SCAFFOLDING

With software tools and peer interactions being used as a way to support learning in classrooms, researchers theorize about a *system* of scaffolding that can describe the complex nature of providing support to multiple students in a classroom. Puntambekar and Kolodner (2005) put forth the notion of *distributed scaffolding* to explain

multiple forms of support in the complex environment of a classroom. In this context, support for the design process was provided through the design diaries; in addition, tools such as pin-up sessions and gallery walks were used to help students discuss their designs, providing opportunities for support from teachers and peers. Puntambekar and Kolodner (2005) found that multiple forms of support, distributed across available tools, activities, and agents in the classroom, and integrated in ways that admit redundancy, enhance the learning and performance of a wide variety of students in the classroom. In a complex classroom environment, it can be difficult to align all the affordances in such a way that every student can recognize and take advantage of all of them. When support is distributed, integrated, and multiple, there are more chances for students to notice and take advantages of the affordances of the environment and the activity.

Tabak (2004) presents the notion of *synergistic* scaffolds, as a form of distributed scaffolding. According to Tabak, synergy refers to a pattern of scaffolding in which different kinds of support, such as software and teacher coaching, address the learning need but in different ways. Tabak (2004), states that “synergistic scaffolds are different supports that augment each other; they interact and work in concert to guide a single performance of a task or goal” (p. 318). For example, the software could help students reflect while the teacher might model the necessary strategies, so that the software and teacher support together provides students with a complete set of supports to help them successfully complete the task.

With the development of software tools and classrooms interactions as forms of scaffolds, the notion of scaffolding has evolved since its original conception and has changed considerably from the 1990s into the early 21st century. While later approaches have helped researchers understand the kinds of support that are needed to help classroom communities learn successfully, there have also been some aspects of scaffolding that have been difficult to achieve because of the reality of scaffolding in a classroom. Thus, although the notion of scaffolding has evolved, and understanding of providing support in multiple formats has been enriched, it is necessary to think about the critical elements that are missing, such as the ongoing diagnosis of student learning, the careful calibration of support, and fading, the transfer of responsibility to the student.

Current instantiations of the scaffolding construct have addressed a key aspect of scaffolding, i.e., that scaffolding be based on knowledge of the task and the difficulties that students have. However, the tools are permanent and unchanging; they provide structure and consistency by highlighting the aspects of the tasks that students should focus on. While this is by no means

trivial, support becomes scaffolding only when it is adaptive, based on an ongoing diagnosis of student learning, and helps students to eventually internalize the knowledge and skills when the scaffolds are removed. More research is needed into how a system of scaffolding can be built, so that ongoing diagnosis and fading can be achieved in classroom situations.

SEE ALSO *Sociocultural Theory; Vygotsky, Lev Semenovich.*

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Sadhana Puntambekar

SCHOOL BELONGING

The term *school belonging* refers to students' subjective perception of being accepted and respected in their particular school setting. Some researchers have also examined the parallel perception in relation to specific classes; typically using the term *class belonging*. Baumeister and Leary (1995) have proposed that all people have an innate need to belong to social groups and to form positive interpersonal relationships with others. Given the amount of time children and adolescents spend in educational settings and the societal importance attached to school-related activities, students' sense of belonging in those settings is particularly important for their healthy development.

Carol Goodenow (1993) defined students' sense of belonging as the sense of "psychological membership in the school or classroom, that is, the extent to which students feel personally accepted, respected, included, and supported by others in the school environment" (p. 80). Other researchers have studied similar perceptions using terms such as *school connectedness* or *bonding to school*; however, these terms are less common (see Anderman & Freeman, 2004, for a review).

The fact that different researchers have examined similar psychological constructs using different terms can make it difficult to synthesize the findings of studies related to students' sense of belonging. Furthermore, this difficulty extends beyond simply the terminology that is used to include differences in both the psychological theories or models that researchers use and the specific ways in which they measure individuals' perceptions of belonging. Because the sense of belonging or connectedness is a subjective perception, it is best measured using students' self-reports. This is done, most commonly, through the use of questionnaire measures, although interviews with students can also be used (e.g., Kester, 1994). Even within the use of questionnaire measures, however, considerable differences exist in the specific measures available. Perhaps the most widely known measure of school or classroom belonging is the Psychological Sense of School Membership Scale (PSSM; Goodenow & Grady, 1993). This measure includes 18 items and was originally developed for use with students in middle school, focusing on students' sense of being liked, included, and respected in their school. More recently, several researchers have adapted the PSSM to develop shorter versions and for use with college-age students. In contrast to the PSSM, other researchers have used measures that include somewhat broader constructs that include the sense of belonging in conjunction with other perceptions and attitudes (such as valuing academic activities or holding shared group norms). These differences contribute to the sometimes mixed findings from research, which are described in more detail below.

CONSEQUENCES OF FEELING A SENSE OF BELONGING

Researchers interested in students' sense of belonging have examined the perception of subjective membership and acceptance at both the classroom and more general school level, although the latter is more common. Regardless of this distinction, and across a range of grade levels, students' sense of belonging has been associated consistently with a variety of positive academic and affective variables. Furthermore, there is growing evidence that the positive consequences of feeling a sense of

belonging transcend ethnic and cultural differences in students (e.g., Sanchez, Colon, & Esparza, 2005).

In terms of academic variables, one of the most common findings is that students' sense of school belonging is associated with a range of adaptive motivational beliefs. For example, students' sense of belonging in a particular class has been associated with higher expectancies for success in that class; higher perceptions of class tasks as being interesting, important and useful; and intrinsic and mastery goal orientations related to the class. Sense of belonging at the school level has also been associated with more general measures of school-related motivation, self-reported effort, and reduced absenteeism. In contrast to the research on students' academic motivation, the literature is much less clear with regard to associations between students' sense of belonging and their academic achievement. In this area, findings are very mixed. Furthermore, the design of many studies does not allow for clear statements of the direction of effects. That is, although some researchers have reported a positive association between sense of belonging and achievement, it may be that students with a stronger record of prior achievement are more likely to feel as though they are accepted and respected in school, compared to their lower-achieving peers. It is not clear whether promoting a sense of belonging can help a student to achieve at higher levels in the future. Nevertheless, many researchers believe that students' sense of belonging and academic achievement may be reciprocally related over time, with each positive outcome reinforcing the other. Of course, for some students, low levels of perceived belonging and poor academic performance may similarly reinforce one another.

Finn (1989) proposed an Identification-Participation model to describe the process by which some students become alienated from, and eventually drop out of, school. In this model, Finn suggests that a sense of belonging combined with valuing of school-relevant goals (called "identification with school") leads to an increase in the quality, as well as the quantity, of students' participation in school activities. Such increased participation, when met with quality instruction, then leads to successful performances and achievement which, in turn, contribute to a greater sense of identification. In other words, Finn proposes that academic achievement can be both a precursor to and an outcome of the sense of belonging. An important point of Finn's model, however, is recognizing that the sense of belonging is necessary but not sufficient for students' achievement. Simply feeling accepted and respected, without accompanying valuing of school-related goals and appropriate instruction, will not lead to successful performance on academic tasks.

In addition to academic outcomes, researchers also have investigated associations between students' sense of

belonging and a range of affective and well-being related outcomes. One highly influential study published by Resnick and his colleagues (1997) reported that the sense of school connectedness (another term for school belonging) was associated with lower levels of emotional distress, lower suicidal ideation, lower levels of involvement in violence, and less frequent use of tobacco, alcohol, and marijuana in adolescents. Subsequently, other researchers have found perceived school belonging to be associated with lower levels of depression and general negative school-related affect, along with avoidance of behavioral problems in school. In addition, belonging is associated with increased positive school-related affect, empathy, self-esteem, and higher levels of general optimism (E. Anderman, 2002; L. Anderman, 1999; Battistich, Solomon, Kim, Watson, & Schaps, 1995).

FACTORS THAT CONTRIBUTE TO THE SENSE OF BELONGING

Given the range of positive academic and affective outcomes associated with students' sense of belonging, it is important to understand those factors that support this perception. Unfortunately, the research in this area is less extensive than that described in the previous section (see Anderman & Freeman, 2004, for a review of this research). Some researchers have reported differences in the sense of belonging in terms of characteristics of the students themselves. For example, there is some evidence that, among adolescents, girls tend to report higher levels of school belonging than do boys. Similarly, as noted earlier, adolescents with lower levels of academic achievement may be less likely to report a sense of belonging than their higher-achieving peers.

Some researchers have also reported differences in reported school belonging related to students' ethnicity; however, the findings in this regard are quite mixed. Although some data suggest that minority students feel less sense of belonging in their schools than do White students, it may be that students' representation within the school population is a critical factor. That is, when African American or Hispanic students make up the majority of a school's population, and particularly when the teaching faculty is ethnically mixed, those minority students have been found to report higher levels of belonging than their White classmates. In other words, minority status in relation to the population of the school, rather than in the more usual sense of the term, may be the more important determinant of students' sense of belonging. Finally, in terms of individual characteristics, students' beliefs about the academic work presented in their classes and their self-concepts also are related to their sense of belonging. A strong global self-concept and high perceived task values (that is, the perception that tasks are interesting, important, and useful;

see Eccles & Wigfield, 1995) are strongly associated with higher levels of belonging.

Beyond individual and group differences in students' sense of belonging, there also is evidence that several characteristics of schools and classrooms themselves can help to foster the sense of belonging for all students. There is clear evidence that average levels of students' sense of belonging vary significantly across schools and classrooms (see Anderman & Freeman, 2004, for a review). Interestingly, these differences do not appear to be systematically related to school or class size, or school type (e.g., public, private, or parochial). In contrast, there is some evidence that students may report higher levels of belonging in rural schools compared to urban schools, and in K-8 or K-12 structured schools compared to traditional middle and high school structures. Finally, average levels of school belonging in adolescents may tend to be higher in schools in which larger numbers of students participate in extra-curricular activities.

Beyond characteristics of the school in general, the instructional and interpersonal characteristics of specific classes also contribute to students' perceptions of belonging at both the class and general school level. In fact, these more proximal influences may be more important in shaping students' day-to-day experiences than are school-level factors. Furthermore, the variables that have been associated with higher levels of belonging are quite consistent across students of different ages, ranging from elementary school to undergraduate students in college.

Battistich, Solomon and their colleagues conducted a long-term intervention in elementary schools, known as the Child Development Project (CDP), aimed at creating a greater sense of community in students. In this work, a sense of community included students' sense of belonging, along with the development of shared values and having a role in decision-making. Schools in the CDP program adopted a range of policies and practices, including the use of cooperative learning activities, developmental discipline strategies, emphasizing interpersonal helping and prosocial behavior, and promoting non-exclusionary attitudes in their students. Direct observation of teachers' classroom behaviors demonstrated that warmth and supportiveness, emphasis on prosocial values, encouragement of cooperation, and elicitation of student thinking all were associated with an increased sense of community among students.

Research conducted in middle-school settings also supports the importance of a classroom social environment characterized by mutual interpersonal respect. L. Anderman (2003) examined change in middle school students' sense of belonging over time and found that, in spite of an overall decline in belonging between sixth and seventh grades, this decline was partially corrected when students

perceived their teachers as requiring students to treat one another respectfully. In addition, that study showed strong support for the importance of a classroom context that focused on individual mastery and learning as the purpose for academic tasks (that is, a mastery goal focus, Ames, 1992). Across the sixth and seventh grades, a perceived focus on meaning and understanding in academic tasks was the single strongest predictor of students' sense of belonging in school, even after other characteristics were taken into account. Finally, preliminary research conducted in college classrooms suggests that very similar characteristics may help promote a sense of class belonging for undergraduate students. Not only is a sense of belonging still important for students at the college level, but their sense of belonging is higher in classes where instructors encourage student participation, are perceived as warm, friendly, and helpful, and as being well organized and prepared for classes (Freeman, Anderman, & Jensen, 2007). Less research has been conducted on promoting a sense of belonging in high schools. This remains an important area to be developed.

IMPLICATIONS FOR TEACHERS

As described in the preceding section, empirical research has demonstrated the importance of a number of school- and classroom-level policies and practices for fostering and maintaining students' subjective sense of belonging. What is particularly notable about these findings is, first, the remarkable consistency in findings across widely varying age groups and, second, that many of the characteristics identified are able to be modified. In other words, students' sense of belonging seems to be shaped less by fixed and objective characteristics of their schooling (such as school size) and more by those attitudes and practices that are within educators' power to control.

Perhaps the first and most important implication of this body of research for teachers is that they need to recognize the value of students' sense of belonging, both in their classes and in the school as a whole. Being aware of students' subjective sense of acceptance, respect and inclusion, as distinct from their objective membership of the school community, may be an important first step in sustaining students' academic and affective development and well-being. Beyond this initial awareness, the research literature also points to a number of specific characteristics of classes that are likely to foster students' sense of belonging at all levels.

In terms of instructional practices and pedagogy, teachers who encourage high levels of student participation in activities, particularly those who ensure equal participation from all students, are likely to foster a sense of class belonging. Importantly, this benefit is most likely to occur when participation is designed as cooperative

and focused on the individual pursuit of understanding and mastery, rather than as demonstrating one's knowledge before classmates or competing. Students' sense of belonging can also be fostered through participation in decision-making within class, such as helping to develop class rules for behavior, or having some limited choices in terms of academic tasks. Teachers who are perceived as committed to their students' learning, holding high expectations for student success and providing assistance when it is needed, also are likely to promote a sense of belonging. Beyond the strictly pedagogical aspects of classes, the interpersonal and affective tone of classes also will support students' sense of belonging. Teachers need to communicate their own warmth and availability to students but they also play a critical role in setting the climate for interactions among students in class. Teachers can communicate the importance of prosocial and cooperative attitudes, active participation and mutual respect among class participants. Taken together, this research suggests that teachers will be most likely to promote and maintain students' sense of belonging when they are able to balance a strong focus on students' learning and academic progress with a climate of warm and supportive interpersonal relationships in class.

SEE ALSO *Classroom Environment; School Climate.*

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Lynley H. Anderman

SCHOOL CLIMATE

Definitions of school climate include a critical core set of common elements. The definition of school climate usually encompasses dimensions of the perceived social environment that: (a) have a contextual influence on the learning and development of students, (b) remain stable over time, and (c) can be meaningfully aggregated across raters. Definitions of climate characteristically focus on conditions as they are perceived by students, teachers, or other participants in a school setting, rather than on objective aspects of the setting. Illustratively, school climate may be reflected in the frequency with which teachers go out of their way to explain material to students, a behavior that can be observed by students. However, objective characteristics of the school, such as the percentage of teachers who are certified in the area that they teach, would not fall within the scope of climate assessment. School climate has been conceived as a set of conditions that influence student outcomes, in part by establishing norms and expectations for behavior. Climate dimensions mediate the effects of educational interventions on student outcomes, rather than being the final outcomes themselves. For example, the amount of emphasis that is placed on learning is a common focus of climate assessment, while students' grade point averages would be viewed as an outcome indicator.

Climate assessments are thought to have a contextual effect in the sense that school-level differences in climate dimensions are thought to be associated with differences between schools in student outcomes in ways that are not accounted for by individual differences in students' background characteristics and prior achievement. Climate dimensions are thought to be stable across time, absent any systematic effort to change them. For example, climate scores in middle schools remain stable over 2 years, even when the student membership of the building turns over (Brand, Felner, Shim, Seitsinger, & Dumas, 2003), suggesting that climate persists over time independent of

the individuals who comprise the membership of a building. Finally, while students may offer diverse opinions about the climate of their school building, their ratings can be meaningfully and reliably aggregated to create school-level scores (Brand et al., 2008; Griffith, 2000).

Research on school climate has focused on the proximal conditions affecting students' learning, focusing on students' and teachers' experiences of the school as a learning environment. A related body of work on the organizational climate of the school also considers teachers' experiences of the school as a workplace (Halpin & Croft, 1963; Hoy & Tarter, 1997; Kelly et al., 1986; Rentoul & Fraser, 1983). Illustratively, the educational climate literature considers such dimensions as teacher support or achievement emphasis, while the organizational climate literature considers teachers' experiences of participation in decision-making at work. The present review focuses on the educational climate of the school, although the influence of organizational climate variables on students' learning and adjustment must also be acknowledged.

Implicitly, many educators and researchers think of school climate as being one-dimensional, in the sense that climate is generally positive or negative. Another form of one-dimensional thinking associates the entire domain of school climate with a specific dimension. In this vein, the domain of climate is equated with just teacher support, personalization, sense of community, relationships, achievement emphasis, or school safety. While each of these may be important aspects of school climate, no single dimension encompasses the entire domain of school climate. Rather, numerous studies suggest that a comprehensive assessment of school climate should encompass multiple dimensions.

An early, and very influential, conceptual framework was proposed by Trickett and Moos (1973), who suggested that classroom climate assessment should address three overarching conceptual dimensions: Relationships, Personal Growth or Goal Orientation, and System Maintenance and Change. This conception of climate dimensions has broadened the perspective of investigators on the multidimensional nature of climate, and has led to efforts to empirically differentiate underlying dimensions of climate through factor analysis. Illustratively, Brand and his colleagues (2003) report that students' ratings of the ten ISC-S scales reflect the following higher-order dimensions: Developmental Sensitivity, Pro-social Emphasis, Contextual Negativity, and Safety Problems. Cumulatively, these perspectives suggest that efforts to improve school climate need to be cognizant of how school conditions vary on multiple dimensions.

ASSESSMENT OF CLASSROOM AND SCHOOL CLIMATE

School and classroom climate dimensions have been assessed through structured inventories that ask participants to indicate the extent to which they agree or disagree with specific statements about the social environment. Scale scores are computed by summing or averaging responses to the items that comprise a dimension. Pioneering work on the development of structured climate inventories was undertaken during the 1960s by Herbert Walberg and colleagues (Walberg & Anderson, 1968) and George Stern (1970). During the 1970s Walberg's work led to the development of the Learning Environment Inventory (LEI) (Fraser, Anderson, & Walberg, 1982) for secondary level classrooms, and the My Class Inventory (MCI) (Fraser et al., 1982), for elementary classrooms. During the same period, Edison Trickett and Rudy Moos published the Classroom Environment Scale (CES) (Trickett & Moos, 1973; Moos, 1979). Though the CES was initially developed for use in secondary level classrooms, this instrument was adapted to assess school-level climate in high schools (Felner, Aber, Cauce, & Primavera, 1985), and classroom climate in the early elementary grades (Toro et al., 1985). Research using the LEI and CES proved to be critical in establishing the importance of climate assessment for research and intervention.

Investigations of climate have often focused on the social climate of classrooms, even in secondary level schools where students occupy multiple classes throughout the school day. The classroom-level focus reflects the interest of investigators in changing instructional practices and conditions in particular subject-specific classrooms. Over the past two decades, increased attention has been given to the assessment of whole school climate, reflecting growing interest in implementing and evaluating the effects of comprehensive school reform models. The emphasis on school-level climate is reflected in the work of James Comer's School Development Program on the School Climate Scale (Haynes, Emmons, & Comer, 1993), as well as climate studies by Shaps (Battisch, Solomon, Kim, Watson, & Shaps, 1995) and Raudenbush (Raudenbush, Rowan, & Kang, 1991), and the Project on High Performance Learning Communities (HiPlaces) (Felner, Seitsinger, Brand, Burns, & Bolton, 2008). As part of the HiPlaces project the Inventory of School Climate (ISC) (Brand, Felner, Shim, Seitsinger, & Dumas, 2003) has been administered in more than 3,000 whole-school assessments in the past two decades. This instrument has also been widely adopted in other projects in the United States and internationally. The ISC assesses the perceived social environment of middle level and secondary schools, and is also available in a form that is appropriate for elementary school children.

In addition, the teacher version of the ISC has been found to predict students' climate ratings and outcomes (Brand, Felner, Seitsinger, Burns, & Bolton, 2008). Drawing upon the work of the authors cited above, and factor analytic research in large and diverse samples, the ISC assesses ten dimensions of school climate, including teacher support, consistency and clarity of rules and expectations, student commitment to achievement, negative peer interactions, positive peer interactions, disciplinary harshness, student input in decision-making, instructional innovation and relevance, support for cultural pluralism, and safety problems. Each of these dimensions of perceived school climate has been found to be associated with multiple indices of students' learning and adjustment, as is shown in the following section.

SIGNIFICANCE OF SCHOOL CLIMATE FOR STUDENTS' LEARNING AND DEVELOPMENT

School climate has been found to be associated with multiple areas of students' learning and development. A pervasive pattern of relationships has been found between climate dimensions and students' academic, behavioral, and socioemotional adjustment, even after partialling out the effects of poverty on student outcomes. The relationship of climate to each of these adjustment domains are considered in turn, focusing on findings from large-scale studies of young adolescents (Brand et al., 2003). The dimensions of school climate discussed below have also been found to be associated with student learning and adjustment in large scale samples of students at the elementary and high school levels (Brand, Felner, Seitsinger, & Hupkau, 2006).

To assess the impact of climate on students' learning, it is critically important to examine variation in students' academic motivation, as well as in their scores on standardized achievement tests. Academic motivation merits attention because students' aspirations, expectations, and sense of self-efficacy influence their long-term adaptation to school as well as decisions about the pursuit of advanced training and education. In schools with higher levels of student commitment to achievement, students attain higher scores on standardized tests of reading and math. In addition, multiple dimensions have been found to be associated with students' academic motivation. Higher teacher expectations, academic aspirations, and academic efficacy have been found in schools with higher school mean levels of teacher support, structure, positive peer interactions, and instructional innovation. In schools that students rated as having fewer safety problems, students reported higher self and teacher expectations, academic aspirations, and efficacy. Better grades and teacher expectations were associated with higher

mean levels of student participation in decision-making, and lower levels of disciplinary harshness and negative peer interactions, while higher student self-expectations and academic aspirations were related consistently with higher mean levels of support for cultural pluralism.

Turning to indicators of students' behavioral adjustment, higher levels of smoking, drinking and drug use, and more favorable attitudes toward these activities, were found in schools that students rated as lower in teacher support, student commitment to achievement, and instructional innovation, and higher in safety problems. Higher levels of delinquency and teacher-rated aggression were found in schools that students rated as having higher levels of negative peer interactions, disciplinary harshness, and safety problems. Higher levels of delinquency and classroom aggression were also found in schools that students rated as having lower levels of teacher support, student commitment to achievement, structure, and positive peer interactions. Turning to indices of socioemotional adjustment, higher levels of peer self-esteem, and lower levels of depression, have been found in schools in which students report higher levels of teacher support, structure, student commitment to achievement, positive peer interactions, and instructional innovation, as well as lower levels of safety problems. In addition to the climate dimensions noted above, support for cultural pluralism appears to be particularly important for academic performance, aspirations, and self-expectations among minority students (Brand, Felner, Seitsinger, Burns, & Jung, 2007). Support for pluralism also moderates the impact of poverty on students' academic performance and motivation. Gaps between students from low-income families and those from more affluent families are significantly smaller in schools that have higher levels of support for cultural pluralism.

While the majority of studies on school climate have been cross-sectional in nature, initial studies have examined the longitudinal impact of climate dimensions on trajectories of adjustment, particularly in early adolescence (e.g., Brand et al., 2007; Kuperminc, Leadbeater, & Blatt, 2001; Loukas & Murphy, 2007). Teacher expectations often decline during the middle school years. However, these declines were not evident in schools that were characterized by higher levels of structure, student commitment to achievement, positive peer interaction, and instructional innovation, as well as lower levels of disciplinary harshness. Gains over time in students' self-expectations and sense of efficacy were associated with higher levels of student commitment to achievement, positive peer interaction, and instructional innovation (Brand et al., 2007). School climate dimensions are associated with differential rates of onset for smoking, drinking, and drug use during early adolescence (Brand, Felner, Seitsinger, Shim, & Hupkau, 2005). Students who did not

smoke, drink or use drugs in sixth grade were less likely to initiate these behaviors by eighth grade in schools that had higher levels of teacher support, student commitment to achievement, student involvement in decision-making, and instructional innovation and relevance, as well as lower levels of disciplinary harshness, negative peer interactions, and safety problems. Cumulatively, findings from the cross-sectional and longitudinal studies again emphasize the importance of a comprehensive, multi-dimensional perspective on school climate.

CURRENT ISSUES IN THE CONCEPTION AND MEASUREMENT OF SCHOOL CLIMATE

The metaphor of “climate” has often, unintentionally, suggested that the perceived social environment of the school is like the weather: critically important, but difficult to control. This view of school climate can, implicitly, lead to the assumption that climate is simply a given, or the product of complex forces that cannot be systematically and deliberately addressed by educators. However, the findings of numerous studies suggest that school climate can be enhanced by systematic changes in the social organization and instructional regularities of the school (e.g., Maehr & Midgley, 1996). Numerous dimensions of school climate are associated with differences in the size, structure, and activities of interdisciplinary teams in middle grade schools (Brand et al., 2007). Other factors affecting school climate include classroom instructional practices, teacher attitudes toward the implementation of research-based practices, teacher readiness and professional development, and teacher role strain and job satisfaction. Change in school climate can result from systematic changes in school organization, instruction, and other regularities of the school. Indeed, the effects of structural and organizational changes on students’ learning may be mediated by dimensions of school climate.

STUDENT PERCEPTIONS OF SCHOOL CLIMATE

Initially, theories of social climate (e.g., Moos, 1979) proposed that social climate reflected consensual perceptions of the social environment of the school that were shared by occupants of the classroom or school building. However, since the late 1990s, numerous studies have shown that ratings of social climate vary much more within school buildings than they do between school buildings. Illustratively, Griffith (2000) reports that only 3% to 6% of the variance in school climate ratings is accounted for by differences between school buildings. Such findings suggest that the average rating of climate in a school does not necessarily reflect the perceptions that are shared by all students. However, even though a

school-level mean score on a climate scale may not reflect a consensus of opinion among students about their building, variation in this score account for a substantial portion of the variance between buildings in indices of students’ learning and adjustment (Brand et al., 2003). Further, school mean scores also tend to be highly correlated when they are drawn from randomly selected subsamples of students from the same building (Brand et al., 2003; Griffith, 2000). Obtaining a consensus of opinion across students might not be a necessary condition for obtaining a reliable and predictive assessment of school climate dimension.

ANALYSIS OF MULTI LEVEL DATA FROM STUDENTS, CLASSROOMS, AND SCHOOLS

Efforts to assess the school-level impact of climate dimensions have been greatly enhanced by advances in the field of Hierarchical Linear Modeling (HLM) (Raudenbush, Rowan, & Kang, 1991). HLM is a statistical technique that has been developed specifically for analysis of multi-level, hierarchical data. Initial efforts to relate climate with adjustment examined correlations at the level of the individual student (which looks at a conceptually quite different level of analysis), or else carried out correlational analyses of the relationship between school mean scores on climate and adjustment (which tends to overestimate school-level effects). HLM has enabled investigators to make more accurate estimates of school-level effects of climate on students’ developmental trajectories, and to better understand how school-level climate can moderate the effects of students’ background characteristics on learning and school adaptation.

ALTERNATIVE METHODS OF ASSESSING CLIMATE

While standard methods for assessing school climate rely on the collection of data from students, circumstances can arise in which reliable survey data from a representative sample of students is not available. In such circumstances, investigators may need to rely on alternate sources of information to assess climate dimensions. Illustratively, Pianta and colleagues (Pianta et al., 2002) have developed an observational system to assess climate conditions, as well as instructional and organizational regularities, in kindergarten classrooms. This approach is particularly critical for the investigation of climate among children who are too young to complete climate inventories. In addition to using observational data, investigators may turn to teacher ratings to assess climate when representative and reliable student data are not available. However, caution should be exercised when using teacher ratings as a proxy for student ratings. It

may be particularly important to choose a teacher instrument that has been validated for the purpose of predicting students' ratings and outcomes (Brand, et al., 2008).

SEE ALSO *Classroom Environment; School Belonging.*

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Stephen Brand

SCHOOL TRANSITIONS

This entry contains the following:

- I. OVERVIEW
Eric M. Anderman
- II. ELEMENTARY SCHOOL
Kristen N. Missall, Robin L. Hojnowski
- III. MIDDLE SCHOOL
Helen Patrick, Brent M. Drake
- IV. HIGH SCHOOL
Patricia Jarvis

OVERVIEW

School transitions mark the time period when students move from one school environment into another. Transitions occur at a variety of ages and vary greatly across school districts. Students often experience problems adjusting to changes in educational environments; consequently, teachers need to receive professional development training to assist students in making successful school transitions.

MAJOR TRANSITIONS

Although transitions can occur at many different time periods, several periods are typical. The transition into kindergarten is the first major school transition; however, for some children, who already have attended childcare or preschool, the transition into kindergarten may be much easier than for other children, who have stayed at home until just prior to kindergarten. Data from the National Center for Education Statistics indicate that most children



Mortarboards against the sky signal school transitions. CHRIS CHEADLE /ALL CANADA PHOTOS/GETTY IMAGES.

do experience at least some care before kindergarten from non-parental caretakers; for example, in 2001, only 26.1% of preschool children were cared for solely by parents (U.S. Department of Education National Center for Education Statistics, 2006). Consequently, for most children, the transition into kindergarten is not the first time they have been out of the home.

The second major transition for most students is the transition from elementary school into middle or junior high school. Much research has been conducted examining the effects of this transition on a variety of outcomes. Research generally indicates that the transition into middle school often is problematic for early adolescents because the instructional practices of many middle schools do not meet the developmental needs of early adolescents (e.g., Anderman & Maehr, 1994; Eccles & Midgley, 1989; Simmons & Blyth, 1987). Many students become less motivated and begin to lose interest in school after this transition.

The third transition often is the transition from middle or junior high school into high school. There is less research on this transition than on some of the other school transitions. Nevertheless, a growing body of evidence suggests that this transition often is traumatic and problematic for some students (Eccles, 2008).

For some students, high school represents the final stage of formal education. However, for many students, the transition from high school into college represents another very important school transition. Some students attend two-year community colleges, whereas others attend four-year colleges or universities. The transition into college for many students represents the first time that the student attends school while simultaneously living away from home. Many students do not adapt well to college life and experience academic difficulties during their first year of school, which can eventually lead to dropping out (Tinto, 2006).

EFFECTS OF SCHOOL TRANSITIONS

Transitions are extremely important because they represent major shifts in the daily contexts in which children and adolescents interact. For some students, the transition is smooth and peaceful, whereas for others it is stressful.

School transitions are related to a variety of behavioral and psychological changes. Research indicates that across transitions, students often experience changes in relationships with peers, parents, and teachers. In addition, behavioral problems often become evident after a school transition, which is particularly true when students interact with new peer groups after the transition. Much research has examined changes in academic variables after transitions; many transitions are related to

notable changes in students' motivation to learn, academic performance, and attitudes toward school.

IMPLICATIONS FOR EDUCATORS

It is very important for educators to be well prepared to assist students during transitional periods. Teachers cannot assume that students will naturally adjust to new learning environments with little difficulty. Educators must attend to the developmental needs of children and work collaboratively with parents, school counselors, and administrators to ease transitions for students of all ages. Programmatic efforts to facilitate such transitions are growing in number.

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Eric M. Anderman

ELEMENTARY SCHOOL

Kindergarten marks the entrance to formal schooling and is an important time of transition for children and families (Pianta, Rimm-Kaufman, & Cox, 1999). Children are changing developmentally in ways that potentially support adaptation to the expectations and demands of the kindergarten setting. Given the number of changes that characterize the transition period, identification of factors that support successful transition are critical. This entry describes the changes children experience as they transition to kindergarten and discusses factors related to successful adjustment to schooling.

TRANSITION TO KINDERGARTEN

Contextual changes from preschool to kindergarten coincide with developmental changes. As children physically mature, their experiences change, providing additional opportunities for skill development in a repeating and reciprocal cycle. Through the preschool years, basic skills increase rapidly. Greater motor coordination allows children to engage in more physical activity (e.g., running, climbing) essential for interactive play and group games that become more prominent in kindergarten. Changes in fine motor skills allow children to participate in academic tasks (e.g., writing, using scissors) and support adaptive skills (e.g., dressing, tying shoes) that promote independence. Language and communication skills become more sophisticated and refined, allowing greater expression and understanding of ideas, feelings, and knowledge. These basic developmental changes that are readily observed are accompanied by changes in cognition and psychosocial development that are explained by theoretical perspectives.

Jean Piaget (1896-1980) developed a theory of cognitive development that placed children of transition age near the end of the preoperational period, moving toward the concrete operational period. This movement is characterized by decreasing egocentrism and increasing flexibility in thinking, leading to increased perspective taking, understanding of functions and relations, cause and effect, and simultaneous consideration of features of objects (e.g., length and width). From an information-processing perspective, changes in cognition are accompanied by increases in learning and memory capacity that result in diversified strategies for learning (Miller, 2002). As cognitive capabilities change, children interact with and store knowledge in a way that increases capacity for learning and connecting new information to existing information. These cognitive advances contribute to effective problem-solving in an academic sense and in interpersonal interactions. Flexibility in thinking, greater memory capacity, and more effective problem-solving can support focused attention, task persistence, and increased motivation to learn. Increased perspective taking can facilitate social problem-solving, the development of empathy, self-regulation and self-control, necessary skills for school success.

Developmental changes are also reflected in theories of social development. According to the psychosocial perspective of Erik Erikson (1902-1994), as an individual develops, new skills create opportunities and demands. Physical and cognitive changes contribute to increasing autonomy and a developing sense of self through participation in new experiences. Adaptation to the opportunities and challenges in school is an important element of Erikson's theory of identity development, which places children of transition age in the stage of

Industry vs. Inferiority, characterized by the sentiment “I am what I learn.” Further, emotional and moral development reflects a shift toward social comparisons and an internalized sense of standards, rules and values based on fairness and equality. Success in school, academically and interpersonally, provides children with a sense of mastery and competence that supports continued development.

Sociocultural theory provides a larger context in which to consider the cognitive and psychosocial changes that children experience during transition. Social interaction is critical to development, and the nature of interaction shifts to accommodate and challenge the growing child. As children mature, their participation in sociocultural activities and interactions with others changes, affording greater opportunities for development as evident in the different experiences from preschool to kindergarten. Key to this process is the notion of the zone of proximal development, developed by Lev Vygotsky (1896–1934), which can be defined as the difference between what a child can do independently and what the child can do with adult support. Successful learning within the zone in academic or social domains is characterized by shared goals, scaffolding, and social interactions between a child and a more competent individual. Thus, teachers, caregivers, and competent peers play a significant role in supporting adjustment to formal schooling.

In sum, developmental changes that characterize the age of transition to formal schooling prepare children to become more active learners and more social beings during a time of increased demands for social competence, both of a learning-related and peer-related nature. In kindergarten children enter a world of opportunities and challenges different from their preschool or home environments, and their experiences in that context set the stage for continued development.

CONTEXTUAL CHANGES IN TRANSITION TO KINDERGARTEN

Preschool and kindergarten settings vary a great deal in curricular content, structure, and focus. In general, preschool settings tend to be characterized by an approach to education that emphasizes child-directed learning through play, whereas kindergarten settings are more likely to emphasize the acquisition of skills and knowledge through direct instruction approaches and structured activities (Hemmeter, 2000). From a sociopolitical context several factors may contribute to observed differences in the two settings. Preschool programs have historically operated independently from the formal schooling system, and evaluation outcomes in preschool have been more likely to focus on health and safety than on early academic performance or development of social competence. Coupled with a significant emphasis on child-directed learning and play,

this has resulted in few formal instructional curricula for preschoolers. In contrast, physically located in schools and conceptually linked to formal schooling, kindergartens may experience accountability demands, attention to performance and standards, and emphasis on foundational academic skills. As such, formal curricula for kindergarten are widely available and used in schools with an eye toward academic outcomes (e.g., learning to read) that change the nature of children’s experiences.

Changing experiences are accompanied by changing expectations related to learning and social interaction. As time on learning increases, classroom daily activities shift from more play-based in preschool to more structured and academically focused in kindergarten. Further, because more children are enrolled in kindergarten classrooms than in preschool classrooms, children may be interacting with a larger and more heterogeneous group of children in the context of higher child-teacher ratios. Learning-related social skills (McClelland & Morrison, 2003) that enable children to attend to instruction, follow directions, participate in group activities, organize materials, and persist in challenging tasks become more important. In addition, membership in group and individual relationships (Schwartz, Garfinkle, & Davis, 2000) becomes increasingly complex to negotiate and requires effective peer-related and adult-related social skills, such as initiating and maintaining positive interactions, sharing, turn-taking (McClelland & Morrison, 2003), effective social communication, and regulation of emotions (Izard, Trentacosta, King, & Mostow, 2004). Behaviors that may be tolerated in preschool settings and viewed as within the range of developmentally appropriate may be considered inappropriate and problematic in terms of school adjustment. For example, difficulty following directions, sharing, compliance, or lack of social interaction is likely to generate more concern in kindergarten settings. As such, it is important to understand expectations of kindergarten settings to facilitate transition.

FACTORS THAT CONTRIBUTE TO SUCCESSFUL TRANSITION

Research suggests that academic development at kindergarten entry has both direct and indirect effects on first grade schooling outcomes, and the link between early performance and later achievement has been demonstrated through grade 10 (Stevenson & Newman, 1986). Thus, upon entrance to kindergarten children need to have foundational skills to support continued development. Critical early literacy skills in language development, phonological awareness, letter-sound correspondence, concepts about print, and alphabetic principles need to be in place for a child to be prepared to read and write (Snow, Burns, & Griffin, 1998). Children’s language structures and word

knowledge continues to grow, facilitating development of more complex phonological neighborhoods that support early literacy skills such as rhyming (Snow et al., 1998). Similarly, children's early informal numerical understanding provides a structure for formal instruction in skills and concepts that expand their ability to use mathematics in abstract ways (Bowman, Donovan, & Burns, 2001). Facility with a mental number line constitutes an important conceptual framework for mathematical learning (Griffin & Case, 1997). Without foundational skills in key academic areas, the gap between children with skills and those without is likely to continue to grow throughout kindergarten and subsequent grades (Bowman et al., 2001).

Although necessary, early academic skills alone are not sufficient for successful transition to elementary. The degree to which children successfully navigate the kindergarten social environment in terms of classroom rules and expectations (learning-related social skills), peer relationships (peer-related social skills), and adult relationships (adult-related social skills), can dramatically affect short-term and long-term adjustment to kindergarten and to school in general.

Acquisition of *learning-related social skills* such as task completion, listening, following directions, active participation, attentiveness, compliance, self-regulation, and independence are necessary for kindergarten success as they facilitate the ability to attend to, participate in, and benefit from instruction (McClelland & Morrison, 2003). Kindergarten children rated by their teachers as having high levels of learning-related social skills have significantly less risk for being identified with behavior problems (Cooper & Farran, 1988). Kindergarten teachers have also specified that key behaviors such as listening to the teacher and complying with teacher directions are critical to successful adjustment to kindergarten (Pianta et al., 1999). Moreover, in a survey of 3,500 kindergarten teachers across the United States, 46% indicated their biggest concern was that entering children "had difficulty following directions" (Rimm-Kaufman, Pianta, & Cox, 2000). Studies have shown connections between learning-related skills at the beginning of kindergarten and later academic success, with learning-related skills accounting for unique variance in children's reading, mathematics, vocabulary, general information and alphabet skills in kindergarten and through the end of second grade (McClelland & Morrison, 2003).

Acquisition of *peer-related social skills* such as the ability to initiate and maintain interactions, share, cooperate, and demonstrate respect for other children (McClelland & Morrison, 2003) significantly affect a child's transition to school and subsequent adjustment (Ladd & Coleman, 1997), and is commonly reflected in the number of mutual friendships that children have, peer social

status, and general climate of peer interactions (Phillipsen, Deptula, & Cohen, 1999). Research suggests that children who engage in high rates of positive initiations toward peers receive high rates of positive initiations from peers (McConnell et al., 1984), and that children tend to maintain similar relationship patterns across kindergarten (Ladd & Coleman, 1997). Children who maintain friendships during the first two months of kindergarten are more likely to view school favorably (Ladd & Coleman, 1997) and children with high levels of prosocial skills tend to have more mutual friendships (Ladd, Birch, & Buhs, 1999). In addition, children who engage in positive peer interactions demonstrate more positive overall engagement in the classroom (Fantuzzo, Bulotsky-Shearer, Fusco, & McWayne, 2005), suggesting a relation between learning-related and peer-related social skills.

Adult-related social skills have an important role in the transition to elementary because children transitioning to kindergarten are still quite young, and have largely relied on adult modeling and nurturance from birth. Because parents and caregivers are the first socialization agents of young children, their influence has lasting effects on their child's social development. Children who report closeness with their parents tend to adjust best to school with more friends, fewer conflicts, and higher levels of peer acceptance, with teachers reporting frequent on-task behavior, following directions, and overall classroom competency (Clark & Ladd, 2000). This is important because children tend to develop relationships with teachers that mirror their relationships with parents, that is, if a child is clingy and needy or distant with a parent, they are likely to interact similarly with a teacher (Clark & Ladd, 2000). Children with appropriate teacher relationships are more likely to have important social skills, including self regulation and independent work habits (Pianta, Nimetz, & Bennett, 1997) as well as higher academic achievement, more mutual friends, and a higher level of peer acceptance (DeMulder, Denham, Schmidt, & Mitchell, 2000). Some research has suggested that parent involvement in school activities starting at kindergarten strongly impacts a child's adjustment to school, which can maintain through at least sixth grade (Pettit, Bates, & Dodge, 1997).

In conclusion, the transition to kindergarten is marked by important changes. Children are changing developmentally in ways that can support their adjustment and growth cognitively and socially when fostered in sensitive interactions with others. Further, the context of learning and social interaction changes as children move from preschool and home settings to formal school environments, resulting in new opportunities and challenges for skill development. With changes in context, typically there are changes in expectations for early academic performance and social behavior that require a

solid foundation as well as continued development of skills and knowledge (Pianta et al., 1999). School success is largely determined by competence in the areas of academic skills and relationships with peers and adults. Key elements from these areas have collective and significant influence on a child's transition to elementary school and subsequent school adjustment (Pianta et al., 1999). Viewed together, a detailed picture emerges of the skills and experiences most likely to lead to successful transition to elementary, providing direction for early education and kindergarten settings in their efforts to support young children's development.

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MIDDLE SCHOOL

Most educational systems in the United States involve students attending a middle school (traditionally called junior high school) for two to three years, sandwiched between the elementary and high school grades. There is considerable variability in the grades included in middle schools, although sixth through eighth are the most common. Grade configuration is influenced primarily by social, demographic, and space considerations within school districts. Middle schools span elementary schools' focus on providing all students with a breadth of educational experiences and developing core knowledge and skills, and high schools' educational specialization that prepares students for the workforce or post-secondary education. They typically offer new subjects that students can elect to study, different levels of a subject within the same grade, and teachers with subject-specific specialization for academic subjects (resulting in students being taught by multiple teachers).

The transition to middle school coincides with early adolescence the developmental transition period between childhood and adulthood. Developmental

changes associated with adolescence have bearing on all students' experiences.

DEVELOPMENTAL CHANGES COINCIDING WITH THE TRANSITION TO MIDDLE SCHOOL

The early adolescent period is a time of dramatic physical, cognitive, social, and psychological growth and development. Not only must adolescents adjust to their own changes, they must also adjust to others treating them differently because of that development.

Physical Development. The onset of puberty usually marks the beginning of adolescence. Females begin puberty approximately eighteen months earlier, on average, than males; however, timing varies widely. Adolescents experience a dramatic growth spurt, with significant gains in height and weight, development of secondary sexual characteristics, and changes in fat and muscle distribution. Sexual interest also develops. Adolescents often appear awkward with their bodies, because of their rapid and irregular growth. Pubertal timing, relative to peers, is related to adolescents' body image and satisfaction with their appearance; late-developing females and early-developing males hold the most positive perceptions.

Cognitive Development. Adolescence is characterized by steady improvement in a range of cognitive abilities, both because of biological maturing and experiences. Adolescents process information faster and more efficiently, and their memory is better than in childhood. They become more meta-cognitive, or able to think about their thoughts and actions. However, they also tend to overestimate their abilities and underestimate their vulnerabilities. Adolescents become increasingly able to engage in complex and abstract thinking, reasoning, decision making, and problem solving. With their improved cognitive abilities they appreciate others' perspectives better, reflect on themselves more, and become more self-aware. With these changes come greater self-consciousness and a tendency to believe that their experiences and feelings are unique to themselves. Finally, adolescents become better at regulating and coordinating their thinking, emotions, and behavior.

Social Relationships. Another dramatic change associated with adolescence is the increased importance of peer relationships. Young adolescents spend more time with peers, and friendships become more intense, close, and involve more self-disclosure. Distinct peer groups, with different characteristics, reputations, and status hierarchies, appear during early adolescence. With this emergence of cliques and crowds comes concern about social image. The desire to fit in and be like others is also strongest in early adolescence. This desire for acceptance

is accompanied by greater use of strategies designed to project a particular image.

Psychological Development. With the development of adult-like characteristics comes a desire for greater independence and autonomy. Changes in young adolescents' physical characteristics, cognitive abilities, and social relationships influence their identity development—perceptions of who they are, what they are good or not good at, what they value or devalue, and what they aspire to or fear becoming. Establishing an identity involves the process of exploring and embarking on commitments (both emotionally, and with time and resources) to particular paths and outcomes. Although identity continues to develop through adulthood, it is especially important during adolescence; choices made at this time can have far-reaching consequences for education, employment, and relationships.

CHANGES WHEN STUDENTS MOVE TO MIDDLE SCHOOL

Middle schools typically afford experiences quite different from those students were accustomed to. The school buildings tend to be larger, serving students from multiple elementary schools, and employ subject-specific specialist teachers. Students also experience changes in what and how they are taught, how they are evaluated, their interactions with teachers and peers, and institutional norms and requirements. The nature of these changes has profound implications for young adolescents' academic and emotional thriving.

Middle Grade Schools (1980s). Research during the 1980s by Roberta Simmons and Dale Blyth showed that the transition to junior high school (as it was called then) was typically accompanied by worrying changes. Compared to students in K-8 schools, those in junior high had lower grades, lower self-esteem, and more negative attitudes about school. Other researchers (most notably Jacquelynne Eccles, Carol Midgley, and their colleagues) identified similar and additional negative outcomes, including lower achievement, perceived ability, and interest in school, less positive and personal student-teacher relationships, and more anxiety and absenteeism. Because the comparison was between students in the same grade, with only the schools' grade configuration differing, prevailing notions that hormones and puberty were responsible for students' difficulties in junior high were shown to be incorrect.

Eccles and Midgley argued that these changes were a result of a mismatch between the school environment and students' development, and they coined the term *stage-environment fit*. They noted that the nature of junior high

schools was antithetical to the developmental needs of young adolescents. That is, at a time when social connections and interpersonal relationships become particularly important, students had less opportunity for personal connections because they moved from class to class, with different teachers and different classmates and experienced predominantly whole class instruction. At a time of dramatic and uneven cognitive development, homogenous classes were formed by ability grouping and students received different learning opportunities. It was then extremely difficult for students in lower tracks to learn material necessary for college entry, and this design worked against those with later, but normal, cognitive development. Worksheets and whole class instruction predominated, so students' lessons were less varied and individualized compared to elementary school. Also of concern, junior high school teachers were less confident about teaching their students than were elementary teachers in the same grades.

When students are particularly concerned about fitting in and are sensitive about how they are viewed by others, they experienced more public and socially comparative grading practices and recognition policies. Also, although students are able to view situations more complexly, understand more abstract and nuanced ideas, and are developing their reasoning and argumentation skills, their lessons were slotted rigidly into short periods. Thus, time constrained the type and complexity of activities they could engage in. When students desire more independence and responsibility, they had fewer choices and opportunities for input. Teachers trusted students less than did elementary teachers of the same grades, and their management and discipline practices were controlling and custodial rather than student-centered.

Middle School Reform (1990s). Concern that junior high schools were not meeting young adolescents' needs led to calls for reform, with the objective of creating middle-level educational environments that are congruent developmentally with their needs. *Turning Points*, the Carnegie Council on Adolescent Development's prominent and influential report, advocated widespread changes to all aspects of the middle grades experience. The National Middle School Association advocated similar changes. Their recommendations included: (1) creating smaller learning environments to promote positive teacher-student relationships and connectedness to school (e.g., interdisciplinary team teaching, advisory programs), (2) teaching more challenging and complex material (e.g., emphasizing critical thinking skills, interdisciplinary curricula, flexible or block scheduling), (3) ensuring all students have common core classes and can be successful (e.g., heterogeneous classes), and (4) preparing teachers for the middle grades (e.g., learning about ado-

lescent development, gaining certification with a middle grade specialty).

Middle Schools between the 1990s and Early 2000s.

The middle school reform recommendations were adopted unevenly, according to reviews by the Carnegie Corporation and the RAND Corporation. Organizational changes were adopted more often than recommendations involving instruction. More than half the middle schools introduced home room classes and team teaching, however, often not as intended, thwarting objectives. For example, team teaching was premised on teachers having time together for shared planning and communicating about students, but teachers' planning times were often not coordinated. Flexible scheduling, which allows longer time periods for more complex activities, had been introduced infrequently. Integration across disciplines was difficult because teaching methods and beliefs vary for different subjects. Students continued to be placed in classes by ability groups in most schools. Although there were promising teaching reforms to increase students' conceptual understanding in mathematics and science (advocated by the National Council of Teachers of Mathematics and the National Research Council, respectively), in the early 2000s these efforts had been supplanted by consequences of high-stakes standardized testing, with its emphasis on knowledge that can be assessed quickly and easily.

Research in the 1990s and early 2000s showed that students' attitudes about school and feeling of connectedness no longer declined after the transition to middle school. Thus, the changes that targeted improving student-teacher relationships and creating a positive school climate had positive results for students. However, students did not fare better academically compared to pre-reform levels. Researchers expressed concern with the nature of instruction and the shortage of qualified teachers. Students viewed their classrooms as emphasizing learning and understanding to a lesser extent than their elementary school classrooms did.

FACTORS THAT PREDICT STUDENTS' TRANSITION EXPERIENCES

Students who are confident about themselves and their learning are most likely to experience the transition to middle school positively, whereas those who begin with academic difficulties are at risk for academic and behavioral problems. Participation in school-affiliated extracurricular activities strengthens school commitment and achievement, especially for low-achieving males. Early pubertal development is a risk factor, particularly for girls. They are more likely to experience low self-esteem, to have older friends, be sexually active, and drink

alcohol; therefore, their social lives may generate tensions with academic demands before they have developed sound coping strategies.

Friends and peers reinforce each others' actions and, therefore, support and encourage positive or negative behaviors and attitudes, depending on peer group characteristics and the intensity of the relationship. Consequently, strong friendships with peers who value school and achievement are positive predictors of transition experiences, whereas socializing with peers whose norms are counter to those promoted by school predicts future academic and social difficulties.

Students are most likely to make a positive transition to middle school when their classroom and school environments promote both their learning and understanding and supportive interpersonal relationships. This transition outcome involves a classroom emphasis on learning and understanding, not just memorization of facts, where success is viewed as self-improvement or in criterion-referenced terms, students have some autonomy, teachers have high expectations for all students, and learning activities are challenging, valued, and relevant to students. Furthermore, positive outcomes are more likely when students believe their teachers are enthusiastic and committed to helping them learn and are able to do so, feel respected as learners and as people, and view their classmates as encouraging them academically and emotionally. In contrast, competitive learning environments in which students' progress is public and expressed relative to others, and teachers' practices are controlling, inconsistent, or inflexible are likely to elicit less positive transition outcomes.

Characteristics of schools and staff affect the nature of the middle school transition. Having student-teacher advisory teams and a consistent group of classmates ease the transition. Also, having teachers who are confident in teaching their students, knowledgeable about their subject-matter and how to teach it, understand and like young adolescents, have opportunities for their own professional decision making, and feel supported by their principal and school administrators, predict middle school students' achievement and socio-emotional well-being. Conversely, students are less likely to thrive when their teachers experience high teaching demands and stress, low autonomy, and feel pressed to cover content, rather than having flexibility to pace material in response to students' understanding.

POST TRANSITION INDICATORS OF POTENTIAL DIFFICULTIES

Academic and social aspects of school are closely related; socio-emotional and behavioral difficulties lead easily to academic problems, however academic problems can pre-

cipitate poor socio-emotional well-being. In general, "standing out and not fitting in are especially detrimental during the middle school years" (Juvonen et al., 2004, p. 48). Indicators of possible difficulties are increases in absenteeism, tardiness, missed homework assignments, and declining class preparedness, interest, participation in lessons, and grades. Also, repeating a middle grade is a strong predictor of dropping out of school. Depression, with its lethargy, decreased emotionality, and sleep disturbances can lead to academic problems. Displaying problem behaviors, such as aggressiveness, disruptiveness, or impulsivity are warning signs of difficulties, as is having relationships with deviant peers. Being socially isolated increases risk for depression, interpersonal difficulties (including bullying or being bullied), poor school performance, and dropping out of school. Finally, likelihood of difficulties at middle school increases with multiple stressors; these also include stressors outside school, such as illness, financial problems, or conflict within the family, divorce, and students' job commitments.

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HIGH SCHOOL

School transition research has included consideration of transitions from elementary to middle and from middle to high school as well as transitions across grades within schools and across schools in adolescence and has documented many problems for adolescents. Jacquelynne Eccles and her colleagues produced the seminal work in this area published in the *American Psychologist* (1993) as well as many other scholarly journals. She hypothesized that most middle and high schools in the United States do not meet the developmental needs of adolescents. She further argued that school transitions are largely discontinuous and disruptive for development. Much data support this hypothesis across diverse populations and strong longitudinal study designs that controlled for many confounding variables (e.g., Simmons, et al., 1987; Eccles, 2004; Isakson, & Jarvis, 1999; Gutman, & Midgley, 2000; Barber & Olsen, 2004).

Generally, students making the transition to high school experience a decrease in self-esteem, participate less in school and extracurricular activities, see a drop in grade point average, miss more school days, and suffer from anonymity. Additionally anxiety is high concerning school procedures and the presence of older peers. Yet characteristics of schools as well as differences between adolescents may influence such adjustment. According to Barber and Olsen, high school students have been assumed to have fewer problems than middle school students given that they have had experience with middle school transitions and are more mature than early adolescents, all of which makes them less vulnerable to peer influence. These authors and many others argue that these assumptions are incorrect, as high school students in middle adolescence also experience significant stressors as they strive to meet the challenges associated with school/grade transitions. The focus of this entry is on empirical findings from research on adolescent adjustment during the transition to high school.

MAJOR DEVELOPMENTAL CHALLENGES FOR ADOLESCENTS

Based on John Hill's 1983 theoretical framework for studying adolescents, biological, cognitive, and social changes are fundamental to the transition from childhood to adolescence. Such changes occur across developmental contexts, including family, peers, schools, work, and leisure. Psychosocial issues, including identity, intimacy, sexuality, autonomy, and achievement, are paramount for adolescent development as well as across the lifespan generally. Adolescents face challenges associated with these psychosocial issues as they move through adolescence and experience the fundamental biological, cognitive, and social changes across contexts that give the

issues greater significance than in childhood. Specific developmental challenges following this theoretical framework for adolescents making the transition to high school include the increased importance of academic achievement (unfortunately largely focused on grade point average) for success after graduation, the increased social significance of peer associations, and high school environments that require more self-reliance in students than was required of them in middle school.

The increased emphasis on social interactions in high school creates an environment in which fitting in and belonging serves an added source of pressure while at the same time peers (and parents) provide support for adolescents during this transitional period. Teacher expectations and demands increase in high school and students experience a higher level of stress than they did in middle school. Stark and colleagues and Phelps and Jarvis found that high school students reported their main problems to be in the areas of school, parents, friends, and dating, which is consistent with the types of developmental adjustments adolescents typically encounter and the high school atmosphere itself. Males reported more school problems, whereas females reported more interpersonal problems in both studies. Thus, adaptive coping strategies are needed by adolescents to handle such challenges. Success or failure at developmental tasks in adolescence sets the pathway for adult adjustment.

MAJOR STRUCTURAL AND ACADEMIC CHANGES IN HIGH SCHOOL

Structural changes in peer groups and schools influence the student transitioning to high school. This transition engenders changes in peer contacts such that adolescents begin to come into contact with older peers who are perceived as having more antisocial values. As with literature on early maturing adolescents, students entering the high school environment may not be prepared to cope with the influences of older, more experienced peers.

In most high schools, the structure of classes is also potentially problematic for adolescents in that classes are even less decentralized than in middle school leaving students without clear connections to caring adults who know their academic and social strengths well. Brief contact with numerous teachers in a more anonymous and bureaucratic setting makes it difficult for adolescents to feel valued and special, especially in overcrowded, resource-impooverished schools. This lack of connections to adults who can listen to adolescents' concerns undermines healthy adjustment, as Barber and Olsen discussed and the Carnegie Council on Adolescent Development noted in their task force report on preparing adolescents for the 21st century. Barber and Olsen assessed transitions to middle and high school in the same students and

found that, although in high school students reported fewer negative changes than they had two years earlier in middle school transition, the types of problems reported were consistent across both school transitions. Specifically, students perceived the school environment negatively (feeling less positive about school, feeling the need for more organization, and perceiving less support) and indicated decreased psychological adjustment (e.g., lower self-esteem, more depressive and anxiety symptoms).

Similarly, the research teams of both Simmons and Eccles noted academic changes such as stricter grading standards and structural changes common to high schools such as more impersonal environments and larger schools that increase anonymity of students. Goodenow found that students' feelings of belongingness in their school positively affected their motivation for school, effort, level of participation, and eventual achievement in school. Finally, Resnick and colleagues, reporting on the first wave of the Add Health data (a longitudinal study of adolescent health involving some 90,000 students in grades 7-12), found that both older and younger students who felt connected to their school reported less emotional distress and violent behavior. These researchers also found that a sense of connection to school protected youth from cigarette, alcohol, and marijuana use, and was associated with delay of first sexual intercourse. Both the structural and academic changes in high schools compared to middle schools alienate adolescents from school.

FACTORS PREDICTING SCHOOL TRANSITION ADJUSTMENT

Among the factors considered that predict school transition adjustment, the consensus is that a myriad of variables interact to explain variability (and resiliency) across populations of students. The main variables that have been found to predict adjustment are parent, peer, and teacher support, and development of effective coping strategies. Social class and ethnicity have also been variables identified as important mediators of adolescent adjustment. Each of these variables is considered below.

Gender differences in coping have been found that support consideration of the complexity of experience for particular adolescents. For example, Phelps and Jarvis found that females tended to use emotion-focused coping such as seeking social support; yet faced with a new, more impersonal high school environment, this coping style may not work if close friends are not present to support the adolescent in times of stress. Either new friends are needed or effective coping styles must be used. This view presumes adolescents do not make school transitions with their friends. In some instances (especially in private schools), such transitions are made from school to school as a group, and problems are less pronounced. Phelps and

Jarvis also found that adolescents identified humor and religion as possible coping strategies but did not indicate that they had used such strategies when faced with stressors; thus, one intervention option is to encourage and support the development and use of adaptive coping strategies (generally defined in the coping literature as active problem solving or seeking instrumental support more than emotional support with solvable problems) in these adolescents.

Furthermore, the role of peers is less clear if one considers the peer group's orientation toward school. Generally, peers provide support for adolescents as they face new challenges. Felner and colleagues found that the level of social support from peers and teachers was positively related to school adjustment after the transition to high school for students involved in a support project. Compared to students not involved in the project, the students in the project had higher GPAs, better attendance, more positive self-concepts, and viewed school more favorably.

Some schools have mentorship programs to help students adjust to high school transitions whereby senior students accepted into the program via an application process serve as mentors for entering freshmen (even meeting with new students before the first day of school to help them find their classes). The students then meet with their mentors (one mentor per three incoming students) weekly to acclimate to the new environment with an experienced partner. The overall effectiveness of such programs has not been adequately studied however.

Parents also play an important role in school adjustment for high school students. Fuligni and Eccles found that parents who treat their adolescents in a more adult-like fashion and grant more autonomy than in childhood ease the transition to high school more than parents who restrict opportunities for growth and development in this transitional stage. Steinberg and colleagues also noted that some parents may be experiencing midlife identity issues of their own and as a result restrict their adolescents' life choices such that their adolescents actually experience greater dependency rather than the more healthy process of becoming autonomous adults.

The role of social class must be considered as well as it is generally concluded in literature on schooling in the United States that the rich get richer and the poor stay the same or fall further behind. Similarly, in school transition literature regarding large urban schools that were resource poor, students showed increasing disengagement from school. Seidman and colleagues documented the same declines in school engagement and academics with more ethnically diverse students at such schools as had been documented previously with more middle class, less diverse, samples but also found an

increase in daily hassles for poor adolescents in poor schools that turned such adolescents even more toward their peers and gravitated toward more antisocial values. It is fairly well documented that students of color are alienated and marginalized in schools in which they are the minority and/or where tracking places them in inferior classes. Taylor and colleagues and Midgley and her colleagues argue that high schools can and must do more to support rather than undermine school engagement and motivation in students, and doing so especially needed for students who are in a racial minority in their school and even more for those minority students who also experience impoverished living conditions. Overall, poor students in poor schools in poor communities suffer the most during times of stress such as a school or life transition and are the most at risk for developmental problems associated with such stressors.

PROBLEM BEHAVIORS AFTER HIGH SCHOOL TRANSITIONS

Academic problems are the most common difficulties students experience after school transitions followed by psychological and interpersonal adjustment difficulties. These findings have been replicated across many studies in the United States as well as in Australia (see the work of Cotterell with adolescents in Australia). Some students recover from transition losses as they develop positive coping skills and if they receive parental, peer, and teacher support while other students fall further behind over the high school years and may even drop out of school. It has been difficult to adequately study such students over time as students who fell too far behind dropped out and are thus not represented in such samples.

Identifying students experiencing school transition stressors early in the first year of high school may guide interventions to prevent greater problems later. For example, students who do not feel they are a part of their school (lower sense of school membership, according to Goodenow) evince misbehavior, decreased motivation, and academic problems during high school. Although a successful transition into high school implies forming social networks with one's peers and increased support from friends may improve feelings of belongingness in the school, such support may also lead to lower academic achievement if students are distracted from academic work by spending too much time with peers.

A compromise position is to set limits such that it is clearly defined which nights of the week an adolescent may spend time with friends and which nights must be devoted to school work (this would include limits on computer and cell phone usage). Both parents and teachers should foster ongoing communication with transitioning adolescents regarding school progress.

Finally, school administrators and teachers who reach out to students suffering from anonymity and provide "a school within a school," as termed by the Carnegie Council on Adolescent Development, such that these students form appropriate close relationships with at least one adult in the school may reverse negative trajectories for such students. It is considered fundamental for intellectual and personal growth that adolescents have stable, close, mutually respectful relationships with adults and peers. Such relationships can develop best if schools support them through this or similar types of school-within-a-school contexts.

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Patricia Jarvis

SCT

SEE *Social Cognitive Theory*.

SECOND LANGUAGE ACQUISITION

Second language acquisition is learning of a nonnative language (i.e., second language) sometime after learning a native language (i.e., first language) has begun. A central characteristic defining second language acquisition is that it occurs in the context in which that language is spoken. For example, native Spanish speakers learning English in the United States or native German speakers learning Japanese in Japan are considered second language learners. However, learning a second language may or may not take place in the context of classroom instruction.

FIRST LANGUAGE VERSUS SECOND LANGUAGE

Second language acquisition is different from learning a foreign language. Second language acquisition of a nonnative language occurs in an environment in which the nonnative speaker has easy access to speakers of the language being learned. In contrast, foreign language learning refers to the learning of a nonnative language in the environment of one's native language. For example, a native English speaker learning French in the United States would be learning a foreign language (Gass & Selinker, 2001).

Understanding second language acquisition requires understanding the difference between learning a first language and a second language. First language develops without formal instruction by children being constantly exposed to language rich environments over the course of many years. The richness of the language environments in which children learn the amount of language they are exposed to and type of language they are exposed to influences how thoroughly children learn their native language. Also, as children learn their native language what they learn influences how well and how rapidly native language learning will occur (Hart & Risley, 1995). In contrast, learning a second language usually depends heavily on learning experiences in more constricted environments associated with the classroom or some other formal setting. In these settings, a major goal frequently is to formally teach children the elements of language that are learned much more informally in their native language. Consequently, assumptions regarding teaching and learning a second language are very different from assumptions about children learning their native language.

THE FIVE PRIMARY LINGUISTIC ELEMENTS.

Acquiring any language means learning five primary linguistic elements: phonology, syntax, morphology, semantics, and pragmatics. Phonology is the knowledge of the sound system in a language. It involves knowing what happens in words in fast speech as opposed to more carefully articulated speech. For example in the sentence: "I'm going to ride my bike", it is plausible that a second language learner would believe the correct pronunciation would be: "I'm goin to RIDEMYBIKE" (i.e., the learner does not articulate all of the phonemes in words and runs words together because she does not hear the words and sounds distinctly).

Phonology. Phonology includes knowing all of the sounds that are included in a language and knowing how the sounds are combined. For example, the English letter combinations *sc*, *sp*, and *st*, do not exist in Spanish at the

beginning of words. Thus, to pronounce these letter combinations, native Spanish speakers learning English tend to add an /e/ sound to the beginning of these letter combinations (e.g. /esc/, /esp/, as in *eschool*, *especial*) because in Spanish words with *sc*, *sp*, and *st* combinations begin with an /e/ sound (e.g. “*escuela*”, “*especial*”).

Syntax. Syntax is grammar, the rules that govern word order in sentences. Knowing the grammatical rules allows the speaker to produce an infinite set of sentences that can be easily understood by any individual proficient in that language. For example, the sentence: “The green turtle ran across the street to look for her friend the duck,” can be understood by proficient native English speakers even though it is unlikely that the individual has encountered this particular sentence before (Gass & Selinker, 2001).

Morphology. Morphology is the study of word formation. Morphemes represent the minimal unit of meaning in words. For example, the word *fitness* is made up of two morphemes: *fit* and *ness*. *Ness* is considered a *bound* morpheme because it can never be a word by itself, while *fit* is defined as a *free* morpheme because it is a word in and of itself like the words *man*, *woman*, and *moon*. Words can be created by adding morphemes, as in *entangle*: *dis+entangle*, *dis+entangle+ing*. The ways words are used in sentences also follow accepted patterns. For example, English speakers say, “Mt. Everest is a high mountain,” but not “The Empire State Building is a high building.” (They would say, “The Empire State Building is a tall building.”) Sometimes the reason certain word combinations are appropriate is clear, while at other times the combination appears to be quite arbitrary (Gass & Selinker, 2001).

Semantics. Semantics is the study of meaning. Knowledge of the semantics of a language also includes knowledge of the reference of words, word combinations, and limitation of word meanings. For example, in English the word *bank* has multiple meanings. When a reader encounters the word *bank* in text such as “The children sat very close to the river bank admiring the elegant movements of the swans,” he knows from the context that the word *bank* is being used to represent a margin. Knowing that words may have multiple meanings, and knowing those meanings, allows listeners and readers to interpret messages appropriately. Word combinations also affect the meaning of a sentence. For example, the meaning of the sentence: “The dog bit the man” is different from the meaning of “The man bit the dog” although both sentences include exactly the same words.

Pragmatics. Pragmatics refers to the way language is used in context. For example, when a teacher says: “Eyes on me,” a direction is being given and the expectation is that students will look at the teacher. The teacher is not suggesting she has eyes on her body somewhere. Word order has also an effect on pragmatics. For example, when a child orders a chocolate and vanilla ice cream cone, the order of the flavors may be important to understand which flavor comes first and which comes second.

The level of importance of each of these elements varies at different points in the development of language proficiency. A mature speaker of a second language uses the language differently from a novice speaker, and the differences follow predictable stages of development. For example, reading development depends on knowing the sounds in words and being able to accurately read words contained in text. Similarly, understanding the pragmatics of a language requires that second language learners understand phonology, morphology, and semantics.

THREE MODELS FOR SECOND LANGUAGE ACQUISITION

Several linguistic models attempt to explain the development of second language acquisition. The three most common models are the Universal Grammar Model, the Competition Model, and the Monitor Model. The Universal Grammar Model refers to the system of principles, conditions, and rules that are properties or elements of all human languages. At the same time, each language has grammatical rules that vary from one language to another. Thus, different languages have a limited possibility of different grammatical structures (Chomsky, 1975). Therefore, second language learners base their second language acquisition on universal principles common to all languages, and on the constraints of the particular rules of each language. For example, adjectives in English usually precede nouns. By contrast, in Spanish adjectives follow nouns. Although adjectives in both languages have the same function, their position depends on the constraints of each of the languages.

The Competition Model is based in the assumption that forms of natural language are created to communicate. Thus, second language learners are faced with the conflict between native language and target language cues and cue strengths. Learners will first resort to their native language interpretation strategies, and when these do not match the target language, then they resort to a universal selection of meaning based on cues as opposed to syntax-based cues. Positive and negative evidence is necessary for learners to realize which cues are correct for the target language (Bates & MacWhinney, 1982).

The Monitor Model (Krashen, 1985) has been very influential in school settings. This model is based on five

hypotheses: the Acquisition-Learning Hypothesis (acquisition occurs unconsciously, learning is conscious knowledge of the second language); the Natural Order Hypothesis (language rules are acquired in a predictable order); the Monitor Hypothesis (the learned system acts as a monitor of the acquired system), the Input Hypothesis; and the Affective Filter Hypothesis (motivation, attitude, self-confidence, and anxiety affect second language acquisition).

Krashen's 1985 Input Hypothesis, central to his theory of second language acquisition, suggests that language instruction just slightly above the student's current level of language proficiency (i.e., comprehensible input) is useful for second language acquisition. Generally, a silent period in the beginning of second language acquisition is natural and desirable until learners feel comfortable expressing themselves. Speaking cannot be taught directly; it is a result of internalizing comprehensible input.

Cummins (1979) hypothesized that second language acquisition includes the development of two proficiencies, conversational skills and academic language. Conversational skills (also called Basic Interpersonal Communication Skills, BICS) refer to the ability of children to use everyday language with adults and peers. The more formal academic language is the language of the classroom, as it is frequently characterized. Academic language enables students to understand and apply academic content in school. Conversational language is easier to learn and is learned more quickly than academic language.

VARIATIONS AND SUBGROUPS

Second language learners in the United States are typically referred as English language learners (ELLs). According to the National Research Council (1998), ELLs are "students who come from language backgrounds other than English and whose proficiency is not developed enough where they can profit fully from English-only instruction" (August & Hakuta, 1997, p. 15). The term Limited English Proficiency (LEP) is the formal term used by the federal government to describe and identify ELLs. The term ELLs is considered more descriptive and less pejorative than other terms (LaCelle-Peterson & Rivera, 1994; August & Shanahan, 2006). Approximately 67% of ELLs are in elementary school settings (Kindler, 2002). This statistic means that over 3 million ELLs attend elementary schools, representing more than 11.7% of the elementary school population. The vast majority of ELLs speak Spanish (79.2%) as their first language, but there are more than 460 native languages spoken by school-age students nationwide. The largest language groups after Spanish are Vietnamese

(2%), Hmong (1.6%), Cantonese (1%), and Korean (1%) (Kindler, 2002).

Approximately two out of every three ELLs reside in five states: California, Texas, New York, Florida, and Illinois. Despite this concentration of ELLs in specific states, virtually all states in the United States have seen dramatic increases in their ELL populations since 1990 when the wave of immigration to the United States rose substantially. Many of these states are experiencing the emergence of ELLs in significant numbers for the first time.

For a high percentage of ELLs, schools have difficulty providing the learning environments necessary for them to succeed academically and keep pace with their native English-speaking peers. A major challenge is teaching ELLs a second language (i.e., English) and academic content simultaneously. Since 1998 the federal government has tracked the progress of ELLs as a separate group on the National Assessment of Educational Progress. In important subjects such as reading and math, ELLs lag considerably behind other students. How to close this achievement gap concerns the research community and bilingual educators (August & Shanahan, 2006).

INTERVENTIONS AND INSTRUCTIONAL PROCEDURES TO ENHANCE EDUCATION OUTCOMES

A central question regarding ELLs acquiring English as a second language is whether it is better to teach them English language and academic content directly in English or to first make sure they have developed literacy skills in their first language. A number of research syntheses have been conducted to address this question. Francis, Lesaux, and August (2006) reviewed these syntheses and also conducted their own analysis. Although the quality of this research is not particularly strong, Francis, Lesaux, and August concluded there is a benefit to literacy development in English when ELLs are instructed in their native language (Francis et al., 2006). Overall, native language instruction resulted in a small positive impact on English reading development. They also noted the effect was strongest in those studies that paired native language instruction with English literacy instruction.

Regardless of the timing of English instruction in relation to primary language instruction, it is essential that English is taught with a strong focus placed on both learning the language and learning academic content in that language. In terms of academic content, much of the instructional approaches that are effective for native English-speaking students should also be effective for students learning English as a second language. For example, Shanahan and Beck (2006) concluded that in terms of English literacy development, the core instructional components

that are effective with native English speakers, such as phonemic awareness, phonics, fluency, vocabulary, and comprehension, are effective with students learning English as a second language. Further, many of the same instructional approaches that are effective in delivering instruction with native English speakers, such as instruction that is systematic and explicit, will be effective with second language students.

In terms of acquiring English as a second language, approaches referred to generally as sheltered instruction, in which students learn English under conditions of high language support, are advocated. In sheltered instruction, the English demands are lower than they are for native English speakers, and the acquisition of English is promoted through instruction in the language and instruction in academic content simultaneously. Frequently, however, explicit instruction in English gets less emphasis and it is more a hope that “language develop occurs” (Gersten & Baker, 2000, p. 459) during content area lessons than a clear instructional objective. This circumstance can pose a particular problem when teachers are required to cover extensive content in science, social studies, and mathematics, and there is insufficient time for English language development, particularly formal academic English.

Although the research on specific instructional variables that affect second language learning is minimal, five variables have some empirical support as well as conceptual merit: (a) vocabulary as a major curricular objective, (b) using visuals to reinforce concepts and vocabulary, (c) implementing cooperative learning and peer-tutoring strategies, (d) using native language strategically, and (e) modulation of cognitive and language demands (Gersten & Baker, 2000). Vocabulary is a key instruction target in second language learning. Vocabulary instruction should include concentration on Tier 2 words, (i.e., words that are likely to appear in a wide variety of texts and in the written and oral language of mature users (Beck, 2002). However, second language learners in the initial stages of language acquisition also benefit from instruction in Tier 1 words (i.e., words that are common in everyday life) because they frequently are not familiar to second language learners.

Using visuals and prompts helps learners visualize the abstractions of language and provide second language learners with the opportunity to practice vocabulary in formats such as small group instruction. Instructional interactions with peers increases the likelihood that information will be retained. In modulating cognitive and language demands, skillful teachers increase second language demands when students are practicing familiar academic content and decrease language demands (e.g., the use of complete sentences) when instruction focuses on the learning of new content. Strategic use of the student’s native primary language in learning new content can help second language learners attach new labels

to concepts they know in their primary language. One problem in using the student’s native language to explain concepts is that sometimes second language learners do not understand the concept in their primary language. As of the early 2000s, research in all of these areas is badly needed.

ISSUES RELATED TO ASSESSMENT AND INSTRUCTION

School-based assessments of students learning a second language are done for two broad purposes: to assess their English language proficiency and to assess their academic content knowledge. A number of problems are associated with both types of assessments, although they can provide information that is useful in school decision-making, such as identifying students for academic programs. For example, measures of English language proficiency do not predict very accurately performance on academic measures. Assessments of language proficiency also may underestimate how well students are prepared academically because performance of second language learners on academic assessments may be influenced by their knowledge of English.

Thus, low language proficiency may obscure what the learner really knows about the academic content being assessed. For example, in the early elementary grades, measures of language proficiency in English are sometimes used to delay literacy instruction until students have acquired the oral language skills considered necessary to learn academic content. A common assumption has been that teaching reading in English should occur after oral language proficiency is developed. Empirical evidence contradicts this position. Measures of oral English proficiency do not predict how well second language learners will learn English literacy skills. Even students whose oral English is very low can make significant progress learning foundations of reading in a second language such as phonemic awareness and understanding of the alphabetic principle (Chiappe, Siegel, & Wade-Woolley, 2002; Geva & Yaghouh Zadeh, 2006; Lesaux & Siegel, 2003).

In the United States, second language instruction has been heavily influenced by Krashen’s 1985 input hypothesis. However, this hypothesis has been criticized for being vague in terms of instructional specificity and lacking empirical support. Many studies have shown that speaking helps comprehension and acquisition of a second language (Pica et al., 1987; Ellis et al., 1994; Gas & Varonis, 1994; Klingner & Vaughn, 1996; Mackey, 1999). Further, in school contexts, Klingner and Vaughn (1996) suggest that providing students plenty of opportunities to practice newly learned vocabulary words in complete sentences in different contexts throughout the school day, providing immediate feedback and frequent monitoring, helps children increase English language

acquisition. In fact, several researchers have found that a major issue in instructional contexts is the lack of opportunities second language students have to use English in the classroom (Arreaga-Mayer & Perdomo-Rivera, 1996; Gersten & Baker, 2000; Ramírez, 1992). In other words, the lack of opportunities for students to engage in meaningful language use that is cognitively challenging may hinder second language acquisition.

Another issue extensively discussed has been whether there is a critical period in second language learning, generally considered to be around puberty, beyond which it is difficult or impossible to learn a second language to the same degree as a native speaker. This hypothesis suggests that young children are more likely to attain native-like proficiency in a second language than are adolescents or adults. Children appear to master the phonology of a language faster than adults, but adults appear to learn morphology and syntax faster.

However, the advantage children appear to have in attaining mastery of a second language (particularly phonology) is not uniformly apparent in all languages. Learning a second language is influenced by the alignment between the native language and the second language, and mastery of skills in the native language influences second language acquisition.

SEE ALSO *First (Primary) Language Acquisition.*

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SELF-CONCEPT

SEE *Relevance of Self-Evaluations to Classroom Learning.*

SELF-DETERMINATION THEORY OF MOTIVATION

Teachers and parents frequently find themselves frustrated with their students or children, wondering how to motivate them to try harder on their schoolwork. Self-determination theory (SDT) is a broad motivational theory that addresses that issue. The theory begins by distinguishing between two different types of motivation—namely, autonomous motivation and controlled motivation—and it then considers the different consequences of these two motivations as well as their different antecedents. SDT also looks at the concept of goals as well as motivations and considers them in a differentiated manner. This entry discusses each of these ideas in turn, beginning with an explanation of the types of motivation.

AUTONOMOUS AND CONTROLLED MOTIVATIONS

Autonomous motivation involves engaging in an activity with eagerness and volition, with a sense of choice and willingness. It is made up of two subtypes: (1) intrinsic motivation, which means doing a task because it is interesting and spontaneously satisfying; and (2) identified motivation, which is a well internalized form of extrinsic motivation and involves doing the task because it feels personally important. A girl is intrinsically motivated when she takes a music class just because it is fun and challenging; a boy's motivation is identified when he studies biology because he is deeply committed to becoming a doctor.

In contrast, controlled motivation involves doing a task with a sense of pressure, demand, or coercion. It comprises two subtypes of extrinsic motivation that have not been well internalized: (1) external motivation, which means doing the activity in order to receive a reward or avoid a punishment; and (2) introjected motivation, which results from partial internalization of the extrinsic contingencies and involves doing an activity because the person would feel approved of for doing it, or guilty and unworthy for not. A boy is externally motivated when he does his homework because his parents pay him for doing it; a girl's motivation is introjected when she takes calculus because she thinks she should and would be ashamed of herself if she did not.

Both autonomy and control are types of motivation; they move students to exert energy and perform tasks. These are clearly distinct from amotivation, which means

not to be motivated for a particular activity or in a particular setting. A student who is daydreaming or paying no attention to a history lesson would be amotivated for history, at least at that time.

When one thinks about the various students in a classroom it is likely that the range of motivations will be present, for example, with some students seeming relatively autonomous and others seeming relatively controlled in their motivations. Self-determination theory focuses both on the outcomes of being more autonomous versus more controlled in one's motivation for schoolwork and on the conditions in classrooms and homes that promote the different types of motivation. Why is it, for example, that some students tend to become more interested in and committed to their school subjects over the course of an academic year, whereas other students come to value school less and become less engaged with learning over the year?

AUTONOMY AND CONTROL: THEIR CONSEQUENCES

Both types of motivation can lead to learning, but the quality of that learning is very different for the two motivations. Wendy Grolnick and Richard Ryan found, for example, that when late-elementary students tended to be autonomous in their motivation because they found the learning material interesting or because they believed the learning was personally important, the students tended to learn the material more deeply—they learned concepts rather than just memorizing facts. But if the students were studying the material because they were told they would be tested on it, they did tend just to memorize facts and not to understand how these facts fit together thematically. In short, the quality of their learning was very different, with autonomy being associated with deeper and fuller learning and control being associated with more superficial learning.

Further, Ryan, along with Richard Koestner, Frank Bernieri, and Kathleen Holt examined school children's motivation for painting pictures and found that when their motivation was more autonomous the students produced paintings that were judged to be more creative than were the paintings produced by students who were more controlled.

Several studies have also linked autonomous motivation to students' adjustment and well-being in school. For example, Grolnick and Ryan found that teachers rated students who were autonomously motivated to be more competent and to have fewer adjustment problems than students who were controlled in their motivation.

In sum, when students are more autonomously motivated because they are interested in learning the material or believe it to be personally valuable, they learn

better conceptually, tend to be more creative, and are better adjusted than when their motivation is controlled. As such, it seems very important to give careful consideration to the factors that tend to increase students' autonomous, relative to controlled, motivation.

THE ANTECEDENTS OF AUTONOMY AND CONTROL

An enormous amount of research has examined how specific events such as the offer of a reward, the provision of feedback, or the imposition of a deadline affect students' motivation. As well, many studies have explored how the general interpersonal climates in classrooms or homes influence students' motivation.

Experiments on Antecedents. Many studies have shown that giving students tangible rewards such as money, prizes, and awards for doing an activity tends to make the students more controlled rather than autonomous in their motivation for the activity. In other words, it tends to diminish their interest in the activity and also makes them dependent on the reward so they will be less likely to do the activity unless the rewards continue. In fact, Edward Deci, with Koestner and Ryan, reviewed more than one hundred experiments that examined the effects of rewards on autonomous motivation and found that overall the effects of tangible rewards were negative. Rewards can indeed prompt students to do well at school work that is routine and memory focused, but when it comes to more interesting and conceptual kinds of schoolwork, reward effects are more negative, diminishing autonomous motivation and performance. Some schools reward students with pizza parties for completing work or passing tests. Unfortunately, that is not likely to help them maintain motivation for such work. It is fine to have pizza parties, but motivationally, it is best not to make them contingent on certain behaviors or outcomes.

Other external motivators such as competition (i.e., telling students to try to beat their fellow students), evaluations (i.e., telling students that their performance will be evaluated), surveillance (i.e., watching closely at what the students are doing), and threats (i.e., telling students they will be punished if they do not do just what they are told to do) also tend to undermine the students' autonomous motivation because, like rewards, they also tend to be controlling. In contrast, offering students choice about what activities to focus on and allowing them to regulate the time they devote to each was found in an experiment to increase their interest and autonomous motivation.

The thing that ties together these various results is that the typical external motivators such as rewards, deadlines, punishments, and evaluations tend to diminish

people's sense of initiation, self-regulation, and volition, whereas offering them opportunities to make choices and guide their own activities tends to allow a greater sense of autonomy. It has become clear, from a huge amount of research, that people need to feel a sense of autonomy or self-determination in order to perform effectively and be well adjusted. In other words, based on many different studies, SDT maintains that autonomy is a basic psychological need—something that must be satisfied for people to be optimally motivated, function effectively, and be psychologically healthy. Factors that help students satisfy this need promote autonomous motivation and positive outcomes, whereas those that are likely to thwart satisfaction of this need diminish autonomous motivation and lead to poorer outcomes.

Other research related to autonomous and controlled motivations has highlighted two other basic psychological needs that are operative in people and affect their motivation. First, it seems that everyone needs to feel competent or effective in dealing with his or her environment. Accordingly, studies have shown that positive feedback enhances students' autonomous motivation because it signifies competence, whereas negative feedback decreases autonomous motivation and leaves students unmotivated. Studies also show that satisfaction of the need for competence leads people to be healthier and more effective, but thwarting of this need leads to a sense of ill-being and poorer achievement. Thus, it is important to recognize that students who get continual negative feedback about their work may get into a spiral of feeling ineffective and unmotivated, performing even worse and showing signs of poor adjustment, which leads to more of the same. Second, all people need to feel a sense of relatedness, a sense that there are other people who know and care about them. Students who feel a satisfying relationship with one or more teachers tend to do better in school than those who do not. In fact, studies have shown that feeling a sense of relatedness to important others supports the students' autonomous motivation, which in turn leads to better performance and adjustment.

Indeed, looking across a range of studies, it seems that external forces that promote satisfaction of all three needs—that is, the needs for autonomy, competence, and relatedness—lead to the most optimal school engagement and adjustment. Students who experience such need satisfaction feel a sense of vitality, interest, and flexibility; but those who do not are uninterested and disaffected, and they show signs of greater adjustment problems.

Classroom Studies. Research conducted in public schools has shown that the interpersonal climate or ambience of classrooms relates to the motivation and well-being of students in those classrooms. For example, Deci and

Ryan, with Allan Schwartz and Louise Sheinman, examined whether teachers in fourth through sixth grade classes were oriented toward controlling the students' behavior versus supporting the students' autonomy. When teachers are controlling, they make all the decisions, tell the students what they have to do, and use rewards and punishments to ensure that the students do what they the teachers demand. This is an extreme version of the traditional classroom that is sometimes called a teacher-centered classroom. Supporting students' autonomy, in contrast, means understanding and acknowledging the students' perspectives, encouraging them to take initiative and solve problems for themselves, allowing students to make choices when possible, and minimizing the use of rewards, punishments, and controlling language (e.g., "should" and "have to"). Such classrooms involve the teachers being supportive of the students' basic need satisfaction and are sometimes referred to as more student-centered classrooms.

At the beginning of a school year, Deci and colleagues did a study in which teachers completed a questionnaire from which the researchers were able to glean whether the teachers were more oriented toward controlling the students' behavior or supporting their autonomy. As well, students in those classrooms completed a set of questionnaires during the first week of school and then two months later. These questionnaires assessed the students' intrinsic motivation, feelings of competence at schoolwork, and general sense of self-worth. Results of the studies showed clear relationships between the teachers' orientations and the students' motivation, perceived competence, and self-worth. In classrooms where teachers were more oriented toward supporting the students' own motivation, the students became more intrinsically motivated and felt more competent and personally worthy, whereas in the classrooms where the teachers were more controlling the students tended to show decreases in intrinsic motivation, perceived competence, and self-worth.

Johnmarshall Reeve and Hyungshim Jang did a study in which they found that specific teacher autonomy-supportive behaviors such as being responsive to students' comments and questions, making time for students' independent work, acknowledging signs of improvement and mastery, offering progress-enabling hints when students seemed stuck, and acknowledging students' experiences and perspectives were linked positively to students' autonomous motivation.

Studies of Parents. Other studies have shown that parents' orientations toward controlling children versus supporting the children's autonomy also affected their children's autonomous motivation for schoolwork and classroom outcomes. For example, Grolnick and Ryan did in-home interviews with parents concerning how

they motivated their late-elementary-school children concerning homework and chores around the house. Mothers and fathers were interviewed separately and two interviewers rated each parent on the degree to which the responses represented autonomy support versus control. The researchers then assessed the children's autonomous motivation and perceived competence in their classrooms and gathered information from the teachers about each student's adjustment and academic competence. Results indicated that parents who were judged to be more autonomy supportive who understood their children's feelings, while supporting and encouraging them had children who reported more autonomous motivation and higher perceived competence than the children of parents judged to be more controlling. Further, the students who were rated by teachers as more academically competent and better adjusted were the ones who had more autonomy-supportive parents.

Some studies have examined students' perceptions of autonomy support from both teachers and parents and have found that each contributes predictability to students' motivation, performance, and adjustment. A study of Russian and American high school students, for example, showed that autonomy support from parents and teachers led students to be focused on learning instead of just on grades and to display greater well-being. A study of Canadians indicated that high school students' perceptions of their parents and teachers being high in autonomy support led the students to be less likely to have dropped out of school a year later.

To summarize, considerable research conducted in the psychology laboratory, in school classrooms, and in homes has indicated that external factors as well as interpersonal climates affect students' sense of volition and autonomy versus their sense of being pressure and control, as well as their school engagement, learning, performance, and psychological growth. Those teachers who are supportive of students' autonomy, competence, and relatedness enhance autonomous motivation, learning, and well-being, whereas those who thwart any of these basic needs tend to diminish the important developmental and educational outcomes.

GOALS AND STUDENT PERFORMANCE

As mentioned above, self-determination theory also studies the kinds of goals people use to guide their life pursuits. Some people, for example, place the strongest emphasis on accumulating wealth, whereas others place the strongest emphasis on having meaningful relationships. Research has shown that these types of goals can be categorized into two broad groups: extrinsic goals and intrinsic goals. For example, Tim Kasser and Ryan found that wealth, fame, and attractive image fell into the category labeled extrinsic

goals because they are concerned with external indicators of worth and do not provide direct satisfaction of the basic psychological needs. In contrast, relationships, personal growth, health, and community involvement fell into the category labeled intrinsic goals because they are satisfying in their own right and lead more directly to basic need satisfaction.

Vansteenkiste and colleagues did research that applied these goal concepts to classrooms. They introduced classroom activities by telling students that learning the material would be useful in the future either for achieving one of the extrinsic goals (e.g., making money) or for attaining one of the intrinsic goals (e.g., contributing to the community). It turned out that when learning activities were framed in terms of the intrinsic goal of helping the community, students learned the material more fully, performed better when using it, and persisted longer in learning about the topic than when it was said to be useful for making money for themselves. Further, in the experiments, the goal framing was done in either an autonomy-supportive or a controlling manner, and results indicated that intrinsic goal framing and the autonomy-supportive style each contributed to better learning outcomes. In short, orienting students learning more toward intrinsic goals and communicating with them in a more responsive and supportive way facilitates autonomous motivation, deep learning, and effective performance.

INFLUENCES ON TEACHERS' AUTONOMY SUPPORT

The fact that teachers' orientations toward autonomy support versus control in their classroom behaviors has been found to have a significant impact on students' motivation, engagement, achievement, and well-being led researchers to consider what school conditions might affect the teachers' orientations with their students. Research by Deci, Ryan, and Koestner, with Nancy Spiegel and Manette Kauffman, hypothesized that when teachers are pressured for accountability, they will tend to become more controlling with their students. The researchers then did an experiment in which teachers were given the task of teaching students how to solve a particular set of problems. In one group, teachers were told it was their responsibility to ensure that their students performed up to high standards, whereas this accountability statement was not made to teachers in another group. Results indicated that those teachers who were reminded of accountability talked much more during the teaching session, made more commands, used language that contained more control words such as "should," and, remarkably, gave the students the answers rather than giving them hints and encouraging them to find the problem solutions themselves. In short, when teachers are pressured, they in turn pressure their students

and teach in ways that have been found to be detrimental to motivation, performance, and psychological adjustment. Facilitating optimal motivation in students is thus not just an issue for teachers, for it is influenced by the school, the district, and political forces acting upon them.

Substantial research has shown that autonomous motivation, in which students read, study, and discuss their work out of interest and the belief in its importance for themselves, is the optimal motivation for deep learning, creativity, and psychological health. It is also clear that this optimal motivation requires teachers and parents to provide supports that allow students to satisfy their basic needs for feeling competence, relatedness, and autonomy by encouraging the students' initiations, respecting them as individuals, listening to their perspectives, creating opportunities for choice and self-regulation, helping out when they run into barriers, and providing positive and constructive feedback. In these ways, teachers and parents will be supporting students' motivation, engagement, achievement, and psychological well-being. When schools, districts, and states create and reinforce conditions that allow teachers to satisfy their own needs for competence, relatedness, and autonomy on the job, schools will be characterized by more effective teaching and learning.

SEE ALSO *Autonomy Support; Interest; Intrinsic and Extrinsic Motivation.*

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SELF-EFFICACY THEORY

In 1986, when he put forth a social cognitive theory of human functioning, *Social Foundations of Thought and Action: A Social Cognitive Theory*, psychologist Albert Bandura painted a portrait of human behavior and motivation in which individuals' self-beliefs are critical elements. His subsequent work, *Self-efficacy: The exercise of control* (1997), advanced the discussion. Of all the beliefs that people hold about themselves and that affect their day-to-day functioning, and standing at the core of social cognitive theory, are *self-efficacy beliefs*, which can be defined as the judgments that individuals hold about their capabilities to learn or to perform courses of action at designated levels. In essence, self-efficacy beliefs are the self-perceptions that individuals hold about their capabilities.

According to social cognitive theory, self-efficacy beliefs provide the foundation for human motivation, well-being, and personal accomplishment: Unless people believe that their actions can produce the outcomes they desire, they have little incentive to act or to persevere in the face of difficulties. These self-perceptions touch virtually every aspect of people's lives—whether they think productively, self-debilitatingly, pessimistically or optimistically; how well they motivate themselves and persevere in the face of adversities; their vulnerability to stress and depression; and the life choices they make. Self-efficacy is also a critical determinant of the self-regulatory practices in which individuals engage as they go about the important task of self-correcting their actions and cognitions.

Self-efficacy beliefs should not be confused with outcome expectations, which are people's judgments of the consequences that their behavior will produce. Typically, self-efficacy beliefs help foster the outcome one expects. Confident individuals anticipate successful outcomes. Students confident in their social skills anticipate successful social encounters. Those confident in their academic skills expect high marks on exams and expect the quality of their work to reap academic benefits. The opposite is true of those who lack confidence. People who doubt their social skills often envision rejection or ridicule even

before they establish social contact. Students who lack confidence in their academic skills envision a low grade even before they begin an exam or enroll in a course. The expected results of these imagined performances will be differently envisioned: social success or greater career options for the former, social isolation or curtailed academic possibilities for the latter.

When self-efficacy belief and outcome expectation differ, the self-efficacy belief is more likely to determine the behavior. Students may well realize that strong academic skills are essential for obtaining a good SAT score and being admitted to the college of their choice, and this, in turn, may ensure a comfortable future lifestyle. But if students lack confidence in their academic capabilities, they may well shy away from challenging courses, will approach the SAT with apprehension and self-doubt, and may not even consider college attendance. In the social interaction, individuals may realize that pleasing manners and physical attractiveness are essential for attracting the attention of others, which is the first step toward building long-lasting relationships. If, however, they have low confidence in their social skills and doubt their physical attractiveness, they may hesitate to make contact and hence miss potentially promising opportunities.

Because individuals operate collectively as well as individually, self-efficacy is both a personal and a social construct. Collective systems develop a sense of collective efficacy—a group's shared belief in its capability to attain goals and accomplish desired tasks. For example, schools develop collective beliefs about the capability of their students to learn, of their teachers to teach and otherwise enhance the lives of their students, and of their administrators and policy makers to create environments conducive to these tasks. Organizations with a strong sense of collective efficacy exercise empowering and vitalizing influences on their constituents, and these effects are palpable and evident.

SOURCES OF SELF EFFICACY BELIEFS

Individuals form their self-efficacy beliefs by interpreting information primarily from four sources: mastery experience, vicarious experience, social persuasions, and physiological reactions. For most people, the most influential source is the interpreted result of one's own performance, or mastery experience. Simply put, individuals gauge the effects of their actions, and their interpretations of these effects help create their efficacy beliefs. Success raises self-efficacy; failure lowers it. Students who perform well on mathematics tests and earn high grades in mathematics classes develop confidence in their mathematics capabilities. This sense of efficacy helps ensure that they will enroll in subsequent mathematics-related classes, approach

mathematics tasks with serenity, and increase their efforts when a difficulty arises.

In addition to interpreting the results of their mastery experiences, young people form their efficacy beliefs through the vicarious experience of observing others perform tasks. Observing the successes and failures of peers perceived as similar in capability contributes to beliefs one's own capabilities (i.e., "If he can do it, so can I!"). Although this source of information is usually weaker than is mastery experience, when adolescents are uncertain about their own abilities or have limited previous experience, they become especially sensitive to it. If there is one finding that is incontrovertible in education and psychology, it is that young people learn from the actions of models, and so this is a prominent area of research in the study of self-efficacy. Vicarious experience also involves the social comparisons that individuals make with each other. These comparisons, along with peer modeling, can be powerful influences on self-efficacy beliefs. In situations in which young people have little experience with which to form a judgment of their competence in a particular area, peer models are especially useful.

Self-efficacy beliefs are also influenced by the verbal messages and social persuasions individuals receive from others, whether these are intentional or accidental. These messages can help one to exert the extra effort and persistence required to succeed, resulting in the continued development of skills and of personal efficacy. Or they can be powerfully disheartening. Persuaders play an important part in the development of an individual's self-efficacy beliefs. But social persuasions should not be confused with knee-jerk praise or empty inspirational homilies. Effective persuaders must cultivate people's beliefs in their capabilities while at the same time ensuring that the envisioned success is attainable. And, just as positive persuasions may work to encourage and empower, negative persuasions can work to defeat and weaken self-efficacy beliefs. In fact, it is usually easier to weaken self-efficacy beliefs through negative appraisals than to strengthen such beliefs through positive encouragement.

Physiological and emotional states such as anxiety and stress, along with one's mood, provide information about efficacy beliefs. Typically, optimism or a positive mood enhances self-efficacy, whereas depression, despair, or a sense of despondency diminishes it. As with the other sources, it is not the intensity of the physical indicator or mood state itself that is important, but the individual's interpretation of it. Adolescents with strong self-efficacy will view the emotional state as energizing, whereas those beset by self-doubt may regard it as debilitating.

MOTIVATIONAL CONSEQUENCES OF SELF EFFICACY BELIEFS

Self-efficacy beliefs can enhance human accomplishment and well-being in countless ways. They influence the choices people make and the courses of action they pursue. Individuals tend to select tasks and activities in which they feel competent and confident and avoid those in which they do not. Unless people believe that their actions will have the desired consequences, they have little incentive to engage in those actions. How far will an interest in medicine take a student who feels hopeless while studying anatomy? Whatever factors operate to influence behavior, they are rooted in the core belief that one has the capability to accomplish that behavior.

Self-efficacy beliefs also help determine how much effort people will expend on an activity, how long they will persevere when confronting obstacles, and how resilient they will be in the face of adverse situations. People with a strong sense of personal competence approach difficult tasks as challenges to be mastered rather than as threats to be avoided. They have greater intrinsic interest and deep engrossment in activities, set themselves challenging goals and maintain strong commitment to them, and heighten and sustain their efforts in the face of failure. Moreover, they more quickly recover their sense of efficacy after failures or setbacks.

Self-efficacy beliefs also influence an individual's thought patterns and emotional reactions. High self-efficacy helps create feelings of serenity in approaching difficult tasks and activities. Conversely, people with low self-efficacy may believe that things are tougher than they really are, a belief that fosters anxiety, stress, depression, and a narrow vision of how best to solve a problem.

Human motivation, cognition, and behavior are influenced by many factors. The success or failure that people experience as they engage the myriad tasks that comprise their life naturally influence the many decisions they must make. Also, the knowledge and skills they possess will certainly play critical roles in what they choose to do and not do. But people must invariably interpret the results of their attainments, just as they must make judgments about the quality of the knowledge and skills they possess. Imagine, for example, two students who receive a B on an important mathematics exam. In and of itself, a B has no inherent meaning, and certainly no causal properties. How will receiving such a grade affect a particular student? A student accustomed to receiving A's in math class and who worked hard throughout the term and studied for the exam will view the B in ways quite dissimilar from those of a student accustomed to receiving C's and who worked equally hard. For the former, the B will be received with distress; for the latter, the B is likely to be received with

elation. The student accustomed to receiving A's is likely to have bruised self-efficacy; the C-acquainted student is sure to have boosted self-efficacy.

SELF EFFICACY BELIEFS AND ACADEMIC ATTAINMENTS

Self-efficacy has been the focus of research in areas as diverse as business, athletics, medicine and health, media studies, social and political change, moral development, psychiatry, psychopathology, and international affairs. In psychology, it has been the focus of studies on clinical problems such as phobias, depression, social skills, assertiveness, smoking behavior, and moral development. Self-efficacy has been especially prominent in educational research, where scholars have reported that, regardless of previous achievement or ability, self-efficacious students work harder, persist longer, persevere in the face of adversity, have greater optimism and lower anxiety, and achieve more. Students who believe they are capable of performing academic tasks also use more cognitive and metacognitive strategies than those who do not. Academic self-efficacy influences cognitive strategy use and self-regulation through the use of metacognitive strategies, and self-efficacy is associated with in-class seatwork and homework, exams and quizzes, and essays and reports.

In psychology, intelligence (in the form of IQ) has typically been acknowledged the most powerful cognitive predictor of achievement. But when researchers tested the joint contribution of self-efficacy and intelligence to the prediction of achievement, they found that students' self-efficacy beliefs made a powerful and independent contribution to the prediction of their academic performance. Self-efficacy is also a critical determinant of the life choices that students make and of the courses of action they pursue. Typically, they engage in activities in which they feel competent and avoid those in which they do not. Doing so is particularly critical at the high school and college levels, where young people progressively have more academic options.

Students with high self-efficacy engage in more effective self-regulatory strategies at differing levels of ability, and self-efficacy enhances students' memory performance by enhancing persistence. In studies of college students who pursue science and engineering courses, high self-efficacy has been demonstrated to influence the academic persistence necessary to maintain high academic achievement.

In general, researchers have established that self-efficacy beliefs and behavior changes and outcomes are highly correlated and that self-efficacy is an excellent predictor of behavior. The depth of this support prompted Graham and Weiner (1996) to conclude that, particularly in psychology and education, self-efficacy has proven to be

a more consistent predictor of behavioral outcomes than have any other motivational constructs.

IMPLICATIONS FOR TEACHERS AND SCHOOLS

The first and major implication that arises from research findings on the role and function of self-efficacy beliefs in academic contexts is that teachers do well to take seriously their share of responsibility in nurturing the self-efficacy beliefs of their pupils, for it is clear that these beliefs can have beneficial or destructive influences. Bandura has argued that beliefs of personal competence constitute the key factor of human agency, the ability to act intentionally and exercise a measure of control over one's environment and social structures. As children strive to exercise control over their world, their first transactions are mediated by adults who can empower them with self-assurance or diminish their fledgling self-beliefs. Because young children are not proficient at making accurate self-appraisals, they naturally rely on the judgments of others to create their own judgments of their capabilities. Teachers who provide children with challenging tasks and meaningful activities that can be mastered, and who chaperone these efforts with support and encouragement, help ensure the development of a robust sense of efficacy. Effective teachers know their students' capabilities. They also know that trying very hard and continually failing can have a devastating effect on one's confidence. For this reason, they are careful to assign work that will indeed be challenging but that they are sure can be accomplished with proper effort.

An incontrovertible finding in educational research is that students learn from the actions of models. Different modeling practices in school can differently affect self-efficacy beliefs. For example, when models make errors, engage in coping behaviors in front of students, and verbalize emotive statements reflecting low confidence and achievement (such as "Gosh, I seem to be having some trouble with this, don't I?"), low-achieving students perceive the models as more similar to themselves and subsequently experience greater achievement and self-efficacy under their tutelage. Social cognitive theorists recommend that teachers engage in effective modeling practices and that they select peers for classroom models judiciously so as to ensure that students view themselves as comparable in learning ability to the models. Peer models should also share similar attributes to the students for whom they are serving as models.

Children inevitably compare themselves to other children, and these social comparisons are critical to the development of self-efficacy beliefs. Social-comparative school practices that emphasize standardized, normative assessments, involve ability grouping and lock-step instruction,

use competitive grading practices, and encourage students to compare their achievement with that of their peers work to destroy the fragile self-beliefs of those who are less academically talented or prepared. As Bandura (1997) has noted, these are practices that can work to convert “instructional experiences into education in inefficacy” (p. 175).

When classroom structures are individualized and instruction is tailored to students’ capabilities, social comparisons are minimized and students are more likely to gauge their academic progress according to their own standards rather than compare it to the progress of their classmates. In cooperative and individualized learning settings, students can more easily select the peers with whom to compare themselves. Individualized and cooperative structures that lower the competitive orientation of a classroom and school are more likely than traditional, competitive structures to increase self-efficacy. Similarly, classrooms that emphasize a mastery goal orientation, which is to say that they emphasize the view that learning is an enjoyable activity and should be undertaken for its own sake rather than for extrinsic or performance oriented reasons, also have beneficial effects on students’ self-efficacy beliefs.

Some researchers have suggested that teachers should pay as much attention to students’ perceptions of competence as to actual competence, for it is the perceptions that may more accurately influence students’ motivation and future academic choices. Assessing students’ self-efficacy beliefs can provide teachers with important insights about their pupils’ academic motivation, behavior, and future choices. For example, unrealistically low self-efficacy, not lack of capability or skill, can be responsible for maladaptive academic behaviors, avoidance of courses and careers, and diminishing school interest and achievement. Students who lack confidence in skills they possess are less likely to engage in tasks in which those skills are required, and they will more quickly give up in the face of difficulty. In such cases, in addition to continued skill improvement, schools must work to identify their students’ inaccurate judgments and design and implement interventions to challenge them. Researchers have identified various ways in which self-efficacy perceptions can be challenged. For example, teachers can set goals for students that are close at hand rather than goals that require a large investment in time. Teachers can also provide frequent and appropriate feedback as students are engaged in a task. Of course, it has been amply shown that effort-focused feedback (such as “Well done, you’re working hard.”) enhance students’ self-efficacy and performance to a greater degree than does ability-focused feedback (such as “Well done, you’re so smart.”).

It seems clear that many of the difficulties that people experience throughout their lives are closely con-

nected with the beliefs they hold about what they can and cannot do. Sound research evidence suggests that students’ academic failures in basic subjects, as well as the misdirected motivation and lack of commitment often characteristic of the underachiever, the dropout, the student labeled at risk, and the socially disabled, are in good measure the consequence of, or certainly exacerbated by, the beliefs that students develop about their ability to exercise a measure of control over their environments.

Empirical findings have amply strengthen the claim of social cognitive theorists that self-efficacy beliefs play an influential role in human agency, and they support the contention of theorists and researchers that students’ self-efficacy beliefs in academic areas powerfully influence their subsequent motivation and performance in these areas. Clearly, researchers and school practitioners should continue to look to students’ beliefs about their academic capabilities as important predictors and determinants of academic achievement, for they are critical components of motivation and behavior.

SEE ALSO *Bandura, Albert; Social Comparisons; Volition.*

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Frank Pajares

SELF-ESTEEM

Self-esteem refers to an individual’s or in some cases a group’s evaluative judgment about himself, herself, or itself. The term and concept were relatively unnoticed prior to the 1960s, at which time various thinkers and researchers began to suspect that it could be an important factor in behavior. By the late 1970s self-esteem had become a major focus of a great deal of research, and people began to seek to raise self-esteem in connection with a broad assortment of interventions, including clinical practice and education.

During the 1980s self-esteem became a national buzzword and was being studied and applied in a staggering variety of settings. Leading proponents such as Nathaniel Branden (1984) contended that deficient self-esteem was a causal factor behind nearly every sort of personal and social problem and pathology. A high point of sorts was reached late that decade, when the state of California established the California Task Force to Promote Self-esteem and Personal and Social Responsibility. Its manifesto (California Task Force, 1990) asserted that raising the self-esteem of California's citizens would help solve many of the state's problems, including violence, drug abuse, unwanted pregnancy, and school underachievement.

Criticism began to mount in the 1990s, and since the early 2000s the value of self-esteem has become the focus of serious debate. As of 2008 there are many programs for boosting self-esteem, especially among schools, and some groups whose livelihoods depend on administering these are fiercely resistant to criticism. On the other side, accumulated research findings have led many experts to question whether high self-esteem or boosting self-esteem has any practical value at all. Most likely an intermediate conclusion is correct.

In 1999 the American Psychological Society (subsequently renamed the Association for Psychological Science) commissioned a panel of experts to review the research findings and provide a summary evaluation of the benefits of high self-esteem. The governing board sought to compose the panel of persons with widely different initial views about self-esteem (i.e., both proponents and critics) and selected a leader (Baumeister) who had held different opinions at different times, reflecting a presumptive willingness to revise his opinions in light of new evidence. Its report filled an entire issue of the journal *Psychological Science in the Public Interest* (Baumeister, Campbell, Krueger, & Vohs, 2003). That report, and a condensed version for lay readers published by the same authors in *Scientific American* in January 2005, offers a relatively thorough overview for interested readers.

DEFINITION AND MEASUREMENT

Self-esteem literally means a person's valuing of himself or herself. It is thus the evaluative dimension of the self-concept. This may include both thoughts and feelings. Related terms include self-love, self-worth, self-respect, self-regard, and narcissism.

Self-esteem is typically measured with a questionnaire inviting respondents to rate how they think and feel about themselves. For better or worse, the brief scale developed by Rosenberg (1965) has become the standard way of measuring self-esteem. Items on self-esteem scales typically include assessment of liking for oneself overall, appraisal of one's confidence at being able to perform

well at work and in school, and ability to get along with others and be liked. Moral self-appraisals are included in some scales.

Self-esteem is thus opinion, not objective appraisal. High self-esteem may refer to accurate, healthy appreciation of one's genuine capabilities and worth as a person, or it may refer to unrealistic, conceited overestimates of the self. Efforts to distinguish inflated egotism or narcissistic conceitedness from so-called true self-esteem have not had much success thus far. One general implication, therefore, is that several different kinds of people score high in self-esteem.

Nearly all research samples find that self-esteem, at least among modern Americans, is relatively high on average. That is, the distribution of scores runs from close to the maximum possible score on the scale down to a bit below the scale midpoint, with then relatively few scores in the bottom register. When researchers compare high and low scores on self-esteem, they divide the sample in its middle, but some critics have suggested that this in effect compares truly high self-esteem against medium self-esteem. Nonetheless, the distribution refutes widespread claims that the American population suffers from an epidemic of low self-esteem. In fact, American self-esteem scores have long been relatively high and have been increasing steadily in recent decades (Twenge & Campbell, 2001).

One important question is whether self-esteem should be measured as a general attitude toward the self overall or, instead, in specific domains. It seems eminently possible for a person to believe himself or herself to be good at math and poor at music; is there a core overall evaluation of self that coexists with these? Most research has focused on global self-esteem, but there are notable exceptions, particularly the work of Herbert Marsh (e.g., 2006), which focuses on academic self-esteem and indeed sometimes emphasizes self-esteem as separate for specific areas of study.

A persistent source of bias in the research literature stems from relying on self-reports. People score high in self-esteem by saying favorable things about themselves on a questionnaire, and so people who tend to flatter themselves on questionnaires end up classified as high in self-esteem. That may sound obvious, but many researchers then give people another questionnaire to ask about other sorts of behaviors and attributes, and when these same people say favorable things about themselves on those questionnaires, researchers sometimes mistakenly conclude that self-esteem contributes to positive outcomes. For example, when researchers ask people how intelligent or physically attractive they are, people with high self-esteem rate themselves higher than those with low self-esteem, which seemingly suggests that high

self-esteem is linked to intelligence and good looks. But when researchers get objective data (e.g., giving an IQ test, or having judges rate how good-looking participants are), those differences disappear completely.

BENEFITS OF HIGH SELF ESTEEM: SCHOOL PERFORMANCE

Much interest in self-esteem was stimulated by the claim that raising self-esteem could contribute to improving schoolwork. Although these hopes appear now to be false, they were plausible. In theory, high self-esteem might improve performance by increasing confidence, by making people willing to persist despite initial failure, by means of self-fulfilling prophecies, by eagerness to seek out challenges, and by other means. These hopes have been fueled by persistent findings that correlate self-esteem with grades in school and test performance, typically around .21 to .26, as noted already by Hansford and Hattie (1982), though the results varied widely from one study to another.

The fact that students with higher grades have higher self-esteem does not necessarily mean that bolstering self-esteem will cause other students to improve performance, however, for two reasons. The first reason is the familiar gap between correlation and causation. High self-esteem appears to be the result, not the cause, of doing well in school, as gradually emerged from painstaking longitudinal studies (e.g., Bachman & O'Malley, 1977). In other words, the good grades come first, and high self-esteem follows, so boosting self-esteem to improve grades may be backwards and hence futile.

Second, even if there were direct causal links between a stable trait of self-esteem and school performance, this does not guarantee that artificially boosting the trait or attitude will lead to improvements in performance. The many programs aimed at increasing self-esteem among students have generally failed to provide any evidence that they improve learning. An early review of such interventions and programs by Scheirer and Kraut (1979) concluded that such interventions were not effective. Subsequently, many professional programs advertised as bolstering self-esteem among students have added modules on study skills and socially desirable behavior, seemingly in tacit acknowledgement that self-esteem boosting alone does not work, but programs originating in the schools themselves may not uniformly recognize this need.

Almost no studies have employed experimental designs with proper controls to investigate the effects of boosting self-esteem. One exception was reported by Forsyth, Kerr, Burnette, and Baumeister (2007). College students with C, D, or F midterm grades were randomly assigned to receive weekly messages containing (1) review questions, (2) review questions plus self-esteem boosting,

or (3) review questions plus reminders to take personal responsibility. Students whose self-esteem was boosted actually got significantly poorer grades on the final examination than on the midterm and poorer than students in the control condition. Thus, boosting self-esteem actually caused a significant decline in performance. The authors were surprised by this result and wished to conduct further studies, but obviously it would be unethical to conduct research that expects to cause students to get bad grades. Still, this result should give pause to anyone interested in improving school performance. Some have pointed out that the widespread embracing of self-esteem in school curriculums has coincided with a general decline in American student performance, though drawing firm causal conclusions from mass societal phenomena is generally unwarranted, especially in comparison with controlled experimentation.

Why might self-esteem cause school performance to get worse? Even proponents of self-esteem such as Nathaniel Branden have begun to suggest that self-esteem has most positive effects when it is earned via legitimate accomplishment. Hence simply telling people to think they are wonderful in the absence of such achievement may foster a sense of being too good to be willing to work hard or other sorts of entitlements. Overconfidence is also a possibility.

OTHER POTENTIAL BENEFITS OF HIGH SELF ESTEEM

Self-esteem has been investigated for a variety of possible benefits beyond school performance. Given the limited space, this entry provides only a brief overview: For a more thorough review, see Baumeister and colleagues (2003).

Interpersonally, people with high self-esteem report and consider themselves to be charming and popular, with good relationship skills and many friends, but when they are rated by other people, most of these advantages disappear. In laboratory studies that assign people to interact with strangers and then report their impressions, high self-esteem persons generally think they have made better impressions than people with low self-esteem, but the actual impressions are no different or in some cases worse.

A longstanding view has surmised that violence and aggression stem from low self-esteem, but the actual evidence for this is extremely sparse and consists mainly of self-reports. Behavioral studies generally find self-esteem to make no difference and people high in narcissism, which can be regarded as one of the less appealing kinds of high self-esteem, are the most aggressive, especially when someone has criticized them. Thus, violence stems more from threatened egotism than from inadequate self-love (Baumeister, Smart, & Boden, 1996). There is some evidence of a correlation between some forms of delinquent,

externalizing, antisocial behavior and low self-esteem, though it is not known which causes which.

The effects of self-esteem on work and task performance resemble those on school performance. Self-reports vary widely but generally point toward a mildly positive relationship, possibly because people with high self-esteem are prouder of their work than are people low in self-esteem. Objective data on task performance generally show little or no difference, with one important exception: High self-esteem leads to better persistence in the face of failure than low self-esteem, as shown in many studies.

Happiness is correlated with high self-esteem. Obviously these studies rely on self-reports of happiness (because no objective measures exist), but the pattern seems robust across many methods and samples, and experimental manipulations that raise or lower self-esteem produce corresponding emotional changes to support the conclusion. There is also a longstanding hypothesis that high self-esteem acts as a buffer to shield the person from the harmful effects of stress and trauma, and some rigorous studies have supported that conclusion. Although other studies have shown somewhat different patterns of results, none finds that low self-esteem leads to better coping or more happiness. Low self-esteem is persistently correlated with depression, though it is very difficult to say which causes the other.

The hope that high self-esteem would help young people resist smoking, drug abuse, early sexual behavior, and other unhealthy patterns has not generally been supported. If anything, more findings link high than low self-esteem to early experimentation with sex and drugs, possibly because popularity contributes to both high self-esteem and experimentation. Among all these domains surveyed by Baumeister and colleagues (2003), the best results were found with eating disorders. Low self-esteem appears to be a risk factor that significantly increases the risk that young women and possibly young men will develop eating disorders, though the effect of self-esteem is only in combination with other factors and possibly indirect.

Overall, two benefits of high self-esteem stood out. High self-esteem promotes initiative, presumably because confidence makes people more willing to take action and rely on their own judgment. This can produce negative effects, but initiative is mostly considered a good thing, and so this is one important benefit.

The other benefit is positive feelings and happiness. High self-esteem seems to be linked to a stock of pleasant, happy feelings that enable the person to enjoy life when it is good and/or avoid depression and misery when things are not going well.

Although these two established benefits of high self-esteem fall far short of what was once hoped, they are far

from trivial, and in combination they can contribute to making life good for people whose self-esteem is high. The question of how much effort and other resources should be devoted to boosting self-esteem in order to increase these two benefits is left to policymakers. It is however noteworthy that these benefits of high self-esteem accrue mainly to the individuals rather than to their relationship partners or to society as a whole. Some experts caution that simply flattering young people or otherwise seeking to boost their self-esteem directly will more likely contribute to increased narcissism and other less desirable forms of self-esteem, and the societal consequences of narcissism (which has been increasing throughout the U.S. population in the last decades of the 20th century; Twenge & Campbell, in press) are if anything negative.

UNDERSTANDING SELF ESTEEM

The question of what are the benefits of high self-esteem is hardly the only important question about self-esteem. Considerable work has been invested in understanding how the behavioral, mental, and emotional reactions of people with high self-esteem differ from those with low or medium self-esteem. Presumably most educators and other leaders will have to deal with people having a variety of levels of self-esteem, and so understanding these differences may be useful for helping them deal effectively with each individual.

In general, low self-esteem is a greater puzzle than high self-esteem. Researchers have found it relatively easy to characterize people with high self-esteem, who like themselves and generally expect life to go well. Competing theories about low self-esteem have flourished, however.

Regarding emotional differences, high self-esteem is associated with generally higher levels of happiness and good feelings than low self-esteem (as noted above). Another difference is in emotional lability (Campbell, Chew, & Scratchley, 1991). People with low self-esteem have more frequent emotional ups and downs. This may indicate that people with low self-esteem lack the stabilizing influence that is associated with the emotional resources that go with high self-esteem.

Regarding cognition, people with low self-esteem experience more uncertainty and instability of self-knowledge (Campbell, 1990). Their self-concepts fluctuate more than those of people with high self-esteem. They are more likely to describe themselves in inconsistent and contradictory ways and to change how they rate themselves from one time to another. They are also more likely to respond "I don't know" to questions about themselves. This is an important clue to the nature of self-esteem. High self-esteem means having firm, clear ideas about who one is and what one wants. Low

self-esteem does not apparently mean being convinced that one is a bad person. Instead, it is the absence of well-defined positive views of self rather than the presence of well-defined negative views.

People with high self-esteem engage in many self-flattering biases, such as assuming and in many cases overestimating how much that others will agree with their opinions and that their abilities are unique. They take credit for success and deny blame for failure. People with low self-esteem have fewer such biases. These mental tricks contribute to some of the biases noted earlier, such as that people with high self-esteem consider themselves smarter, more popular, and better-looking than other people, whereas objective evidence generally disconfirms these self-flattering views. Thus, an essential part of high self-esteem in many cases is convincing oneself that one is better than one really is.

Turning to motivation, what do people with low self-esteem want? Mostly they do not seek failure and rejection. Instead, they seem to want the same things that people high in self-esteem want (such as success and social approval), but they are less certain than others that they will achieve these goals (McFarlin & Blascovich, 1981).

The level of aspiration is different, and as a result, the overarching social motivations are different. People with high self-esteem want and expect to succeed, and so they are willing to take chances to stand out. They have a self-enhancing orientation, which means they look for ways to increase their stock of successes and to improve how others see them. In contrast, low self-esteem is associated with a prevention orientation: These people go through life seeking to remedy problems and avoid failures. They may focus on their weaknesses (whereas people with high self-esteem focus on their strengths) and avoid risky situations (for review, see Baumeister, Tice, & Hutton, 1989).

People with low self-esteem lack confidence in their own views and ideas, and so they are relatively willing to do what others tell them. Indeed, some of the earliest research on self-esteem emphasized that low self-esteem produces a relatively high susceptibility to persuasion and influence (Janis, 1954; for review, see Brockner, 1983). The behavior of these people varies across situations as they yield to current pressures. High self-esteem, in contrast, tends to promote acting on one's own and disregarding the influences and even the good advice of others.

Abundant research has shown that people desire high self-esteem: They strive to think well of themselves. Why is the concern with self-esteem seemingly so deeply rooted in the psyche? If high self-esteem conferred many positive benefits, the desire for it would be understandable, but given the relatively few advantages, it presents a puzzle. Noting that high self-esteem feels good provides a

partial answer, but because emotions are presumably there to help people survive and prosper, the question again arises, why are emotions tied to self-esteem?

One answer offered by Mark Leary and his colleagues is that self-esteem is a kind of internal measure of something that is vitally important, namely one's prospects for social acceptance (Leary, Tambor, Terdal, & Downs, 1995). High self-esteem is typically based on thinking one has the traits that will bring acceptance: attractiveness, likeability, and competence. Low self-esteem in this view is essentially a belief that one does not have what it takes to attract and keep relationship partners and group memberships. Human survival has long depended on belonging to important groups, and so self-esteem may be one's internal measure of how likely that is.

SEE ALSO *Relevance of Self-Evaluations to Classroom Learning.*

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SELF-EVALUATIONS

SEE *Relevance of Self-Evaluations to Classroom Learning*.

SELF-EXPLANATION

Simply defined, learning involves the use of existing knowledge to make meaning of new information (Driscoll, 2000). The process of explaining to-be-learned materials to oneself has been called *self-explanation* and is considered to be a constructive activity (e.g., Calin-Jageman & Ratner, 2005; Tajika, Nakatsu, Nozaki, Neumann, & Maruno, 2007). Self-explanation facilitates learning in one of two manners. The process prompts students to form inferences beyond the provided information, extending and supporting their knowledge revision (McNamara, 2004; Taboada & Guthrie, 2006). This form of self-explanation helps students compensate for text inadequacies, inconsistencies, and incompleteness. Self-explanation also encourages students to revise their current understandings of concepts by prompting them to compare their inaccurate and/or incomplete understandings with those presented in text. New learning unfolds as students attempt to reduce inconsistencies between their existing knowledge structures and new information (Ainsworth & Burcham, 2007).

EFFECTIVENESS OF SELF EXPLANATIONS

In their seminal work, Chi and colleagues (Chi, Bassok, Lewis, Reimann, & Glaser, 1989; Chi & Bassok, 1989) instructed undergraduate students to provide self-explanations in response to worked examples. The researchers observed that undergraduates who demonstrated proficiency in problem solving (82% correct or higher) produced twice as many self-explanations, confirming earlier findings that providing justifications for solution steps while problem solving improves learning (e.g., Gagné & Smith, 1962). Moreover, Chi and colleagues observed that the nature of students' explanations differed qualitatively. Successful problem solvers provided self-explanations that refined, defined, and expanded action components of the examples, and used them as references to principles and concepts outlined in the text. These students' explanations indicated self-monitoring of new understandings and misunderstandings. Students who were less successful problem solvers generated insufficient and/or superficial explanations and did not monitor their learning with subsequent analyses confirming these distinctions (Chi & VanLehn, 1991; Renkel, 1997). Equally important, these studies revealed that, in the absence of specific instructions or supports, most students either do not generate self-explanations or generate superficial ones only (e.g., Atkinson, Renkl, & Merrill, 2003; Chi & Bassok, 1989; Chi, Leeuw, Chiu, & LaVancher, 1994; McNamara, O'Reilly, Best, & Ozuru, 2006; Schworm & Renkl, 2007).

Findings from earlier research documented that undergraduates who generated self-explanations demonstrated greater learning than students who did not produce self-explanations. However, they learned less overall than students who were provided with expert-generated explanations (Stein & Bransford, 1979). Closer analysis revealed that expert-generated effects were limited to instances in which students generated imprecise elaborations, corroborating that self-explanation effects are contingent on having students produce meaningful explanations that either establish connections between text ideas or integrate them with relevant prior knowledge (Chi, 2000; King & Rosenshine, 1993; McNamara & Kintsch, 1996; Rosenshine, Meister, & Chapman, 1996; Scardamalia & Bereiter, 1992).

The quality of instructor-generated explanations is also an important instructional factor. When experts or instructors verbalize "why-type" explanations, they encourage students to practice self-explanation. This is especially true when working with young students (Crowley & Siegler, 1999; Peters, Messer, Smith, & Davey, 1999; Pine & Messer, 2000; Siegler, 1995). When prompted to describe the instructor's problem-solving strategy, kindergarten students produced superior self-explanations and used this problem-solving strategy more frequently than did students

who responded to their own thinking (Calin-Jageman & Ratner, 2005). Modeling provides students with the opportunity to reflect on instructors' rationales and reasoning, and provides them with opportunities to gain proficiency in the use of self-explanation.

There is substantial evidence that all students can be taught to produce self-explanations and that doing so produces subsequent learning gains relative to not doing so or being provided with generated explanations (post-secondary: Alevan & Koedinger, 2002; Bielaczyc, Pirolli & Brown, 1995; de Bruin, Rikers, & Schmidt, 2007; Reimann & Neubert, 2000; secondary: Chi et al., 1994; Siegler, 2002; Wong, Lawson & Keeses, 2002; elementary: Davis, 2003; Tajika & Nakatsu, 2005; Tajika, Nakatsu, & Nozaki, 2006). For example, Rittle-Johnson's 2006 study (2006) demonstrated that students in grades 3 to 5 were able to solve more mathematical equivalency problems following instructions to generate self-explanations than were students who were not provided with such instructions. Students' learning gains held across measures of immediate and delayed learning and were especially pronounced for measures of procedural learning and transfer.

ENHANCING QUALITY OF SELF EXPLANATIONS

Providing students with instruction in the use of specific thinking prompts and learning strategies can enhance the quality of self-explanation. The use of thought-provoking question stems is one technique for assisting students to generate quality self-explanations when processing text independently, in pairs or in small groups (King, 1989; 1990; 1991; 1992; 1994). Question stems are based on higher-level thinking skills and are intended to encourage students to draw upon their existing knowledge to generate applications (e.g., "How would you use _____ to _____?"), explanations (e.g., "Explain why . . .") evaluations (e.g., "Which one is the best _____ and why?"), and other forms of higher-level thought (e.g., "What do you think would happen if . . .?"). Students who generate self-explanations that extend beyond the literal level of the text demonstrate enhanced retention and understanding (e.g., National Reading Panel, 2000; Taboada & Guthrie, 2006).

Students have also benefited from receiving instruction intended to promote the use of multiple strategies that promote self-explanation and metacognitive awareness (McNamara, 2004). McNamara found that undergraduates instructed to generate elaborations and predictions, use logic, make bridging inferences, and paraphrase and monitor comprehension, demonstrated superior learning for unfamiliar materials compared to their uninstructed peers. They titled their program the

Self-Explanation Reading Training (SERT). While students with high and low levels of prior knowledge benefited from instruction, gains were especially pronounced for participants with low prior knowledge when responding to text-based questions.

Self-explanation may benefit certain students more than others. Specifically, students who possess relatively low levels of prior knowledge demonstrate greater learning following self-explanation than those with higher levels of prior knowledge (Renkl, Stark, Gruber, & Mandl, 1998). The former group of students typically do not activate prior knowledge or engage in other elaborative processes during new learning experiences (McNamara, 2001; McNamara & Kintsch, 1996). Presumably, engaging in the process of self-explanation is more helpful for these students than their peers who possess higher levels of prior knowledge as it encourages them to adopt strategic processes while studying and allows them to maximize working memory capacity (Best, Rowe, Ozuru & McNamara, 2005). There is also evidence that the accuracy of the self-explanation does not dramatically affect students' learning gains. That is, the process of producing self-explanations, regardless of the accuracy of the explanations, seems sufficient to enhance the learning process. To this end, some researchers have argued that the process of generating self-explanations itself induces greater understanding of domain principles (Chi, 2000; Chi & VanLehn, 1991).

Having instructors or experts provide students with instructions to produce self-explanations is not always feasible. However, research supports the conclusion that paraprofessionals and tutors can also promote processing that involves self-explanation. Students working with tutors trained to prompt self-explanation demonstrated superior learning relative to those whose tutors engaged in the typical processes of initiating questions, providing constructive feedback and assessing comprehension. Presumably, scaffolding and prompting in this manner encourages students to control their own learning. Self-explanations in tutoring are especially conducive to addressing students' misconceptions (Anderson, Boyle & Reiser, 1985; Chi, 1996; Chi, Siler, Jeong, Yamauchi, & Hausmann, 2001).

Peers can also encourage each other to generate self-explanations (Chin & Brown, 2000; Minick, 1989). For instance, Webb and her colleagues (Webb, 1991; Webb & Palincsar, 1996) demonstrated that students can be trained to encourage explanations from each other (rather than provide responses) when working in cooperative learning groups. In these learning situations, how instructors interact with students as part of their large group instruction influences the nature of small group interactions (Webb, Nemer, & Ing, 2006). If students are encouraged to

verbalize their thinking or ask “why-type” questions as part of teacher-led instruction, they are also likely to adopt these behaviors as part of small group interactions. In essence, students’ small-group behaviors mirror instructors’ discourse and expectations (Webb et al., 2006). Instructional environments that are entrenched in cultures of low-level questions and sparse explanations produce long-term learning effects that are difficult to overcome.

USING COMPUTER MODELS TO REPRODUCE SELF EXPLANATION EFFECT

Computer-based learning environments also provide alternative instructional venues for the promotion of self-explanations. One of the earliest computer models devised to account for and reproduce the self-explanation effect through the use of analogies was Cascade (VanLehn, Jones, & Chi, 1992). More recent computer-based learning environments provide students with tutorial-like dialogues that analyze their explanations while problem solving, recognize omissions in their explanations, and provide appropriate feedback. For instance, students who explained their problem-solving steps using Cognitive Tutor demonstrated greater learning for target questions and transfer problems than students who did not use the program and were not required to explain their problem-solving steps (Anderson, Corbett, Koedinger, & Pelletier, 1995; Alevin & Koedinger, 2002; Alevin, Popescu & Koedinger, 2001a; 2001b).

Other computer-based learning environments promote self-explanation through the use of inquiry and metacognitive prompts (Graesser, McNamara, & VanLehn, 2005). In the computer-based program, Point & Query (Graesser, Langston, & Baggett, 1993) students are encouraged to ask questions and form deep causal questions. Students control the question-answering process through hypertext, hypermedia, and other learning environments. Similarly, the computer-based program, Autotutor (Graesser, Lu, Jackson, Mitchell, Ventura, Olney, & Louwerse, 2004; Graesser, Person, & Harter, 2001; Graesser, VanLehn, Rose, Jordan, & Harter, 2001), coaches students to produce explanations by responding to their questions in natural language.

One of the most recent computer-based learning environments to assist students’ acquisition of metacognitive strategies and reading comprehension is iSTART. The iSTART program (Interactive Strategy Trainer for Active Reading and Thinking; McNamara, Levinstein, & Boonthum, 2004; McNamara et al., 2006) is a computer-based learning environment modeled after the face-to-face reading comprehension instructional program SERT. The program is designed to assess the quality of students’ self-explanations, provide them with

elaborative feedback, and promote the use of active reading strategies.

As part of the iSTART program, students observe a simulated classroom, identifying the strategies that simulated learners use to explain the actions of the simulated instructor. They then produce self-explanations under the guidance of the simulated instructor (McNamara et al., 2004). Adolescents using iSTART demonstrated greater learning for science text than their peers who were provided with a demonstration on how to self-explain text (McNamara, et al., 2006). Applications of iSTART confirm that all students benefited from participating in this program, although learning gains vary as a function of students’ prior knowledge. Those with low prior knowledge demonstrate substantial improvement when responding to text-based questions while students with high levels of prior knowledge demonstrate greatest growth when responding to inferential questions (McNamara et al., 2006).

In summary, self-explanation is a versatile, effective strategy that students can use independently or as part of group processing to enhance their learning across a variety of instructional tasks, including the processing of expository texts, mathematical problem solving, and the studying of worked examples. Students from kindergarten through postsecondary school have benefited from instruction in the generation of self-explanations, demonstrating enhanced learning and metacognitive awareness. Learning gains associated with self-explanation are especially powerful for students who possess relatively low levels of prior knowledge for target materials. Instructors, tutors, and peers can effectively encourage students to adopt self-explanation practices with minimal training. Alternatively, computer-based learning environments also hold great promise with respect to enhancing students’ use of this effective learning strategy.

SEE ALSO *Cognitive Strategies*.

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SELF-HANDICAPPING

Self-handicapping refers to the undermining of one's own performance, usually for the sake of impression management (Kolditz & Arkin, 1982). When individuals fear or expect they may fail at tasks that are important to them, they often engage in practices that may actually increase the probability of failure (or at least lower achievement) so they have an excuse, other than lack of ability, for the failure. For example, individuals who value romantic relationships but doubt their ability to sustain one often engage in relationship-destructive behavior (e.g., infidelity, verbal abuse, neglect) so that, when the relationship inevitably fails, they can attribute the failure to their controllable behavior rather than some unchangeable characteristic of themselves. This "shooting-oneself-in-the-foot" can and does appear in any activity or domain, but academic self-handicapping has received a considerable amount of attention because academic achievement reflects on a valued characteristic (i.e., intelligence) and there are frequent opportunities for students to display their abilities, or lack thereof, in public ways. In other words, students often worry that they will appear unintelligent if they perform poorly on a test or assignment, so they sometimes engage in self-handicapping behavior that provides an excuse, other than lack of ability, for the poor performance.

Procrastinating, becoming overly busy with too many activities, placing oneself in a loud or noisy environment to study, getting drunk the night before an important exam, selecting tasks that are much too difficult for one's ability level, failing to study, and failing to get enough sleep are just a few of the many possible self-handicapping behaviors that individuals can engage in. Self-handicapping behavior can range from active (e.g., getting drunk before a test) to passive (failing to study),

but they all have the same effect of potentially undermining performance.

To be considered self-handicapping, the behavior must include several features. First, it must occur before the activity that provides the opportunity for poor performance. Students who simply tell their friends they did not study for the exam after taking the exam are providing an excuse for their potentially low performance, but if they actually did study for the exam they did not self-handicap. Second, many agree that self-handicapping is intentional. Student who do not study because they forgot that there was an exam the next day are not self-handicapping. But purposefully failing to study so that one can have a ready excuse for low performance on the test is self-handicapping. Finally, self-handicapping is a behavior undertaken for the specific purpose of influencing the judgments, or attributions, of others, and possibly oneself. Student who procrastinate until 2:00 a.m. before starting to write their term paper may well perform badly on the paper and may reasonably attribute his or her poor performance to procrastination. But the procrastination behavior would only be considered self-handicapping if the purpose of the procrastination was to provide an excuse for the poor performance, should it occur. Self-handicapping, then, is the intentional, *a priori*, performance-undermining behavior that individuals engage in to create the impression that it is this behavior, and not a lack of ability, that causes the low performance (Berglas & Jones, 1978).

ANTECEDENTS OF SELF HANDICAPPING

Self-handicapping has been conceptualized as a trait-like tendency (Jones & Rhodewalt, 1982) and as a situationally induced behavior (Tice, 1991). Those who have described it as a trait argue that some individuals are simply more inclined to self-handicap than others, and this inclination is present across situations. Sources for the development of such a trait may be biological (i.e., more anxious personality) or can arise from socialization experiences in childhood, such as a strong emphasis on the importance of appearing able. Self-handicapping is also associated with a variety of stable characteristics that may contribute to self-handicapping behavior such as low self-esteem, low perceptions of control, high self-consciousness, and a belief that intelligence is a fixed trait (Berglas, 1985; Rhodewalt, 1994; Knee & Zuckerman, 1998). Researchers who have conceptualized self-handicapping as a situation-specific behavior tend to focus on environmental factors as the sources for the self-handicapping behavior. For example, Midgley and Urdan have examined the association between an emphasis on performance goals in the classroom and self-handicapping behavior (Midgley & Urdan, 2001; Urdan,

Midgley & Anderman, 1998; Urdan, 2004). According to this research, students are more likely to self-handicap in classrooms where they perceive an emphasis on competition and trying to outperform classmates. Similarly, experimental research often creates situations in which participants are told that they will be given a difficult task and that performance on the task is indicative of ability (e.g., Tice, 1991). When individuals can be primed to fear that they may not succeed and that any lack of success may indicate a general lack of ability, self-handicapping is more likely to occur.

Perhaps the strongest experiential predictor of self-handicapping is a history of low achievement. Individuals who perform poorly can develop the expectation of low achievement on similar tasks in the future, especially if they believe the failure is caused by stable and uncontrollable causes, such as a lack of ability. Once individuals develop the belief that they may fail on an upcoming task, they become more likely to engage in self-handicapping behavior, which increases the probability that they will fail again. This cycle of failure→self-handicapping→failure can result in a gradual withdrawal of effort in school (or in any domain), leading to dropping out of the activity altogether (Urden & Midgley, 2003; Zuckerman, Kieffer, & Knee, 1998).

A fair amount of research examining the association between motivation and self-handicapping has revealed that certain motivational characteristics of students and teacher instructional practices are associated with self-handicapping behavior. When students are concerned with not performing worse than other students, and with not appearing academically unable, they are more likely to self-handicap (Kaplan, Middleton, Urden, & Midgley, 2002; Urden, 2004). These concerns, known as *performance-avoidance goals*, can be influenced by teacher behaviors. Teachers who emphasize social comparison and competition in the classroom and publicly display reports of student achievement (e.g., test scores, grades) can promote the adoption of performance-avoidance goals in the classroom (L. Anderman & E. Anderman, 1999). In contrast, Turner and her colleagues found that in classrooms where teachers explicitly supported student autonomy and intrinsic motivation, performance-avoidance goals and self-handicapping were reduced (Turner, Meyer, Midgley, & Patrick, 2003).

CORRELATES AND CONSEQUENCES OF SELF HANDICAPPING

Self-handicapping behavior is associated with lower achievement. Because self-handicapping behavior represents a reduction or withdrawal of effort toward a given task (e.g., not studying for a test), it is not surprising that

self-handicapping is associated with lower performance on these tasks. But there may also be some benefits of self-handicapping. Some research indicates that self-handicappers do feel better about themselves after failure than do students who do not handicap (Drexler, Ahrens & Haaga, 1995; Feick & Rhodewalt, 1997). So there does appear to be some ego-protective function of self-handicapping in failure situations. In addition, there may be benefits for students who are able to succeed despite self-handicapping (Feick & Rhodewalt, 1997). Tice (1991) found that students with low self-esteem were more likely to self-handicap when they feared failing at a task, whereas students with high self-esteem were more likely to handicap when they believed they had a chance to stand out as exceptionally able by succeeding at a task. Some evidence suggests that students who succeed even after engaging in self-handicapping behavior do experience temporary increases in self-esteem. In addition, research indicates that self-handicapping is often successful at helping individuals divert the judgments of others away from low-ability attributions for failure.

Unfortunately, even though self-handicappers are often successful at their attempt to provide excuses other than low ability for their low achievement, they usually do not delude themselves. Self-handicappers describe themselves with words such as “lazy” and “shiftless” (Covington, 1992). Moreover, observers of self-handicappers developed negative attitudes about the personalities and work habits of self-handicappers (Rhodewalt et al., 1995; Smith & Strube, 1991).

PRACTICAL IMPLICATIONS

Because self-handicapping behavior undermines achievement and can lead to long-term withdrawal from achievement activities (such as school), it is important for parents and teachers to discourage self-handicapping and to avoid behaviors that might encourage it. Dweck (1999) and her colleagues have long argued that teachers and parents should promote a view of intelligence as a modifiable characteristic, something that can be improved through effort. They suggest that teachers and parents praise children for using the correct strategies rather than simply telling them how smart they are, as the latter may encourage them to think of ability as fixed, a view that contributes to self-handicapping. Midgley, Urdan, and their colleagues have suggested that teachers should emphasize individual growth, improvement, and understanding of the academic material rather than social comparison and competition, as the latter can make students concerned with appearing able or, more importantly, fearing they might appear stupid. Because it is this fear that leads students to engage in self-handicapping, efforts to reduce this fear will likely result in reduction in self-handicapping as well.

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Tim C. Urdan

SELF-REGULATED LEARNING

Educators increasingly are emphasizing self-regulated learning as a means of raising students' achievement outcomes. Self-regulated learning (or self-regulation) refers to learning that results from students' self-generated thoughts and behaviors that are oriented systematically toward the attainment of their goals (Zimmerman, 2001). Researchers have identified several self-regulatory processes that students instigate, modify, and sustain, such as attending to instruction, cognitively processing information, rehearsing and relating new learning to prior learning, believing that one is capable of learning, and establishing productive work and social environments. Research shows that increases in self-regulation result in higher student learning and achievement.

BACKGROUND OF SELF REGULATED LEARNING

The emphasis on self-regulated learning in education began as an outgrowth of behaviorally oriented research on self-control in which individuals learned ways to reduce dysfunctional behaviors such as impulsive or disruptive actions. Behavioral researchers (e.g., Mace, Belfiore, & Hutchinson) stress self-regulating processes such as self-monitoring (self-observation and self-recording of one's own behaviors), self-instruction (rules or strategic steps that one applies and often verbalizes during a task), self-evaluation (comparing some aspects of one's behaviors with standards), self-correction (correcting one's behaviors to better match standards), and self-reinforcement (rewarding oneself with reinforcers such as points or free time when behaviors meet or exceed standards).

An issue with behavioral theories is that because they do not consider learners' internal states such as thoughts, beliefs, and emotions, they offer incomplete explanations

of learning. Against this backdrop cognitive theories of learning began their ascendance in the 1960s and soon became the dominant focus of human learning. But researchers often found that cognitive skills and abilities did not fully account for students' learning, which suggested that other factors such as motivation and self-regulation were important (Zimmerman, 2001). These findings led to the emergence of cognitive theories of self-regulated learning.

THEORIES OF SELF REGULATED LEARNING

Cognitive theories of self-regulated learning differ in many ways but share some common features (Zimmerman, 2001). One common feature is an emphasis on learners being proactive and exerting control on their learning processes and environments. Self-regulated learners do not passively take in information but rather proactively develop their skills and strategies. Cognitive theories also assume that self-regulated learning is a cyclical process in which learners set goals, implement strategies, monitor their learning progress, and modify their strategies when they believe they are not effective. A third common feature is an emphasis on motivation. Self-regulated learning does not occur automatically; rather, students approach learning with goals and the extent to which they self-regulate depends on motivational factors such as their commitment to their goals, their beliefs about the likely outcomes of their actions, and their self-efficacy, or personal beliefs about their capabilities to learn or perform actions at designated levels.

Although there are various cognitive self-regulated learning theories, three that have been applied extensively to school learning are information processing, social constructivist, and social cognitive theories. Information processing theory stresses cognitive functions such as attending to, perceiving, storing, and transforming information. For example, Winne and Hadwin postulated that self-regulated learning comprises four phases: defining the task, setting goals and planning how to reach them, enacting tactics, and adapting metacognition. Initially learners process information about the conditions that characterize the task to clearly define it. Sources of information include task conditions (task information that learners interpret based on the environment such as a teacher's directions) and cognitive conditions that learners retrieve from long-term memory such as how they did on prior tasks and motivational information (e.g., perceived competence). In the second phase learners set a goal and a plan for attaining it to include the learning strategies they will use. During the third phase learners apply their strategies, and in the fourth phase they adapt their plans and strategies based on self-

evaluations of their success (this phase is optional if no adaptation is needed).

Within each phase, cognitive information processing constructs new information or information products. Information processing works on existing information and includes processes characterized by the acronym SMART: searching, monitoring, assembling, rehearsing, and translating. While working on a task, students fill in slots in a script that includes conditions, operations, products, evaluations, and standards. Information processing outcomes are judged against standards and these evaluations (e.g., progress is on target or too low) are used to bring new conditions to bear on students' learning activities.

Vygotsky's theory of development provides a social constructivist account of self-regulation. Lev Vygotsky (1896–1934) believed that people and their cultural environments constitute an interacting social system. Through their communications and actions people in children's environments teach children tools (e.g., language, symbols) needed for developing competence. By using these tools within the social system, learners develop higher-level cognitive functions such as problem solving and self-regulation. Self-regulated learning includes the coordination of such mental processes as memory, planning, synthesis, and evaluation. These coordinated processes do not operate independently of the context in which they are formed. A student's self-regulated learning processes reflect those that are valued and taught in the culture of the student's home and school.

Vygotsky believed that people learn to self-regulate through control of their own actions. The primary mechanisms affecting self-regulation are language and the zone of proximal development (ZPD), or the amount of learning possible by a student given the proper instructional conditions. Initially children's actions are directed by the language (speech) of others but children gradually internalize this self-directing language and use it to self-regulate. Through interactions with adults in the ZPD children make the transition from behaviors regulated by others to behaviors regulated by themselves, or self-regulated learning.

Bandura's social cognitive theory posits that human functioning results from reciprocal interactions among personal factors (e.g., cognitions, emotions), behaviors, and environmental conditions. Self-regulated learning fits well with this idea of reciprocal interactions because personal factors, behaviors, and environmental conditions change during learning and must be monitored. Such self-monitoring can lead to additional changes in students' strategies, cognitions, affects, and behaviors.

This process is reflected in Zimmerman's 2000 three-phase self-regulated learning model comprising forethought, performance/volitional control, and self-

reflection. The forethought phase precedes performance and refers to processes that set the stage for action. The performance/volitional control phase includes processes that occur during learning and that affect motivation and action. During the self-reflection phase, learners mentally review their performances and determine whether changes in behaviors or strategies are needed.

Various self-regulatory components come into play during the different phases. Two processes active throughout the model are goals and self-efficacy. In the forethought phase, learners set goals and hold a sense of self-efficacy for attaining them. During the performance phase they implement learning strategies and cognitively compare their performances with their goals to determine progress. Their self-efficacy is sustained when they believe that they are making goal progress. During self-reflection learners determine whether their present strategy is effective. If they feel self-efficacious for succeeding but believe that their present strategy is not working well enough, they may alter their strategy such as by working harder, persisting longer, deciding to use a different method, or seeking help from others. These self-regulatory processes promote learning, motivation, and self-efficacy.

DEVELOPMENT OF SELF REGULATED LEARNING

The self-regulated learning processes discussed in the preceding section do not appear automatically in learners. Rather, students become more proficient self-regulators as a function of cognitive development and learning.

The development of self-regulation depends heavily on the use of self-regulatory or private speech (speech that is non-socially communicative). According to Kopp, increasing self-regulation involves a transition from responding to the commands of others to the use of speech and other cognitive tools to plan, monitor, and direct one's activities. Young children's actions are directed by adults. The meaning of actions depends on both the context and the tools (e.g., language, symbols) used to describe the actions. Through interactions with adults in the ZPD, children make the transition from behaviors regulated by others to behaviors regulated by themselves. This transition occurs as children develop the capability for using private speech to direct their actions. Such speech which often may be talking aloud eventually becomes internalized. The internalization of self-regulatory speech does not imply the absence of adult influence. Children's private speech may heavily reflect the directive speech of key adults (e.g., parents, teachers).

Research has identified other developmental changes. Zimmerman and Martinez-Pons found that between grades five and eight children increase their use of planning, sequencing, and goal-setting. Academic studying also

undergoes changes. Meece noted that younger children equate studying with rereading material, whereas older students make greater use of note taking and underlining. Younger children also are less capable of monitoring their comprehension. Older children are better able to determine inconsistencies in text and when they find them they act to resolve them such as by rereading the passage to ensure that they read it accurately or by reading the broader passage to better determine the context.

Thus, improvements in self-regulated learning involve cognitive development and learning. As children become older they are better able to cognitively engage in such self-regulatory activities as planning, goal setting, monitoring comprehension, evaluating progress, and adjusting strategies as needed. But teaching also is important because students can learn to be better self-regulators, as discussed below.

RESEARCH ON IMPROVING SELF REGULATION SKILLS

As discussed by Schunk and Ertmer, much educational research shows that children, adolescents, and adults can be taught self-regulated learning skills, that their use of these skills improves learning, and that skills can maintain themselves over time and generalize to new learning settings. For example, teaching students to use goal setting can improve their self-regulated learning. There are different distinctions among goals, but one is between a process goal (what skill or strategy students are attempting to learn) and an outcome goal (the intended performance). In algebra a student may be trying to learn how to use the binomial theorem (process goal) or trying to finish a problem set (outcome goal). Researchers have found that focusing students' attention on process goals especially in the early stages of learning improves self-regulated learning better than focusing on outcome goals. However, Zimmerman and Kitsantas found benefits from shifting from process to outcome goals. High school students were taught a writing revision strategy. Students received a process goal (following steps in the strategy), an outcome goal (number of words in sentences), or initially a process goal but then were advised to shift to an outcome goal. Learners who changed goals as their revision skills developed demonstrated higher self-efficacy and skill than students who pursued either the process or the outcome goal.

Self-monitoring and perceptions of progress are key self-regulated learning processes. Researchers have found that students can be taught self-monitoring skills and that giving them feedback on their learning progress improves their use of self-regulatory skills. Schunk and Swartz found that providing students with a process goal of learning to use a writing strategy and feedback that linked strategy use

with improved writing performance led to the highest use of a writing strategy and that this strategy usage maintained itself over time and generalized to writing tasks on which students had received no instruction.

Self-evaluations of progress help students focus on self-regulation processes and can raise their motivation and self-efficacy for continuing to improve. Research shows that allowing students to periodically evaluate their learning capabilities raises their self-efficacy, motivation to self-regulate, and use of self-regulated learning strategies. A particularly effective approach is to give students a learning process goal (e.g., learn to use a strategy to solve problems) and allow them to self-evaluate their capabilities for using the strategy successfully.

There are formal programs designed to improve students' self-regulation skills. Weinstein, Husman, and Dierking described a university course in strategic learning that teaches students to use several steps in working on academic material: set a goal, reflect on the task and one's personal resources, develop a plan, select potential strategies, implement strategies, monitor and evaluate the strategies and one's progress, modify strategies as needed, and evaluate the outcomes to determine if this approach should continue to be used. Prior to the course students complete the Learning and Study Strategies Inventory, and instructors use this information to help students improve their skills, motivation, self-regulation, and academic environment.

EDUCATIONAL IMPLICATIONS

The preceding research makes clear the connection between effective self-regulation and gains in students' learning and achievement. Research findings also suggest ways to help students improve their self-regulated learning skills.

One suggestion is that, although students may discover effective self-regulated learning strategies on their own, they benefit from sound instruction and models that explain and demonstrate strategies. This does not imply that strategy instruction programs must be formally structured, but some guidance to students is important especially in the early stages of learning. As students become more proficient they are better able to construct effective strategies on their own and, as Zimmerman and Kitsantas found, pursue outcome rather than learning process goals.

A second point is that self-regulation should be taught in conjunction with an academic subject and not separately. Students benefit from seeing how they can use what they learn. Many self-regulation strategies are generic and can be applied to different content, but their implementation typically will vary depending on the content area. Thus, self-monitoring is a general strategy but what students self-monitor will vary depending

whether they are reading passages in text, writing essays, or solving problems in geometry. When general strategies are taught it is important also to show students how the strategy can be adapted for use with other content.

Students should be taught how to evaluate their learning progress and given opportunities to do so. Typically in school students have their learning evaluated for them by teachers. But self-regulation is a cyclical process in which students self-regulate, check their progress, and adjust their approach as needed. Students need opportunities for self-evaluation because they may not do it automatically and it affects their motivation and self-regulated learning.

Developmental factors must be taken into account in teaching students to be better self-regulated learners. Self-monitoring is best kept simple for young children, such as by having them use a check list or count how many problems they have completed. With development, students can implement more elaborate self-regulation strategies; however, they are apt to benefit from instruction showing how to evaluate progress in areas where progress may be difficult to assess, such as writing improvement or reading comprehension.

Motivational variables also should be included in self-regulation programs. Developing effective self-regulation strategies takes time and effort, and students may not be motivated to self-regulate unless they see benefits compared with their usual approaches. They also may not feel self-efficacious about improving their self-regulation. Providing students with progress feedback linking strategy use with improved performance can raise their self-efficacy and motivation and enhance their self-evaluations of progress.

School learning typically is focused on academic content. Self-regulated learning skills do not develop automatically, but these skills will benefit students for life-long learning. Therefore, it behooves teachers and parents to help students develop their self-regulatory competencies and encourage them to practice using them in all facets of their lives.

SEE ALSO *Learning Styles; Self-Efficacy Theory.*

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Dale Schunk

SENSATION-SEEKING

Sensation-seeking is characterized by researchers as a basic human need and as a component of human personality. The need for sensation runs along a continuum, wherein some individuals have a high need for sensation, whereas others have a low need for sensation. An individual who has a high need for sensation seeks sensation in the form of novelty, complexity, or physical stimulation from the environment (Zuckerman, 1979, 1988). Some researchers argue that sensation-seeking includes the willingness to actually take risks, whereas others argue that the willingness to take risks is a separate but related construct (e.g., Arnett, 1994).

The concept of sensation-seeking primarily has been studied in the domains of clinical psychology, personality

psychology, health psychology, and communications. From an evolutionary perspective, attention to novel stimuli in the environment was necessary for human survival. Specifically, the detection of new stimuli alerted humans to potential dangers (Franklin, Donohew, Dhoundiyal, & Cook, 1988). For example, an awareness of new sounds in the environment could alert an individual to the approach of a potential predator. Most researchers in the early 2000s view sensation-seeking as an important personality trait of humans, albeit not one that is necessary for survival. The fact that sensation-seeking is viewed as a personality variable is important because personality variables are often not easily malleable; thus an individual who expresses a high need for sensation is unlikely to change much over time.

Research from the field of communications generally indicates that individuals with a high need for sensation are more likely to attune to and pay attention to messages (i.e., communications from teachers, messages from television commercials, etc.), when such messages or communications are presented in ways that catch and hold the attention of the individual.

THE IMPORTANCE OF SENSATION SEEKING

Much of the research on sensation-seeking that is relevant to education and to educational psychology emanates from the field of health communications. In addition, much of this work has been applied research, often in school settings, and often with adolescent populations. Specifically, communication researchers have found that individuals pay attention to messages (e.g., media messages such as radio or television advertisements) based on (a) the individuals' need for sensation and (b) the level of sensation or stimulation that is provided by a given message. A media message that provides high levels of sensation is typically loud, colorful, and filled with motion and action. Intervention studies have found that when the sensation-value of a message is increased (i.e., it is made to be more stimulating by making it loud, including more colors and motion, etc.), the message is more attractive to individuals with a high need for sensation and thus has more effect on individuals' subsequent attitudes and behaviors (Donohew, Lorch, & Palmgreen, 1998).

Individuals who have high sensation needs typically engage in certain predictable behaviors. Most notably, the research indicates that individuals who exhibit a high need for sensation often are more likely to engage in risky or dangerous behaviors, such as abusing substances and having unprotected sexual intercourse (Baer, 2002; Donohew, Zimmerman, Novak, Feist-Price, & Cupp, 2000). However, research also indicates that high-sensation seekers exhibit other diverse characteristics. For example, one

study found that these individuals report greater use of the Internet than do individuals with lower reported levels of sensation-seeking (Lin & Tsai, 2002).

Research indicates that sensation-seeking rises markedly during early adolescence (Donohew et al., 1994). For many adolescents, this increase coincides with the transition from elementary school into middle school. Thus although students with high needs for sensation are present in elementary, middle, and high schools, these students may be particularly prevalent in middle school settings.

SENSATION SEEKING IN THE CLASSROOM

Students with high need for sensation are likely to display certain predictable characteristics. First, these students may engage in risky activities in school, such as running in the hallway, jumping off desks, throwing food in the cafeteria, or more serious activities such as using illicit substances or getting into physical fights. Second, these students may be particularly attracted to stimulating experiences in school; such students may want to listen to loud music or to look at highly visually stimulating materials (e.g., colorful books with many bright pictures). Third, these students are likely to get bored easily; they may not fare well in classrooms in which they are required to sit for long periods of time and listen to lectures.

Nevertheless, these students still pay attention to tasks, activities, and media messages that are low in sensation-value, if the topic is particularly salient to them. For example, individuals may attend to a seemingly boring documentary on cancer research, if they have close relatives or friends who is suffering from the disease; they may attend to a lecture on the stock market if they have just received the gift of a larger sum of money.

SUGGESTIONS FOR EDUCATORS

Scholars who study sensation-seeking have examined in particular how media (e.g., television programs or commercials) and general communication in the classroom (e.g., the ways that teachers communicate information to students) affect learning. Students with a high sensation needs benefit from instructional practices that meet those needs. It certainly is not possible to meet the needs of these students at all times, but some lessons can be altered to better hold their attention. Clear suggestions for educators emerge from this literature.

First, these students are more academically engaged in classrooms in which novel, unpredictable activities occur. These students get bored easily in monotonous settings in which activities are repeated daily. Thus, these students benefit from changes in daily routines and the presentation of new instructional materials from time to time (e.g., the use of new texts, the introduction of novel

activities, the use of videos and the Internet, holding class outside on a nice day).

Second, educators can adapt curricular materials and classroom activities to make them more appealing to students who have high sensation needs. Whereas these adaptations benefit the high sensation-seeking students, they also may be interesting and novel for students who do not have such high needs. Researchers have identified specific ways in which curricula can be adapted for students with high sensation needs. These adaptations include: (a) the use of dramatic role-playing activities (including the videotaping of such activities), (b) the incorporation of videos and music into traditional lessons, (c) the inclusion of outside speakers with real-world experiences, and (d) the opportunity for students to facilitate conversations and activities in the classrooms (Anderman, Noar, Zimmerman, & Donohew, 2004).

Donohew and his colleagues have identified the characteristics of academic tasks and media messages that are likely to be attractive to adolescents with a high sensation needs (Donohew et al., 1998). These include: (a) tasks that are novel or unusual, (b) tasks that are complex, (c) tasks that provide auditory and visual stimulation, (d) tasks that are unconventional, (e) tasks that are fast-paced, (f) tasks that are complex or ambiguous, and (g) tasks that are suspenseful.

Third, educators need to be aware that students with high sensation needs may also experience problems with behavior in the classroom. These students are more likely to get out of their seats, to talk to their neighbors, and to seek attention from the teacher. Thus targeting students with high needs for sensation early on and setting up classroom contexts to provide for these students' needs may alleviate some potential behavioral problems in the classroom.

Finally, although most of the research has focused on students who exhibit high needs for sensation, educators must be aware of students who have a low need for sensation as well. Although research suggests that tasks that are low in sensation value appeal to students with a low need for sensation (Zuckerman, 1988), it is incorrect to assume that all academic tasks or media messages that are low in sensation-value will always be attractive to these individuals. Donohew and others suggest that these messages may simply be boring and ineffective for all learners. However, educators also must be aware that students with low needs for sensation may find tasks that are high in sensation value particularly over-stimulating.

SEE ALSO *Impulsive Decision Making*.

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Eric M. Anderman

SERVICE-LEARNING

Students and faculty are engaged in service-learning at every level of the educational ecology; state and international communities, K-12 schools, and colleges and universities in the United States and abroad. The National Center for Education Statistics (NCES) estimates that more than 13 million K-12 students participated in service and service-learning during the 2000-2001 academic year (Fiske, 2001). During the 2005-2006 academic year more than 6 million college and university students attending more than 1,000 institutions of higher education also were engaged in some type of service-learning (Campus Compact, 2007). These data suggest that service-learning is a comprehensive and innovative pedagogy in college, universities, and K-12 schools.

DEFINITION

In the early 2000s, service-learning projects continue to grow and evolve in schools and institutions of higher education in such a way that a common definition has not yet emerged; however, a number of accepted definitions for service-learning are used by researchers and practitioners. One definition proposed by Campus Compact (2001) focuses on service-learning as pedagogy: "service learning is an educational methodology which combines

community service with academic learning objectives, preparation for community work and deliberate reflection” (p. v.). A second definition offered by Campus Compact states: “service-learning means a method under which students learn and develop through thoughtfully organized service that is conducted in and meets the needs of a community and is coordinated with an institution of higher education (or K-12 school), and with the community; helps foster civic responsibility; is integrated into and enhances the academic curriculum of the students enrolled; and include structured time for students to reflect on the service experience” (p. 15). Tom Ehrlich of the Carnegie Foundation for the Advancement of Teaching defines services learning as follows: “the various pedagogies that link community service and academic study so that each strengthens the other. The basic theory of service learning is Dewey’s: the interaction of knowledge and skills with experience is key to learning” (1996). Researchers Robert Bringle and Julie Hatcher (1995) define service-learning as “a credit-bearing, educational experience in which students participate in an organized service activity that meets identified community needs and reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility.”

Staff at Learn and Serve America offer a core concept of service-learning, which holds wide agreement among both researchers and practitioners: “service learning combines service objectives with learning objectives with the intent that the activity change both the recipient and the provider of the service. This is accomplished by combining service tasks with structured opportunities that link the task to self-reflection, self-discovery, and the acquisition and comprehension of values, skills, and knowledge content” (retrieved from <http://www.servicelearning.org>, on April 15, 2008).

The National Commission on Service-Learning (Fiske, 2001) suggests that service-learning is a teaching and learning approach that integrates community service with academic study to enrich learning, teach civic responsibility, and strengthen communities. The intentional and planned link to the curriculum is the hallmark of service-learning. A second distinction is the reciprocal nature of the partnership between campus and community in the identification of the need and in the benefits resulting from the partnership. In other words, service-learning activities provide a mechanism for active learning and the construction of authentic learning experiences. It allows students to translate and reflect on their experience and to work in teams with other students and community members who may be different from themselves toward solving authentic problems in the community. Service-learning projects are group projects that prepare students for membership in teams in schools and

future professions. Finally, service-learning projects provide faculty with a strategy for moving away from the role of lecturer to the role of a facilitator and guide who facilitates the incorporation of new knowledge with old and the application of information to authentic, new, and varied contexts or persons.

One challenge in the implementation of service-learning activities is the misconception that these are equivalent to other community-based activities such as experiential education, volunteerism, internships, practica, and field experience. Furco (1996) provides a conceptual model for differentiating service-learning from other forms of experiential education that uses two factors: the intended beneficiary and the overall balance between service and learning as the discriminating variables. For example, volunteerism may be defined as an experience in which students provide a service and the intended beneficiary is the community partner. Community service is the engagement of students in activities with a primary focus on the service provided and the benefits accrued for the community partner. Students may acquire some benefit, but it is not necessarily tied to their discipline. At the other end of the continuum, internships engage students in service activities with the purpose of providing hands-on learning opportunities to enhance the learning and application of a set of skills or knowledge: The focus is the student.

Field experiences provide students with the opportunity to perform a service as part of a program designed primarily to enhance the understanding of a field of study: The emphasis is on the student’s acquisition of skills within the field of study. Service-learning is distinguished from these other forms of experiential education by the intention to benefit the student and the community in a reciprocal and equal partnership. The focus is equally divided between the service provided and the learning that occurs. Weigert (1998) identifies six elements of service-learning that further differentiate it from other community-based outreach activities: (1) the service is meaningful to the community; (2) the service meets a need or goal; (3) the service is defined and identified by the community; (4) the service is embedded in course objectives; (5) assignments which require reflection are used to link service with objectives; and (6) the assignment has value and is assessed and evaluated.

THEORETICAL MODEL AND IMPLEMENTATION

The conceptual model that has guided service-learning was proposed by David Kolb (1984) and was built on the process of experiential inquiry proposed by John Dewey. The six step process of inquiry (encountering a problem; proposing a problem or question to be answered; gathering

information to answer the question or solve the problem; making hypotheses; testing hypotheses; and making judgments or assertions) was used by Kolb to develop a learning cycle that included four phases: concrete experiences, reflective observations, abstract conceptualization (with faculty mentoring and guidance), and active experimentation. These phases are cyclical and generative.

Billig (2006) provides eight principles of effective practice in the development of service-learning activities within the curriculum: (1) service must be integrated in the curriculum; (2) diverse perspectives and experiences foster civic discourse and democratic values for all participants, both student and community partners; (3) the service is meaningful, requiring problem-solving and critical thinking; (4) reflection is used to encourage critical and creative thinking; (5) students contribute ideas in each phase of the experience; (6) the process is monitored by knowledgeable faculty and staff; (7) the experience is of sufficient intensity and duration; and (8) partnership is reciprocal and collaborative.

Faculty implementing service-learning generally move through four stages. First, community needs are identified and defined by community and campus partners, goals are then set for both learning and service. Faculty and community partners clearly delineate responsibilities and expectations and typically provide some type of orientation for students and staff if needed. The service experience constitutes the second phase and provides authentic and meaningful experience linked to the discipline and course objectives. Reflection is phase three and may occur in multiple ways: by analyzing concepts, evaluating experiences, posing questions, and reflecting on the problem/need and potential solutions. Evaluation and celebration is the final stage and recognizes the work of the student and community partner and provides a public mechanism to share the accomplishments of the students and community partners in meeting the need and/or solving the problem.

IMPACT

A number of large and small sample studies have demonstrated the positive impact of service-learning on personal outcomes, such as efficacy, identity, spiritual growth, and moral development (Astin & Sax, 1998; Eyler & Giles, 1999), the ability to work with others, leadership, and communication skills (Driscoll, Holland, Gelmon, & Kerrigan, 1996). Social outcomes such as the reduction of stereotypes, facilitation of cultural and racial understanding, sense of social responsibility, and citizenship skills (Eyler & Giles, 1999) have also been positively impacted (Bringle & Kremer, 1993). Participation in service-learning has also been documented to affect community involvement and volunteerism after graduation (Astin, Sax, & Avalos, 1999).

Faculty report that service-learning has a positive impact on academic learning and improves students' ability to apply what they have learned in the real world (Driscoll et al., 1996; Eyler & Giles, 1999). For example, a study of California high school students found that those students who participated in service-learning scored higher on all of the study's academic measures than those students enrolled in the comparison group who did not participate (Furco, 2002). These findings have been replicated in Philadelphia, Denver, and Hawaii (Billig, 2006). A study of fifth graders in Michigan also found that participation in service-learning activities was positively correlated with state test scores (Klute & Billig, 2002). Similar findings are reported for sixth grade students in Philadelphia (Billig, 2006). Participation in service-learning has been associated with higher attendance rates (Shumer, 1994) and decreased referral for disciplinary reasons (Follman, 1998). Service-learning also contributes to career development (Astin & Sax, 1998) and to students' greater sense of belonging and identification with their school (Eyler & Giles, 1999). Most importantly, students who are engaged in service-learning are more likely to graduate (Astin & Sax, 1998).

As of 2008, increased attention to service-learning was occurring concurrently with a focus on engaged teaching and learning. Researchers, scholars, and professional organizations have encouraged U.S. schools, colleges, and universities to focus on student learning and academic outcomes. Faculty state that their involvement in service-learning is motivated by one of three philosophical questions. First, is the value of service-learning for enhancing academic and interdisciplinary learning? If so, this philosophy would also support service-learning as a methodology that allows students to deepen their understanding of their discipline while developing strategies of inquiry appropriate across all disciplines and life experience. Second, is the use of service-learning for the acquisition of the skills and behaviors of leadership? Knowledge of and skills necessary for effective leadership are best experienced and gained firsthand in the real world. Third, is the service-learning conducive to civic engagement? This connection is frequently explored in published research.

In summary, service-learning has been demonstrated to benefit all members of the partnership: students, faculty, and community. Students have the opportunity to apply knowledge in meaningful ways, to work in interdisciplinary partnership with students from other disciplines and communities, and to acquire and/or change disposition and lifelong behaviors and attitudes. Community partners are able to meet an identified goal and establish positive relationships with students and the sponsoring institution. Faculty have the opportunity to support the expansion of student knowledge in application and applied settings; to

demonstrate or model the application of discipline specific knowledge in applied settings; to establish partners in the application of research, and to respond to the needs identified by community partners for engaged research. Schools and other educational institutions are able to make connections to the community and form trusting and authentic partnerships with community members and organizations in engaged research and service.

RESOURCES

After the devastation of Katrina and other hurricanes in the Gulf Coast region of the United States, student organizations and faculties across the country responded through service-learning and other community outreach and engagement efforts. Student groups organized efforts to provide books, school supplies, clothing, and other necessities. Campuses offered displaced students and faculty places to live, tuition waivers, and opportunities to complete degrees that would have otherwise been abandoned. In 2005 the U. S. Housing and Urban Development and the Corporation for National and Community Service funded the Gulf Coast Universities Rebuilding America Partnership in response to the needs of communities affected by the hurricanes. This program provides an organized mechanism for supporting and engaging college and university students, faculty, and staff in helping rebuild the Gulf Coast region (for more information, see <http://www.learnandserve.org/about/programs/index.asp>).

Serve America (the predecessor of Learn and Serve America) was created in 1990 through funding by the National and Community Service Act (As amended through December 17, 1999, 170, P.L. 106 170) and the Domestic Volunteer Service Act (as amended by Public Law 106 170, approved December 17, 1999) to integrate community service with curricula through service-learning. In 1993 President Clinton signed legislation to create the Corporation for National and Community Service whose mission is to improve lives of Americans, strengthen communities, and foster civic engagement through service and volunteering. The corporation provides opportunities for more than two million Americans of all ages and backgrounds to serve their communities and country through Senior Corps, AmeriCorps, and Learn and Serve America, which provides support to K-12 schools, institutions of higher education, and community groups. The mission of Learn and Serve America is to facilitate service-learning projects by providing grant support for school-community partnerships, technical support and training, and the collection and dissemination of information about model programs, curricula, and research (for more information, see <http://www.learnandserve.org>).

Campus Compact, which is funded by a number of public and private sources (i.e., Corporation for National

and Community Service, Ford Foundation, Andrew Mellon Foundation, Pew Charitable Trusts, and the Carnegie Corporation of New York), began in 1985 as a collaboration of the presidents of Brown, Georgetown, and Stanford universities in cooperation with the Education Commission of the States. These university presidents believed that students on their campuses were socially and politically responsive to the needs of their communities and neighbors and were actively involved in community service. They sought a mechanism to document these efforts and to encourage supportive structures to increase the participation of other students. By 1991 the Compact had funded more than 120 grants and 130 service-learning workshops across the nation to faculty who linked community serve with the academic mission of higher education, and in 1999, a total of 51 college and university presidents crafted the Presidents' Declaration on the Civic Responsibility of Higher Education. By 2003, one-fourth of all higher education institutions in the United States were members of Campus Compact. These members promote civic engagement through shared knowledge and resources in the provision of service-learning efforts in the areas of literacy, health care, hunger, homelessness, the environment, and senior services. The Campus Compact mission is "to advance the public purposes of colleges and universities by deepening their ability to improve community life and to educate students for civic and social responsibility" (retrieved April 15, 2008, from www.compact.org).

Students at Campus Compact's more than 1,000 member colleges and universities contributed an estimated \$7.1 billion in services to their communities during the 2005 2006 academic year. Nearly one-third of students participated in volunteer and service-learning work coordinated by campuses, performing an average of 5.6 hours of work each week, for a total of 377 million hours of service. It is important to note that these figures represent only work organized or supported by member colleges and universities; it does not capture other student volunteer work. The most common service programs on member campuses focused on tutoring and mentoring, a reflection of the high number of member institutions that have partnerships with local K-12 schools and other youth-serving organizations. Other commonly addressed issues included poverty, reading/writing, housing/homelessness, hunger, the environment, health care, multi-cultural issues, and services to seniors (Campus Compact, 2007).

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Katherine M. McCormick

SEXUAL ORIENTATION

While commonly considered a way to divide the world into dichotomous and unambiguous categories of heterosexual/homosexual or gay/straight, sexual orientation is, in reality, a complex configuration of sexual attraction/desire, sexual behavior, and sexual identity. For many individuals, these three aspects of sexual orientation are neither neatly aligned nor stable across the lifespan. For example, a young adolescent female may only engage in sexual intercourse with her boyfriend, may experience sexual/romantic attractions to both males and females, live in a heterosexual marriage for a number of years during early adulthood, and claim a lesbian or bisexual identity in mid-adulthood. Likewise, a young male may be aware from an early age that his attraction is oriented to other males; he may engage in insertive-only sexual behaviors with other male sex partners, and he may claim a heterosexual identity throughout adulthood. Therefore, those who identify as gay, lesbian, or bisexual (GLB) or even heterosexual, do not form distinct, homogenous groups. Each of the three aspects of sexual orientation exist on a continuum, with fewer individuals endorsing exclusive attraction or behavior toward one sex, and with many other individuals endorsing some level of attraction to or behavior toward each sex.

Even this generally accepted tripartite conceptualization of sexual orientation vastly oversimplifies the human experience of sexuality. By focusing on the anatomy of the chosen sex partner(s) as the determining factor of sexual identity, the understanding of the complexities of sexuality and how it develops within the social context of family, peers, schools, and communities is truncated. Acknowledging this oversimplification of a complex phenomenon, the remainder of this article focuses on youth who are (or who are perceived to be) same-sex attracted.

Given this necessarily limited scope, readers are urged to consult other resources on transgender youth, another distinct and non-homogenous social identity. Transgender individuals represent the *T* in the common acronym GLBT (gay, lesbian, bisexual, transgender). However, transgender identities are constructed around the experience of the self as male or female rather than one's sexual orientation toward other persons perceived as male or female. That is, a transgender person may identify as either male or female (in contrast to the perceived and assigned sex) and then separately as heterosexual, homosexual, or bisexual depending on the perceived/assigned sex of those to whom the person is sexually attracted. Transgender youth share with GLB youth the experience of having to negotiate a stigmatized identity in often hostile or rejecting environments. However, their experiences and needs cannot be assumed to be the same. Further information and focused discussion of

the important and unique needs of transgender youth in schools can be found in most of the resources suggested at the end of this entry.

As with other socially constructed categories (e.g. race, ethnicity, sex, age), sexual orientation categories reinforce power hierarchies within the culture. Heterosexual identities are privileged and non-heterosexual identities are invisible or even oppressed. For example, displays of heterosexuality in the form of social dating opportunities, proms, homecoming kings and queens, are “embellished, protected, and promoted” in schools (Leck, 2000, p. 344). In stark contrast, several states have passed legislation forbidding positive representations of homosexuality in schools (Kosciw & Diaz, 2006).

The realities of heterosexism and homophobia are the social context in which sexual minorities (the term commonly used to refer to all of those who are perceived to be or who claim to be non-heterosexual) develop their identities. In response to heterosexist and/or homophobic social contexts and social interactions, sexual minority adolescents and adults frequently conceal their same-sex sexuality (even on confidential research surveys), making it impossible to know with certainty the distribution of sexual minority identities in the general population. Additionally, for other individuals, the available categorical labels for those who experience same-sex attractions do not adequately describe their experience and thus they chose not to check a box on surveys or in their self-referent discourse (Diamond, 2005; 2006). With these caveats in mind, the best and most recent (as of 2007) population studies have determined that approximately 2 to 4 percent of the general population has a homosexual orientation (Laumann, Gagnon, Michael, & Michaels, 1994). In real numbers, this statistic implies that in a high school of 1,000 students, approximately 20 to 40 individuals will, by adulthood, identify as gay, lesbian, or bisexual. While a relatively small percentage of youth in any one school may identify as GLB, exponentially more heterosexually identified youth have at least one GLB parent, sibling, or other close family member.

School communities, thus, are filled with students, teachers, and staff who either are non-heterosexual themselves or have a close affiliation (friend or family member) to someone with a non-heterosexual identity. Public education that promotes democratic values and produces an informed citizenry that will positively contribute to a diverse, global society requires multicultural (rather than monocultural) competence that includes accurate information about and respectful interaction with sexual minorities. The respectful, professional, and inclusive treatment of sexual minority teachers, school personnel, and students provides a powerful opportunity for increasing multicultural competence among all. The absence of strong mod-

eling of this kind of inclusivity perpetuates heterosexism and is detrimental to the goals of social justice and democracy. Having now emphasized that school communities include GLB teachers, GLB staff, GLB students, children of GLB parents, and family members of GLB individuals, the remainder of this article focuses on the needs of GLB youth in the school context.

NORMATIVE DEVELOPMENT OF SEXUAL MINORITY YOUTH

Like all adolescents, sexual minority youth face the developmental task of consolidating their identities within the context of their families, peers, and communities. That is, like heterosexual youth, sexual minority youth are trying to answer the question of who they are in relation to others and the world around them. To the extent that youths live in a social context that is characterized by homophobic attitudes and the heterosexist assumption that all so-called normal youth are heterosexual, sexual minority youths must weigh the risks of disclosing their sexual orientation. Conforming feminine or masculine appearance may make concealment a realistic option for some sexual minority youths. In any case, the on-going decisions to disclose or conceal one’s identity from various people in the social network (e.g., family members, friends, teachers, and other adults) can be a significant source of chronic stress for some youths, particularly for those from racial/ethnic groups, religious groups, families, schools and/or communities that are intolerant of same-sex sexuality. Such adolescents may remain closeted rather than risk the loss of family and/or community support. In some cases, disclosure could result in the threat of violence and/or homelessness. Overall, however, same-sex attracted youths (particularly boys) are acknowledging same-sex attraction, questioning their sexual orientation and/or coming out at younger ages than in past generations (D’Augelli, 2005), perhaps due to increasing visibility of sexual minority individuals and families in the media and in many communities.

Regardless of the decision to disclose or conceal same-sex attraction, this milestone is considered the beginning of the coming out process for sexual minority youth. While identity models have portrayed a linear, lock-step process of gay and lesbian identity development that begins with acknowledgment and acceptance of one’s same-sex sexuality and ends with claiming a stable identity and disclosing it to others, the actual experiences of this process have been demonstrated (most notably in young women) to be rarely this simple, tidy, and final (Diamond, 2005; 2006). Some youths altogether reject sexual identity labels and categories and others identify as *queer* rather than gay, lesbian, or bisexual as a way to reclaim or reframe a derogatory label as one of power and pride.

RISK AND PROTECTIVE FACTORS

As noted above, sexual minority youths face chronic stressors that are typically not a part of heterosexual youths' life experience. These chronic stressors, referred to collectively as "minority stress" (Meyer, 2003) include experiences of discrimination and prejudice, anticipation of rejection, internalized homophobia (i.e., negative attitudes and feelings incorporated into the self-image), and, as mentioned above, disclosing or concealing one's identity in various social contexts and relationships. Perhaps the most pervasive and destructive minority stressor frequently experienced by GLBT students in schools is peer harassment, bullying, and violence (Russell, Franz & Driscoll, 2001; Human Rights Watch, 2001; Udry & Chantala, 2002). A 2005 national survey of sexual minority youths' perceptions and experiences of their school climate found that two out of three students had been verbally harassed because of their perceived sexual orientation. Half of the participants had been verbally harassed because of the way they expressed their gender. A full three out of four participants felt unsafe at school because of treatment they received because of one personal characteristic, usually sexual orientation or gender expression (Kosciw & Diaz, 2006).

Harassment affects the educational outcomes of sexual minority youth. Large population-based studies have found that sexual minority youth are significantly more likely than their heterosexual peers to be threatened or harassed at school and to skip school because they feel unsafe (Goodenow, Szalacha, & Westheimer, 2006; Robin et al., 2002). Sexual minority youth also report lower levels of school belonging (Galliher, Rostosky, & Hughes, 2004; Rostosky, Owens, Zimmerman, & Riggle, 2003) and more negative attitudes about school and difficulties in school (Russell, Seif, & Truong, 2001). Sexual minority students are also less likely to perceive that there is an adult at school that is available to them for support (Goodenow, Szalacha, & Westheimer, 2006). The combined effect of a negative school environment and meager social support increases the risk for poor educational outcomes (Kosciw & Diaz, 2006; Murdock & Bolch, 2005).

Strong social support from family, from peers, or from other gay-affirmative adults (including teachers and other school personnel) may buffer at least some of the effects of minority stress on sexual minority youths. However, sexual minority youths who do not enjoy adequate social support or who have difficulty coping with the levels of minority stress in their lives may be at increased risk for poor psychosocial outcomes. While the majority of sexual minority youths develop coping strategies and coping resources that help to minimize the effects of minority stress, the overall higher rates of

psychological distress (Elze, 2002; Udry & Chantala, 2002) and substance abuse problems (Rostosky, Owens, & Zimmerman & Riggle, 2003; Russell, Driscoll, & Truong, 2002) among these youths are of serious concern. For example, research has established links between the school bullying and victimization experiences of sexual minority youth and their higher rates of suicidality and depressive symptoms (Bontempo & D'Augelli, 2002; Goodenow, Szalacha, & Westheimer, 2006).

CHARACTERISTICS OF SCHOOLS AND CLASSROOMS REGARDING RISK

Providing access to safe schools for all children and adolescents is a necessary requirement for positive educational outcomes. The increased risks of harassment and educational disruption and interruption for sexual minority youths must be addressed at multiple levels. First, state-wide legislation that comprehensively and specifically protects students of all socially disadvantaged groups must be enacted. The majority of GLB students in the United States are not protected, and research has demonstrated that blanket coverage through generic legislation that does not enumerate protected categories is no more effective in reducing harassment than no legislation at all (Kosciw & Diaz, 2006).

District-wide and school-level establishment and enforcement of strong anti-bullying policies that are comprehensive and inclusive of sexual orientation sends a strong message that all students will be protected from physical and psychological harm. Research findings indicate that GLB students in schools with comprehensive anti-bullying policies that include sexual orientation are more likely to report harassment, and teachers in such schools are more likely to intervene in such harassment than those GLB students and teachers in schools with generic anti-bullying policies (Kosciw & Diaz, 2006).

Safe schools create and adopt inclusive curricula that affirm the intrinsic worth of all individuals, including those who are sexual minorities. All students, including sexual minority students, have a right to a school environment that is safe and that facilitates rather than inhibits learning. Integrating sexual minority lives into classroom curricula models acceptance and appreciation of diversity. Resources on GLBT-related topics should be made available in the library and on the Internet. Students should be exposed to positive representations of GLBT issues, achievements and contributions, and current events.

At the classroom level, appropriate professional training on issues related to sexual minority youths and families should be provided since the majority of GLBT students indicate that they talked with a teacher at least once during the previous school year (Kosciw & Diaz,

2006). Unfortunately, many teachers and school staff lack even basic knowledge about sexual orientation and, therefore, are unprepared to provide information, protection, or support to their sexual minority students (Ryan & Rivers, 2003). Beyond providing support to these students, however, teachers and staff need to be trained in and encouraged to exercise skills in confronting the use of derogatory language and in effectively intervening in anti-gay bullying and harassment. Such training has been demonstrated to be significantly associated with an improved school climate (Szalacha, 2003).

School personnel should also be provided with resources (time, expertise, rewards) for grappling with their own assumptions about and biases toward others who are different from themselves. To provide effective multicultural education for students, school personnel must first have opportunities to address the ways they as individuals have personally benefited from and suffered from power hierarchies attached to social categories. This type of professional development requires a safe and trusting environment and investments of time, effort, and resources. However, the effect of this investment on school climate and educational outcomes can be significant.

At the student level, research has shown that sexual minority youths who perceive that their teachers are supportive of them and that their school environment is not rejecting of them report better school-related adjustment (Murdock & Bolch, 2005). Schools should be safe places for both GLBT students and teachers. In the 2005 school climate survey, over half of sexual minority students reported that they did not know an *out* teacher or school staff member (Kosciw & Diaz, 2006).

Finally, sexual minority youths in schools with gay/straight alliances (GSAs) or other types of groups aimed at providing support and ending discrimination and prejudice are less than half as likely as sexual minority students in other schools to report school victimization or to skip school due to fear of victimization (Goodenow, Szalacha, & Westheimer, 2006). Attending a school with a GSA (or similar support group) or perceiving that one has access to a school staff person to whom one could go for support is associated with lower rates of suicidality (Goodenow, Szalacha, & Westheimer, 2006). Principals and other school administrations need to visibly and vocally support of these groups.

SOME SUGGESTED RESOURCES FOR EDUCATORS

Safe Schools Coalition (<http://www.safeschoolscoalition.org>) has lesson plans and handouts for addressing issues of sexual diversity in age appropriate ways in the classroom. There are also many resources for sexual minority

youths and their friends and allies, including greeting cards that can be downloaded.

The American Psychological Association's Healthy Lesbian, Gay, and Bisexual Students Project was founded "to strengthen the capacity of the nation's schools to prevent the behavioral health risks of lesbian, gay, and bisexual students through knowledge development, dissemination, and application, working with and through national organizations of school stakeholders." Their Web site (<http://www.apa.org/ed/hlgbaboutus.html>) provides links to national education organizations' policies and the latest research on sexual minority youths, including a link to *Just the Facts About Sexual Orientation & Youth: A Primer for Principals, Educators and School Personnel*.

The Gay, Lesbian, and Straight Education Network (<http://www.glsen.org>) "strives to assure that each member of every school community is valued and respected regardless of sexual orientation or gender identity/expression." More than 1,000 resources related to current events and issues, tools for ensuring safe schools, policies and legal issues, and lesson plans and curricula for the classroom are available from its Web site.

Advocates For Youth Gay, Lesbian, Bisexual, Transgender and Questioning (GLBT) Youth Initiative (<http://www.advocatesforyouth.org/about/glbqtq.htm>) "works to address homophobia within communities, sensitize youth-serving professionals to the needs of GLBTQ youth and to encourage GLBTQ youth to become powerful advocates for themselves and other youth by sharing culturally relevant information and access to tailored services." Available at this Web site are tips for teachers and teens for dealing with harassment and for creating inclusive programs. Several fact sheets and tip sheets are available for transgender youth and for the adults in their lives.

Parents, Friends, and Families of Lesbians and Gays (<http://www.pflag.org>) offers support and information for families of LGBT people with more than 400 chapters nationwide. PFLAG offers Safe Schools Training for school personnel.

Children of Lesbian and Gays Everywhere (<http://colage.org/>) was formed "to engage, connect, and empower people to make the world a better place for children of lesbian, gay, bisexual, and/or transgender parents and families." The Web site offers a link to "Tips for making the classroom safe for children with LGBT parents," as well as lists of books and films.

SEE ALSO *Bullies and Victims; School Belonging; School Climate.*

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Sharon Scales Rostosky

SHARED COGNITION

Shared cognition occurs when two or more people intertwine their thinking processes, yielding feelings of "being on the same page" and often leading to intellectual accomplishments that "belong to us." In some settings, such as when a mother and child playfully plan a tea party, shared cognition may appear to occur naturally and effortlessly. Indeed, the basic mechanisms underlying shared cognition are readily available to school-age children and adults. Yet in many situations, shared cognition does not easily occur. Partners can bring very different life experiences, assumptions, and knowledge to their joint efforts, creating the need for strategies that can bridge their unique perspectives. Shared cognition, then, is an achievement realized in a designed environment through intentional and skillful interaction.

Both formal and informal learning settings can encourage the development of shared cognition, and doing so can have benefits both for individual learning and for students' future life opportunities. Research has shown that collaborative approaches to learning are beneficial for individual and collective knowledge growth, including the development of disciplinary practices. Studies also indicate that collaborative approaches can help students develop positive affective qualities, such as confidence and motivation. Teachers can support the expression and development of collaborative capacities through the careful design of activities, assessments, and methods for establishing and maintaining classroom norms that support productive joint work.

TRADITIONAL AND KNOWLEDGE WORK PERSPECTIVES

Traditional perspectives on learning view collaboration instrumentally. For example, a teacher may ask students to work together, but only count their individual test results toward their grade. Alternatively, a knowledge work perspective can lead to seeing collaborative learning as valuable in itself, because collaborative learning reproduces a desirable cultural practice of sharing cognition. For example, *Science for All Americans, Project 2061* (American Association for the Advancement of Science, 1989) argues:

The collaborative nature of scientific and technological work should be strongly reinforced by frequent group activity in the classroom. Scientists and engineers work mostly in groups and less often as isolated investigators. Similarly, students should gain experiences sharing responsibility for learning with each other. In the process of coming to understandings, students in a group must frequently inform each other about procedures and meanings, argue over findings, and assess how the task is progressing. In the context of team responsibility, feedback and communication become more realistic and have a character very different from the usual individualistic textbook homework recitation approach. (p. 202)

THE SCOPE OF SHARED COGNITION

Shared cognition is one of several overlapping concepts: Intersubjectivity, social cognition, collective cognition, distributed cognition, group cognition, team cognition, collective consciousness, communities of practice, grounding processes in conversations, and transactive memory are all foci of research on how people learn together. To give a sense of the possible scope of shared cognition, we briefly review two concepts, intersubjectivity & joint problem solving, that are closely related to the notion of shared cognition, and the somewhat contrasting perspective of distributed cognition.

Intersubjectivity. Intersubjectivity refers to shared understanding of what has been happening and what is going to happen next. The concept of intersubjectivity has also been central in studies of infant-parent interaction. Some definitions of intersubjectivity build on a sharing metaphor, highlighting overlap and coming to consensus. Other definitions focus on the dynamics of mutual engagement and pay equal attention to disagreement, diversity of views, and conflict (Matusov, 1996). In this view coordination of perspectives is emphasized and intersubjectivity can be achieved without agreement or complete overlap of perspectives.

Joint Problem Solving. Problem solving emerged in cognitive psychology as the signature cognitive activity. When solving problems together, people often find the need to share goals, ideas, plans, explanations, justifications, judgments, and many other aspects of intellectual life. For example, students can develop shared understanding of an “if-then” problem-solving rule (e.g., if the slope is steeper, the rate is faster) by spreading the parts across utterances (“Look, it’s steeper!” “So, we *know* it’s going faster.”) A distinction is made between cooperation or coordination, in which partners merely agree on breakdown of work, and true collaboration, in which partners help each other think the problem through (Teasley & Roschelle, 1993).

Distributed Cognition. Distributed cognition expands the unit of analyses beyond interacting partners to include the cognitive affordances of multiple partners, tools, and representations. A well-known example comes from Ed Hutchins (1995) who analyzed the navigation of a ship coming into harbor and showed that successful navigation of the ship was dependent on complex coordinations between the knowledge of team members, measurement tools, and representational systems. Based on this and other analyses he argued that human intelligent action is productively conceived as an accomplishment that arises from *properties of interactions* between people or between people and artifacts in the world.

BUILDING BLOCKS OF SHARED COGNITION

Close analyses of conversations have led to deeper understanding of building blocks that support the accomplishment of shared cognition. Four building blocks are discussed below.

Joint Attention. Joint attention is first observed between 9 and 15 months (Adamson & Bakeman, 1991). Studies of infant-mother interaction provide interesting insights about the subtle ways in which partners help regulate the attention of the other and highlight how both partners are active contributors to the process. Achieving joint attention during problem-solving situations depends on the mutual intent of group members to share a focus and come to a common understanding.

Making and Acknowledging Contributions. Participants build a sense of shared cognition through interactions that make and acknowledge contributions (Clark, 1996). Participants take knowledge to be shared only after a first participant’s bid to introduce an idea is accepted by a second participant. This can occur in two short utterances or be the result of a lengthy deliberation.

Grounding. The everyday phrase “finding common ground” is a practical solution to a pervasive problem in sharing cognition: How can participants tell if an idea is mutually understood? A simple “uh, huh” provides weaker evidence than a more elaborate paraphrase that participants agree on. Common ground can also be found in action; smooth translation of ideas to satisfactory joint actions is good evidence the ideas were shared. Conversational analysis shows that people flexibly apply a variety of grounding strategies and criteria of mutuality depending on the purposes of communication and the channels of communication available (Clark & Brennan, 1991).

Repair. Of course, attempts to share cognition often go astray. Successful collaborators notice divergence and engage in repairs. For example, in baking a cake one might have the following exchange: “The recipe called for 1 teaspoon of baking soda.” “No, baking *powder*.” “OK, I’ll put in 1 teaspoon of baking powder.” In this set of three utterances, by saying no and emphasizing the word *powder* the second person repairs the misconception of the first and the two people achieve shared knowledge of the right ingredient.

Although these building blocks have been described in generic terms, one can imagine their application to classroom situations. In order to share cognition, teachers and students must also achieve joint focus of attention, make and acknowledge contributions, find common ground, and repair misunderstandings.

In one example, researchers observed students constructing a “joint problem space” (Roschelle, 1992; Teasley & Roschelle, 1993). A joint problem-solving space was defined as a shared conceptual structure developed in the course of collaborative work. In a study of two girls using a computer simulation designed to provide a dynamic view of velocity and acceleration, Roschelle (1992) argued that the creation of a joint problem-solving space was accomplished through repeated cycles of displaying, confirming, and repairing understandings. As the conversation progressed, the students expected increasingly explicit evidence that they understood one another.

HOW SHARED COGNITION CONTRIBUTES TO LEARNING

Theorists have given varied accounts of how shared cognition leads to learning. More recently, researchers have developed more specific accounts and analyses.

Conflict was central in the theory of Jean Piaget (1896 1980) about how social exchange can result in cognitive development (Piaget, 1932). Different perspectives on the same problem can lead to disagreements, de-centering from one’s own perspective, more advanced

stages of cognitive development, and sometimes mutual understanding.

Interaction within a *zone of proximal development* was central to the theory of development put forward by Lev Vygotsky (1896 1954) (Vygotsky, 1978). This zone represents the level of challenge at which a learner cannot independently accomplish a task but can do so with the help of a more expert peer or teacher. *Internalization* occurs because the child is actively playing a role in the joint activity and the more expert partner is attending to when and where assistance is needed. The child comes to own not only skills but the cultural tools that have been developed over long periods of time, such as writing systems, maps, language, and numerical systems.

More recently, investigators have offered more detailed explanations of how group work can support individual learning. These include opportunities to share original insights (Bos, 1937), resolve differing perspectives through argument (Amigues, 1988; Phelps & Damon, 1989), explain one’s thinking about a phenomenon (King, 1990; Webb, Troper, & Fall, 1995), provide critique (Bos, 1937), observe the strategies of others (Azmitia, 1988), listen to explanations (Coleman, 1988; Hatano & Iganaki, 1991), and generate new insights through shared abstract representations, such as diagrams (Jeong & Chi, 2007; Schwartz, 1995).

Increasingly it is recognized that asking learners to work in groups does not automatically lead to interactions that capitalize on the knowledge and skills of all group members. One of the most challenging aspects of group projects involves developing an understanding of what knowledge is shared and what knowledge members hold uniquely. The extent to which learners come to a common or shared understanding of their efforts can vary, depending on multiple factors including their prior experiences, their personal relationships, broader power structures in society, and the extent to which their goals for the task are aligned.

Research that attends explicitly to variability in group interaction has provided information about how relational challenges can interfere with the shared cognition, even when collaborators have similar levels of prior knowledge. Barron (2003) analyzed the interactions of 16 triads in order to understand the sources of variability in how well the students collaborated and how much individuals learned. She found less joint attention in groups in which partners were competing, and this translated into poorer performance even when correct solutions were voiced. If a collaboration is going well: (1) many students will be involved in the discussion as contributors and responders, (2) the contributions are coordinated rather than consisting of many independent, unrelated conversational turns; (3) students attend to

one another and to their work in common as indicated by eye gaze and body position. These are good markers of *mutual engagement and joint attention*, important elements of collaborative work.

SCHOOLING PRACTICES

A great deal of work has been done to specify the kinds of tasks, accountability structures, and roles that help students collaborate well. It is generally agreed that tasks requiring interdependence of team members, accountability structures at the group and individual level, and opportunities to reflect on group progress and interaction are key elements. Two approaches, complex instruction and jigsaw, are described below.

Complex Instruction. Cohen and her colleagues developed *Complex Instruction*, one of the best-known and well-researched approaches. Complex Instruction uses carefully designed activities that require a diversity of talents and interdependence among group members. Teachers are encouraged to pay attention to unequal participation that often results from status differences among peers and are given strategies that will allow them to bolster the status of infrequent contributors (Cohen & Lotan, 1997). In addition, roles are assigned that support equal participation. The roles include a recorder, a reporter, a materials manager, a resource manager, a communication facilitator, and a harmonizer. A major aspect of the approach is the development of “group-worthy tasks” that are both sufficiently open-ended and multi-faceted in their cognitive demands to require and benefit from the participation of every member of the group.

Jigsaw Method. The jigsaw method divides topics among students so that each class member becomes an expert in a subtopic. Experts then teach their group members what they know so that the group benefits from the distributed work. For example, groups of four to five students might be asked to write proposals to study a specific animal species (Engle & Conant, 2002). The groups are then assigned an animal based on the quality of their group proposal. A final product of the group is required, such as a written report to which all members of the group contribute. Individual students become expert on a specific subtopic, such as reproduction strategies or defense mechanisms, and contribute chapters that focus on these subtopics. After they have shared this knowledge with their group, the entire group writes the introduction and conclusion.

IMPLICATIONS

Education traditionally downplays the importance of shared cognition in favor of sequestered test-taking skills. This bias appears shortsighted in an era driven by the intellectual accomplishments of teams. By understanding the building blocks of shared cognition, the ways in which shared cognition can enhance learning, and research-based school practices, educators can enable students to learn both subject matter content and how to succeed in realistic adult tasks.

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SIMON, HERBERT (ALEXANDER) 1916–2001

To the outside world American psychologist and computer scientist Herbert Alexander Simon (1916–2001) appeared to be a Renaissance man. A political scientist who won a Nobel Prize in economics (1978) and the first National Medal of Science for behavioral sciences, Simon pioneered artificial intelligence and made significant contributions in diverse fields, including philosophy, physics, the history of science, business administration, and the psychology of learning. Yet Simon described himself as a monomaniac singularly focused on understanding the processes of human learning, problem solving, and decision making.

Born and raised in Milwaukee, Wisconsin, Simon became interested in decision-making processes as an undergraduate at the University of Chicago. There he conducted a study on the administration of the Milwaukee Recreation Department for Clarence Ridley's course on evaluating city government. After earning his BA in political science in 1936, Simon became Ridley's assistant at the International City Managers' Association in Chicago. In 1939 Simon moved to the University of California at Berkeley to head a three-year study on local

government, while completing his doctorate from Chicago on decision-making in organizations.

In 1942 Simon joined the political science faculty at the Illinois Institute of Technology, becoming department chair in 1946. There he continued his collaborations at the University of Chicago and the Cowles Commission for Research in Economics. In 1949 Simon joined the new Graduate School of Industrial Administration at the Carnegie Institute of Technology (later Carnegie-Mellon University) in Pittsburgh, Pennsylvania. He remained there for the rest of his life, from 1965 on as the Richard King Mellon University Professor of computer science and psychology.

Simon challenged a basic tenet of classic economic theory when he argued that business decision-makers could not have enough information to maximize profits. He developed the theory of "satisficing" or "bounded rationality" to describe the balancing of factors for making satisfactory rather than optimal decisions. Later Simon applied his theory to the teaching of algebra.

In the 1950s Simon began using computers to study how humans think and learn, with a goal of improving teaching methods. In early experiments with Allen Newell and Clifford Shaw of the RAND Corporation, Simon had subjects verbalize their reasoning while working through problems in logic. These human problem-solving processes were then codified as computer programs. The Logic Theorist program and subsequent General Problem Solver were the first computer programs to simulate human reasoning and the forerunners of artificial intelligence. Simon and his colleagues subsequently developed computer programs as models of other human cognitive processes, including learning.

According to Simon, educational programs should first determine what students need to know and then design experiences that result in learning the desired skills and information. For example, geometry teachers should begin by determining what students need to know to solve problems and prove theorems and then design the appropriate learning experiences. Simon and his colleagues found that working through step-by-step examples of solutions to problems was a powerful learning method. As the students worked through the examples, they learned how to get from one step to the next. Subsequently Simon developed computer programs that learned new skills by examining worked-out solutions to problems. In other experiments Simon and K. Anders Ericsson demonstrated that the verbalizing of thought processes often improved student learning.

While developing computer programs for playing chess, Simon found that pattern recognition rather than analysis was a key to learning and developing expertise. He concluded that more emphasis should be

placed on teaching pattern recognition. During the 1980s Simon also studied short-term memory with Chinese colleagues and used computers to simulate human memory processing and determine the limits of short-term memory. The researchers discovered that it takes eight seconds to learn a pattern for one day, but substantially longer to learn a pattern permanently.

Using computer programs as models Simon and colleagues at the Chinese Academy of Sciences designed a middle-school curriculum in algebra and geometry. Traditional algebra textbooks explained the rules for solving equations, but not how to decide which rule to use. In their experimental classrooms, large groups of students learned algebra by working through examples, while the teacher tutored individual students rather than lecturing. Simon found that the children learned algebra about 50% faster than with traditional methods. By 1998 the curriculum was being used in some 200 Chinese schools.

Simon and his colleagues at Carnegie-Mellon were pioneers in the use of computers in education. To design computer displays for teaching, Simon set out to determine what humans were capable of visualizing, how they visualized, and how students utilized visual material. For example he observed what students doodled as they tried to understand complex problems in math and physics. Simon died in Pittsburgh at the age of 84.

Ericsson and others subsequently extended Simon's findings on learning and the acquisition of expertise and applied it to K-12 education.

SEE ALSO *Decision Making*.

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Margaret Alic

SINGLE-CASE DESIGNS

The term *single-case designs* refers to a family of research designs that are true experiments. They can be used to infer causal relationships between an intervention program (e.g., in education, therapy, rehabilitation) and change in client functioning and behavior. The unique feature of these designs is the capacity to conduct experimental investigations with the single case, that is, one subject or one group. However, the designs can evaluate the effects of interventions with multiple subjects and groups.

CHARACTERISTICS AND UNDERPINNINGS OF THE DESIGNS

There are key features of the designs that are pivotal for drawing causal inferences. As with designs in the quantitative-group tradition, control and comparison of conditions, prediction, and testing of predictions are all central. These are accomplished in novel ways in single-case designs.

Logic of the Designs. The designs draw causal inferences based on how the assessment information is used over the course of the design. Each design includes phases or periods of time (e.g., week, month) in which baseline (no intervention) or intervention are presented (e.g., to one or a few individuals or a group). The designs usually begin with a baseline phase, a period of observations before the intervention is implemented. The data in this phase have two purposes: to describe current performance and predict what performance is likely to be in the immediate future without an intervention. After the baseline pattern is clear, an intervention is implemented in a new phase, all the while data are being collected. Data in the intervention (and any subsequent phases) have three purposes: to describe as in baseline; to predict what performance would be likely if the intervention were to continue, and to test the prior prediction from baseline. Baseline is used to predict likely performance; if the intervention is having any effect in the next phase the data ought to depart from that projected level of performance.

Essentially, single-case designs are based on describing, predicting, and testing predictions. The logic of this is exactly like that of experiments in the quantitative-group tradition, in which describing performance without intervention and testing whether the intervention

departs from that is achieved by a control group of subjects (e.g., no treatment, waiting list). In single-case and group research methods, the question is whether the intervention (variable, experimental manipulation) made a difference in a way that departs from the control phase or group, respectively.

Assessment Requirements. The most fundamental design requirement is repeated observations of performance over time. The performance of one or more clients is observed on several occasions, usually before the intervention is applied and continuously over the period while the intervention is in effect. Typically, observations are conducted on a daily basis or at least on multiple occasions each week to provide the information to describe, predict, and test predictions, as noted previously. Continuous assessment provides the observations that allow the comparisons of interest (e.g., intervention versus no intervention) within the individual subject.

Because baseline performance is used to predict how the client will behave in the future, it is important that the data are stable. Data stability refers to minimal fluctuation or variability in the subject's performance over time. Excessive variability in the data during baseline or other phases can interfere with drawing conclusions about treatment. Whether the variability is excessive and interferes with drawing conclusions about the intervention depends on many factors, such as the initial level of behavior during the baseline phase and the magnitude of behavior change when the intervention is implemented.

MAJOR EXPERIMENTAL DESIGN STRATEGIES

There are many single-case designs that vary in the way the intervention is presented and evaluated over time. Three designs are presented here to illustrate the methodology.

ABAB Design. As with all of the designs, continuous observations of performance are made over time for a given client (or group of clients). In ABAB design, typically two separate phases are alternated over time, including the baseline (A phase), when no intervention is in effect, and the intervention (B phase). The A and B phases are repeated again to complete the four phases. The effects of the intervention are clear if performance improves during the first intervention phase, reverts to or approaches original baseline levels of performance when the intervention is withdrawn, improves when the intervention is reinstated in the second intervention phase, and again changes in the final intervention phase.

The most commonly used version of the ABAB design has been discussed here as a four-phase design

that alternates a single intervention with baseline phases. However, designs are available that include more than one treatment and more than four phases or that end with a new phase in which procedures are included to maintain the gains. For example, suppose that the treatment (B1) does not change behavior after the baseline phase. The investigator would not continue the phase but would try another treatment (B2). This latter treatment would constitute a new phase and would probably be implemented later in the design. The design could be represented as an AB1 B2 AB2 design.

As a general rule, problems related to reversing behavior make the ABAB design and its variations undesirable in educational and other applied settings. If a reversal does occur, that may be problematic if the behavior is important for the clients or for those in contact with them. If a reversal does not occur, this raises obstacles in concluding that the intervention led to the change. Yet the power of the design in demonstrating control of an intervention over behavior is very compelling. If behavior can, in effect, be turned on and off as a function of the intervention, this is a potent demonstration of a causal relation. Other designs can also demonstrate a causal relation without using a reversal of conditions.

Multiple-Baseline Designs. These designs evaluate change across different baselines that refer to two or more: behaviors of a given individual, individuals, settings, or time periods. The intervention is introduced to the different baselines at different points in time, for example, in a staggered fashion. Ideally, change occurs when the intervention is introduced in sequence to each of the baselines. The different baselines might, for example, consist of three children in a classroom (or three entire classrooms). Each child's behavior is observed and graphed separately. After baseline observations, the intervention is introduced to one of the children. The other children continue to be observed and remain in a baseline phase. Later the intervention is introduced to the other children in a staggered fashion so that by the end each is receiving the intervention. The effect of the intervention is demonstrated by showing that the behavior of each child changed when and only when the intervention was introduced.

Multiple-baseline designs are user friendly in educational and clinical applications because the intervention is applied in a gradual or sequential fashion across different responses of the individual (or different individuals, or different situations). If the intervention is effective, then it can be extended to all of the other responses for which change is desired. As important, if the intervention is not effective or not effective enough to achieve important changes, it can be altered or improved before it is extended.

Changing-Criterion Design. This design demonstrates the effect of an intervention by showing that behavior changes in increments to match a performance criterion. The design begins with a baseline phase after which the intervention is introduced. When the intervention is introduced, a specific level of performance is chosen as a criterion for the client. The daily criterion may be used as a basis for providing response consequences or an incentive (e.g., token reinforcement). When the performance meets or surpasses the criterion level on a given day (e.g., certain number of cigarettes smoked, number of calories consumed), the response consequence (e.g., tokens) is provided.

A specific criterion usually is invoked continuously for at least a few days. When performance consistently meets the criterion, the criterion is made more stringent (e.g., fewer cigarettes or calories consumed daily). Consequences are provided only for meeting the new criterion on a given day, and the criterion again is changed if the performance meets the criterion consistently. The criterion is repeatedly changed throughout the intervention phase until the terminal goal of the program is achieved. A causal relation between an intervention and behavior is demonstrated if behavior matches a constantly changing criterion for performance over the course of treatment. By implementing a given criterion for at least a few days (or even longer), the behavior shows a step-like effect that is not likely to result from a general incremental change occurring as a function of extraneous events.

As with the multiple-baseline design, the changing-criterion design can be quite compatible with demands of the applied settings. Many therapeutic regimens focus on gradual development of behavior or skills (e.g., improving reading comprehension or participation of activities) or reduction of problematic function (e.g., overcoming anxiety). Shaping these behaviors or gradually exposing individuals to an anxiety-provoking situations may proceed in ways that can reflect increasing the performance criteria as changes are evident. Thus, progress can be monitored and evaluated in a changing-criterion design.

DATA EVALUATION

Data evaluation refers to the way the numbers are examined to infer whether there was a veridical intervention effect. Investigators working with single-case designs as a matter of choice often prefer nonstatistical evaluation of the data, a method referred to as visual inspection. Visual inspection depends primarily on examining four characteristics of the data across phases of the design:

Changes in means: Consistent changes in means (average) across phases;

Changes in level: A shift or discontinuity of the data point from the end of one phase to the beginning the next phase; an index of the immediacy of change;

Changes in slope or trend: Changes the direction (e.g., accelerating or decelerating slope) of behavior as the intervention is applied or withdrawn; and

Latency of the change: The more immediate the change after a phase is altered, the more likely the intervention can be inferred to be responsible for change.

Although visual inspection is the most frequently used method of data evaluation, statistical tests are available and often applied to the data. Statistical tests for single-case designs consist of methods (e.g., time-series analyses, randomization tests) not usually taught in social and biological sciences. Characteristics of single case data (autocorrelation) often preclude the straightforward application of more familiar statistical tests.

STRENGTHS AND LIMITATIONS

There are strengths of the designs. First, they are well suited to evaluating interventions in diverse settings. Most programs in schools, institutions, the home, and the community at large are not evaluated empirically and have no evidence in their behalf in part because randomized controlled trials are not feasible. Single-case designs permit careful and rigorous evaluation. Second, the designs allow for changes during a study, a feature that is well suited to applied settings. If the intervention is not working well or optimally, modifications can be made, and the design can continue to provide a rigorous evaluation. Third, the designs can address many questions of interest in intervention research beyond the effects of a particular intervention such as the components of the intervention that contribute to change and the relative effectiveness of two or more interventions.

There are limitations as well. First, when only one or a few subjects are used, there is difficulty in identifying characteristics (moderators) that might explain why some individuals respond better than others or do not respond. The sample is inherently too small to conduct post hoc analyses of characteristics (e.g., by age, sex, ethnicity) that might influence responsiveness to treatment.

Second, an oft-cited but probably misunderstood concern or limitation is the extent to which the results with one or a few subjects can generalize to others not included in the study. This concern has not proven to be an issue. Also, the concern reflects a misunderstanding of group research; when means are compared one has no idea within a study how many individuals responded. In addition, unless the group was randomly selected from a population, generalizing beyond the sample is a problem.

Tests of generality invariably require replication. The limitation of single-case designs is not generality of the effects but identifying the dimensions or categories which may influence the extent to which the intervention exerted impact.

Finally, the use of visual inspection can be a limitation of the designs. When the visual inspection criteria are not clearly met, agreement on interpretation of the data becomes less clear. Studies of how individuals invoke the criteria for visual inspection have shown that judges, even when experts in the field, often disagree about particular data patterns and whether the effects were reliable.

APPLICATIONS IN EDUCATIONAL SETTINGS

Single-case designs have been used extensively in educational settings, from preschool through college. There is a special role for these designs in schools because school is often a place in which diverse programs are implemented and at different levels (e.g., classroom, schools, districts, and states and provinces). Among the many examples are programs with an academic focus (e.g., reading comprehension), study habits (e.g., homework compliance and completion), classroom deportment (e.g., decreases in disruptive behavior), risky behaviors among adolescents (e.g., substance use, unprotected sex), skill acquisition (e.g., voice, musical instrument), and safety (e.g., driving). It is not feasible to even consider randomized trials to evaluate such programs. Single-case designs are quite useful for evaluation in general and in the many situations in which there is or cannot be a control group. Single-case designs and programs in educational (but other institutional settings) are a natural combination because one can develop the program by examining its impact on student functioning, can make changes during the evaluation to improve the program, and identify causal relation between interventions and outcomes without the constraints of large samples, random assignment, and control condition.

Single-case designs are rarely taught in graduate training in social and biological sciences. This is unfortunate because people in education, psychology, counseling, medicine, and other disciplines frequently are interested in evaluating interventions at the level of the individual, groups, and institutions. The designs can be used in applied settings and hence serve as a way to translate laboratory findings to real world settings as well as identifying promising interventions that might warrant further research in laboratory settings.

SEE ALSO *Applied Behavior Analysis; Research Methods: An Overview.*

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Alan E. Kazdin

SITUATED COGNITION

Many practices of conventional schooling consider knowledge and skill as discrete structures of cognition that can be adequately transferred from teachers to students in classrooms and studied in laboratories. Knowing and thinking, in this view, are assumed to go on in individual minds isolated from the complexity of the world outside, from which abstract knowledge can be successfully distilled. However, a growing body of research that considers cognition and learning in activities outside specialized learning environments is undermining the plausibility of these presuppositions (e.g., Brown, Collins & Duguid, 1989; Engeström, 2001; Greeno, Collins, & Resnick, 1996; Hutchins, 1995a; Lave & Wenger, 1991; Nersessian et al., 2003; Rogoff, 1990; Rogoff & Lave, 1984). This research supports the view that knowing and learning by individuals are inextricably situated in the physical and social contexts of their acquisition and use. It is a mistake to think that classrooms or laboratory experiments produce knowledge or follow principles of learning that are somehow context-free. Cognition and learning by individuals always occur in a context; the issue has to be what the context is, not whether there is one.

For most of time between 1950 and the early 2000s, active research programs have been studying structures and processes of social interaction, as well as cognitive processes of representing and transforming information. But these research programs have been largely separate from each other. Situative research and theorizing attempts to unify the two perspectives of individual cognitive theory and the analysis of interactional structures and processes. The primary level of a situative analysis is an activity system, in which one or more individuals participate along with material and informational resources in the environment. Cognitive processes are understood as aspects of the practices of

a community or group. Studies include analyses of perceiving (Goodwin, 1996), remembering (Hutchins, 1995b), reasoning and understanding (Greeno & Van de Sande, 2007; Ochs, Gonzales, & Jacoby, 1996), and learning (Bowers, Cobb, & McClain, 1999; Engeström, 2001; Engle, 2006; Stenning et al., 2002). In these analyses, successful cognitive performances are considered as part of an interactive system, and analyses focus on how the multiple participants coordinate their contributions. Information structures, which the individual cognitive perspective attributes to individual minds, are attributed in the situative perspective to the interacting group as achievements of communication that enter the group's common ground (cf. Clark, 1996). Such analyses do not preclude also having analyses of the same events that focus on one or more individual participants, identifying their respective contributions to the interactions and explaining these in terms of their individual capabilities, and with other participants and systems considered as the context (cf. Bowers, Cobb & McClain, 1999; Hatano & Inagaki, 2003).

If knowing is understood as successful situated participation, then many conventional assumptions must be questioned. In particular, a situative theory of knowing challenges the widely held belief that abstraction of knowledge from situations is the key to transferability. An examination of the role of situations in structuring knowledge suggests that abstraction and explication provide an inherently impoverished and often misleading view of knowing. Knowing by an individual is fundamentally a capability of the person to interact in the world. In this view, hypotheses or assessments of an individual's or group's knowing are about their capabilities for interacting in situations. Hypotheses that represent knowledge only as abstract propositions do not capture the densely interwoven nature of knowing.

The situative perspective views knowing as distributed among people and their environments, including the objects, artifacts, tools, books, and the communities of which they are a part. Analyses of activity focus on processes of interaction of individuals with other people and with physical and technological systems. Several research traditions have contributed to the situative perspective. The best established of these is ethnography, including the study of cultural practices and patterns of social interactions, as well as discourse analysis and conversation analysis in activity theory, sociolinguistics, anthropology, and sociology. Another research tradition is ecological psychology, which studies behavior as physical interaction in which animals, including people, participate in physical and technological systems. A third research tradition is situation theory in logic and philosophy, which analyzes meaning and action as relational systems and is developing a reformulation of logic to support these relational analyses. Knowing in this per-

spective is both an attribute of groups that carry out cooperative activities and an attribute of individuals who participate in the groups. Learning by a group or individual involves becoming attuned to constraints and affordances of the material and social systems with which they interact. Discussions of motivation in this perspective often emphasize engagement of individuals with the functions and goals of the community, including interpersonal commitments and ways in which individuals' identities are enhanced or diminished by their participation.

APPRENTICESHIP AND IDENTITY

When knowing is viewed as practices of communities and of the abilities of individuals to participate in those practices, then learning is the strengthening of those practices and participatory abilities. Systems in which individuals learn to participate in social practices are very common and include apprenticeship and other forms of being initiated into the practices of a group. Lave and Wenger (1991) reviewed several studies of learning by newcomers to communities of practice and concluded that a crucial factor in the success of such a system is that learners must be afforded legitimate peripheral participation, which involves access to the practices that they are expected to learn and genuine participation in the activities and concerns of the group.

Lave and Wenger characterized learning of practices as processes of participation in which beginners are relatively peripheral in the activities of a community, and as they become more experienced and adept, they progress toward fuller participation. A crucial issue in the nature of learning is whether, and in what ways, the peripheral participation of beginners is legitimate. They described four cases of learning by newcomers and emphasized how learners' identities derive from being part of the community as they become more fully participating members in the community. They also noted that an apprenticeship relationship can be unproductive for learning, as in a case of meat cutters they cited, where the apprentices worked in a separate room and were isolated from the working community. For an environment of apprenticeship to be a productive environment of learning, learners need to have opportunities to observe and practice activities in order to progress toward more full participation.

The degree to which people participate fully and are respected by other members of a community determines their sense of identity (Lave & Wenger, 1991; Wenger, 1998). The fully participative roles are those that most directly contribute to the collective activities and knowledge of the community. The motivation to participate more fully in a community of practice can provide a powerful incentive for learning. Smith (1988) argued that children learn to read and write if the people they

admire read and write. That is, they will want to join the “literacy club” and will work hard to become members. Learning to read is part of becoming the kind of person they want to become. Identity is central to deep learning.

An important aspect of learners’ identities are the ways that they are positioned in the participant structures (Phillips, 1972) of learning activities. An important distinction by Pickering (1995) involves different kinds of agency, called conceptual and disciplinary. Students who are positioned with disciplinary agency only participate as receivers and reproducers of the established meanings and procedures of the discipline, and their learning is evaluated only by whether they can perform procedures and explanations correctly. Students who are positioned with conceptual agency are expected to question and adapt concepts and methods of the discipline. For example, they might construct understandings that utilize disciplinary concepts in novel ways or consider alternatives to standard definitions of concepts. As an example, research by Boaler (2002) compared learning of mathematics in two English secondary schools and found that students who learned primarily through investigations understood mathematics as a general resource for understanding and problem solving, whereas students whose learning was primarily mastery of set procedures understood mathematics as a set of rules to be followed.

Wenger (1998) argued that people participate in a variety of communities at home, at work, at school, and in hobbies. In his view a community of practice is a group of people participating together to carry out different activities, such as garage bands, ham-radio operators, recovering alcoholics, and research scientists. Wenger stated: “For individuals, it means that learning is an issue of engaging in and contributing to the practices of their communities. For communities, it means that learning is an issue of refining their practice and ensuring new generations of members. For organizations, it means that learning is an issue of sustaining the interconnected communities of practice through which an organization knows what it knows and thus becomes effective and valuable as an organization.” (pp. 7–8).

The view that learning occurs through participation is at the root of the practices of apprenticeship, where apprentices are guided and supervised by masters. In successful apprenticeship learning, masters teach by showing apprentices how to do a task (modeling), and then helping them as they try to do it on their own (coaching and fading). Lave and Wenger (1991) emphasized how an apprentice’s identity derives from becoming part of the community of practitioners. The motive for becoming a more full participant in a community of practice can provide a powerful motivation for learning. Of course, what is learned in apprenticeship may not

generalize easily to other contexts. Collins, Brown, and Newman (1989) attempted to characterize how the modeling, coaching, and fading paradigm of apprenticeship might be applied to learning the cognitive subjects of school in an approach they called “cognitive apprenticeship.”

EDUCATIONAL APPLICATIONS OF THE SITUATIVE VIEW

A major goal of educational reform is to have students participate more actively and legitimately in learning communities, including participation in formulating and evaluating questions and problems, and constructing and evaluating hypotheses, evidence, arguments, and conclusions (Brown & Campione, 1996). Abilities for participating in these activities have to be learned, and the research literature on that kind of learning is sparse. Several projects have been focused on creating classroom practices of discussion and inquiry, and the investigators in those projects have discussed some aspects of the process of establishing norms and expectations by the students that support productive collaborative learning (Cohen, 1986; Lampert, 1990; Slavin, 1983).

In the view of learning as coming to participate more fully in a community of practice, transfer is often thought to be a problematic issue (e.g., Anderson, Reder & Simon, 1996). Viewed in the situative perspective, transfer can occur when learning leads to better performance or learning of new practices within a community (e.g., for school communities this might mean working new problems or accomplishing new kinds of tasks) or outside the community (e.g., for school these might be work environments such as those studied by Beach, 1995, and Saxe, 1990). Many of the resources and supports that occur within a community of practice do not carry over to a different community, and so the problem of transfer becomes one of marshalling the resources needed to be successful in a new environment. Doing so requires sophisticated social and information-processing skills, which are the kinds of skills that businesses think they will need in the future.

In a view of transfer in the situative perspective proposed by Greeno, Smith, and Moore (1993), transfer depends on constraints and/or affordances that are invariant under the transformations that change the learning situation into the transfer situation. For transfer to occur, learners must become attuned to those invariants in their initial learning. One of the ways to be attuned is to have an abstract representation that can apply in the new situation, but this is only one possible way for attunement to occur and may not be the typical way for many learned activities to generalize (Greeno, 1997).

Although the situative view insists that all cognition and learning are situated, learning designers who take a

situative perspective generally attend to the activity settings in which learning is to occur. For example, in goal-based scenarios (Schank et al., 1994; Nowakowski et al., 1994) learners are given real-world tasks and the scaffolding they need to carry out such tasks. They can be set either in computer-based environments or naturalistic environments. In one computerized goal-based scenario, learners are asked to advise married couples as to whether their children are likely to have sickle-cell anemia, a genetically linked disease. In order to advise the couples, learners must use the facilities in the system to find out how different genetic combinations lead to the disease and run tests to determine the parents' genetic makeup. There are scaffolds in the system to support the learners, such as various recorded experts who offer advice. Other goal-based scenarios support learners in a wide variety of challenging tasks, such as putting together a news broadcast, solving an environmental problem, or developing a computer-reservation system. Goal-based scenarios make it possible to embed cognitive skills and knowledge in the kinds of contexts where they are to be used. So people learn the basic competencies they will need and also when and how to apply these competencies.

Video and computer technology has enhanced the ability to create simulation environments in which students are learning skills in context. A novel use of video technology is the Jasper series developed by the Cognition and Technology Group (1997) at Vanderbilt University to teach middle-school mathematics. In a series of 15 to 20 minute videos students are put into various problem-solving contexts, for example, deciding on a business plan for a school fair or a rescue plan for a wounded eagle. The problems are quite difficult to solve and reflect the complex problem solving and planning that occurs in real life. Middle-school students work in groups for several days to solve each problem. Solving the problems develops a much richer understanding of the underlying mathematical concepts than the traditional school-mathematics problems.

Another novel use of technology is the curriculum developed by the Middle-school Mathematics through Applications Project (MMAP) at the Institute for Research on Learning (Goldman & Moschkovich, 1995; Greeno et al., 1999). The leading activities in the MMAP curriculum are design problems, supported by software that provide computer-aided design environments in which students design floor plans of buildings, models of population growth and decline, lexicographic codes, or geographical analyses of environmental quality. Mathematical reasoning and problem solving involving topics such as proportional reasoning, linear and exponential functions, and geometrical properties of geographical space are required for successful progress in the design activities. Printed curriculum materials are provided to support

teachers in organizing activities for students to encounter, recognize, and learn important mathematical concepts and methods.

These kinds of learning tasks are different from most school tasks because the contexts of most school tasks lack characteristics of practices that occur outside of school. Traditionally, academic material has been taught abstractly without practical real-world context; the equivalent to which might be learning tennis by being told the rules and practicing the forehand, backhand, and serve without ever playing or seeing a tennis match. If tennis were taught that way, it would be hard to see the point of what the students were learning. Yet in school, students are taught algebra and the works of Shakespeare without being given any idea of how they might be useful in their lives. That is not how a coach would teach students to play tennis. A coach might first show them how to grip and swing the racket, but very soon they would be hitting the ball and playing games. A good coach would have the students go back and forth between playing games and working on particular skills—combining global learning with focused local knowledge. The essential idea in the situative view of cognition is to consider learning and cognition as participation in an activity system. This view supports designers' and educators' efforts to tightly couple a focus on accomplishing authentic tasks with a focus on the underlying competencies needed to carry out the tasks.

For centuries, the epistemology that has guided educational practice has concentrated on abstract representations of concepts, assuming that knowing abstract concepts is a condition for acting and perceiving effectively in a broad range of situations. A situative theory of cognition suggests that conceptualization is embedded in activity and perception and that more attention needs to be focused on them. Learning through legitimate peripheral participation, enables learners to acquire and develop tools and skills, including conceptualizations, through authentic work and membership in communities of practice. Through this process, novices enter the culture of practice. So the concept of learning through legitimate participation helps to emphasize the centrality of activity in learning and knowledge and highlights the inherently content-dependent and enculturating nature of learning.

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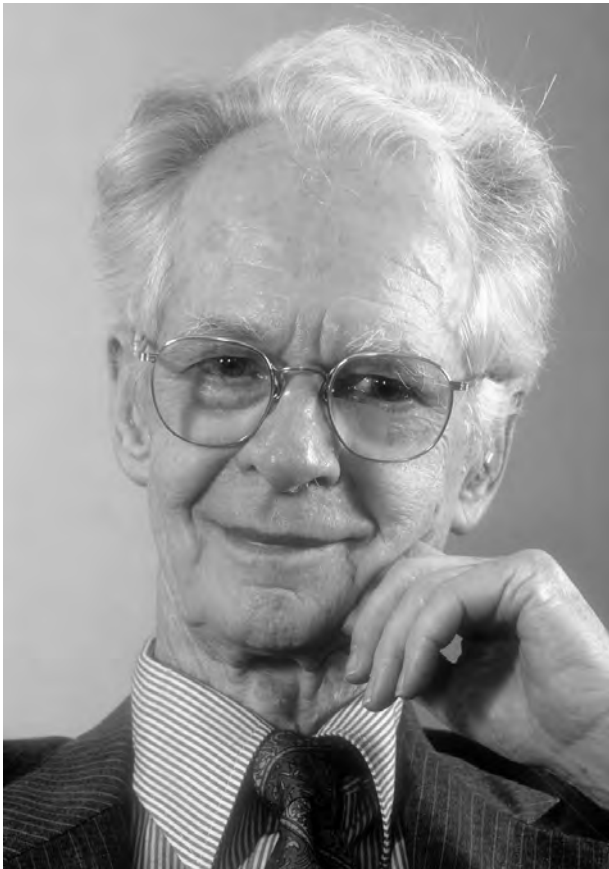
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Allan Collins
James G. Greeno

**SKINNER, B(URRHUS)
F(REDERIC)**
1904–1990

Burrhus Frederic Skinner (1904–1990) is considered by many to be the most influential psychologist of all time and by some to be one of the most influential people in history. A research scientist, author, and philosopher, his work has had a lasting impact on psychology, education, psychotherapy, psychopharmacology, philosophy, and even the business world.

Skinner was born March 20, 1904, in the small town of Susquehanna, in Pennsylvania, the son of a lawyer father and a housewife mother. He earned his undergraduate degree at Hamilton College in New York, intending to become a professional writer. Soon discouraged, a book about behaviorism by psychologist John B. Watson inspired him to enter graduate school at Harvard University in 1928. There his extraordinary mechanical skills allowed him to invent a series of devices for studying rat behavior. Ultimately one of those devices, subsequently known as the Skinner Box, gave him unprecedented control over ongoing behavior, summar-



B. F. Skinner, April 1, 1987. YVONNE HEMSEY/GETTY IMAGES.

ized in his first book, *The Behavior of Organisms: An Experimental Analysis* (1938).

Behaviorists inspired by the work of Russian physiologist Ivan Pavlov (1849–1936) had focused on relatively simple stimulus-response reflexes, whereas Skinner was able to show a high degree of orderliness in more common, fluid, everyday behavior, which Skinner called *operant behavior*. Skinner showed that a great deal of behavior that appeared to be spontaneous and voluntary was the product of a “history of reinforcement,” and he also showed how a *reinforcer* (a stimulus that strengthens the behavior it follows) could be delivered in optimal ways to alter future behavior. In a major breakthrough, Skinner showed that entirely new behaviors could quickly be taught simply by selectively reinforcing successive approximations to that behavior, a process he called *shaping*.

During the 1940s, 1950s, and 1960s, Skinner extended his laboratory discoveries to a number of practical human domains. During World War II he trained pigeons to guide missiles for the U.S. military (a project never fully implemented). In 1948 Skinner published a novel called *Walden Two*, in which he speculated about how a science of behavior might be used to create an ideal community. During the 1950s, in work with psychotic patients, he laid the foundations for modern *behavior therapy*, a term that was coined by his research team. He also invented sophisticated mechanical teaching machines and developed the first programmed textbook, advances which helped lead the way toward modern computer-aided instruction.

During the 1960s Skinner’s students and adherents guided by his numerous essays on education (brought together in 1968 in his book, *The Technology of Teaching*) developed successful reinforcement-based classroom management techniques, which were subsequently widely used in countries around the world. His work also inspired business professionals to develop new management techniques and incentive systems, and professionals working with developmentally disabled individuals were inspired to develop powerful new training and treatment techniques, which later became standard in virtually all treatment facilities for such individuals.

In its impact on education, Skinner’s work is similar to that of Edward L. Thorndike. In the late 1890s, while a graduate student at Harvard, Thorndike conducted animal experiments that convinced him of the enormous power of behavioral consequences, which led to Thorndike’s formulation of the Law of Effect, which remains influential in education in the early 2000s. Thorndike’s experiments had been relatively crude and were conducted in open chambers. Skinner eventually learned how to conduct such experiments in closed chambers, which eliminated distractions and the need for handling the animals, thus allowing

Skinner to determine much more precisely how behavior actually works. It was the precision in Skinner's research that helped lay the foundations for a true science of both animal and human behavior.

SEE ALSO *Operant Conditioning*.

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Robert Epstein

SOCIAL COGNITIVE THEORY

Social cognitive theory (SCT) refers to a psychological model of behavior that emerged primarily from the work of Albert Bandura (1977; 1986). Initially developed with an emphasis on the acquisition of social behaviors, SCT continues to emphasize that learning occurs in a social context and that much of what is learned is gained through observation. SCT has been applied broadly to such diverse areas of human functioning as career choice, organizational behavior, athletics, and mental and physical health. SCT also has been applied extensively by those interested in understanding classroom motivation, learning, and achievement (Pajares, 1996; Schunk & Zimmerman, 1994; 1998).

SCT rests on several basic assumptions about learning and behavior. One assumption concerns triadic reciprocity, or the view that personal, behavioral, and environmental factors influence one another in a bidirectional, reciprocal fashion. That is, a person's on-going functioning is a product of a continuous interaction between

cognitive, behavioral, and contextual factors. For instance, classroom learning is shaped by factors within the academic environment, especially the reinforcements experienced by oneself and by others. At the same time, learning is affected by students' own thoughts and self-beliefs and their interpretation of the classroom context.

A closely related assumption within SCT is that people have an agency or ability to influence their own behavior and the environment in a purposeful, goal-directed fashion (Bandura, 2001). This belief conflicts with earlier forms of behaviorism that advocated a more rigorous form of environmental determinism. SCT does not deny the importance of the environment in determining behavior, but it does argue that people can also, through forethought, self-reflection, and self-regulatory processes, exert substantial influence over their own outcomes and the environment more broadly.

A third assumption within SCT is that learning can occur without an immediate change in behavior or more broadly that learning and the demonstration of what has been learned are distinct processes. One reason for this separation is that SCT also assumes that learning involves not just the acquisition of new behaviors, but also of knowledge, cognitive skills, concepts, abstract rules, values, and other cognitive constructs. This division of learning and behavior is a shift from the position advocated by behavioral theories that defined learning stridently as a change in the form or frequency of behavior. It also means that students can learn but not demonstrate that learning until motivated to do so.

HISTORICAL ORIGINS OF SCT

Born in 1925, Albert Bandura was trained and began his career in the mid-twentieth century when explanations of human functioning, including classroom learning, were dominated by behavioral models advocated by researchers such as B. F. Skinner, Clark Hull, Kenneth Spence, and Edward Tolman. In this context, Bandura, along with his students and colleagues, initiated a series of studies designed to examine social explanations for why and when children displayed aggressive behaviors. These studies demonstrated the value of modeling for acquiring novel behaviors and provided initial evidence for the separation of learning and performance. They also indicated the importance of the learner's perceptions of the environment generally, of the person modeling a behavior specifically, and of the learner's expectations regarding the consequences of behavior. In doing so, findings from this systematic research contradicted assumptions within behavioral models that learning was the result of trial and error learning or that changes in behavior were due primarily to the consequences of one's own actions.



Children learn by observing others. JENNY ACHESON/RISER/GETTY IMAGES.

By the mid 1970s these studies helped form the foundation for what Bandura initially called observational learning theory and then later social learning theory (Bandura, 1977). This precursor to SCT established a viable model for understanding how people learned through observation of models. Additional work during this time expanded aspects of the theory dealing with abstract modeling, language, and conceptual learning. In the years that followed, SCT continued to evolve, spurred by the work of Bandura and his colleagues stressing the processes of goal setting, self-efficacy, and self-regulation. The evolution of SCT also drew ideas from information processing models of psychological functioning to describe the cognitive processes that mediate learning. Ultimately, Bandura noted in the preface to his 1986 treatise, *Social Foundations of Thought and Action: A Social-Cognitive Theory*, that, in an effort to be inclusive of these more motivational and cognitive processes, he was using the label “social cognitive theory” rather than social learning to describe his framework. Throughout this book, Ban-

dura describes the philosophical and conceptual foundation for SCT and reviews empirical evidence for its main components. Hence, it provides a concrete milestone for the birth of contemporary SCT. Since that time, SCT has continued to grow and expand especially with regard to the work on self-efficacy, self-regulation, and agency (Bandura, 1997; 2001; Zimmerman, 2000).

CORE CONCEPTS WITHIN SCT

SCT integrates a large number of discrete ideas, concepts, and sub-processes into an overall framework for understanding human functioning. Five of the central concepts are described below. For a more complete explanation of SCT, readers are directed to works by Bandura and to the relevant chapters within textbooks on learning.

Observational Learning/Modeling. From its inception one core premise within SCT has been that people learn through observation. This process is also described as vicarious learning or modeling because learning is a result of watching the behavior and consequences of models in the environment. Although observational learning is dependent upon the availability of models, who or what can serve this role is defined broadly. Live demonstrations of a behavior or skill by a teacher or classmate, of course, typify the notion of modeling. Verbal or written descriptions, video or audio recordings, and other less direct forms of performance are also considered forms of modeling. There also distinctions among different types of models. Mastery models are proficient when demonstrating a skills, whereas coping models struggle, make mistakes, and only eventually show proficiency. Abstract modeling occurs when the skill or knowledge being learned is conveyed only indirectly, and cognitive modeling occurs when a model verbalizes her thoughts while demonstrating a cognitive process or skill.

According to SCT, observational learning of novel behaviors or skills is dependent on four inter-related processes involving attention, retention, production, and motivation. Attentional processes are critical because students must attend to a model and the relevant aspects of behavior in order to learn. Retention refers to the processes necessary for reducing and transforming what is observed into a symbolic form that can be stored for later use. Production processes are necessary when students draw on their stored codes and make an effort to perform what they have observed. Finally, motivational processes are key for understanding why students engage in the prior sub-processes, including whether they ever attempt to use or recreate the new skills they have observed. Each of these processes, furthermore, are affected by factors such as the developmental level of the learner and characteristics of the model and modeled behavior.

Beyond new learning, modeling is also important for understanding when or why previously learned behaviors are exhibited. Students' may inhibit their engagement in a behavior if they observe a model suffer consequences they would prefer to avoid. For instance, if a teacher glares at one student who is talking out of turn, other students may suppress this behavior to avoid a similar reaction. In a related fashion, students may disinhibit or engage in a behavior they had initially suppressed when they fail to see any negative consequences accrue to a model. For example, students may refrain from shouting out answers unless they are called upon only until they see others do so without repercussions. Finally, through a process labeled response facilitation, models can simply prompt others to behave in known ways.

Outcome Expectations. Outcome expectations reflect individuals' beliefs about what consequences are most likely to ensue if particular behaviors are performed. For instance, children may believe that if they get a hit during a baseball game the crowd will cheer, they will feel good and will be admired by their teammates. These beliefs are formed enactively through students' own past experiences and vicariously through the observation of others. Outcome expectations are important in SCT because they shape the decisions people make about what actions to take and which behaviors to suppress. The frequency of a behavior should increase when the outcomes expected are valued, whereas behaviors associated with unfavorable or irrelevant outcomes will be avoided.

Perceived Self-efficacy. Self-efficacy also has emerged as a prominent and influential concept within SCT. Self-efficacy reflects individuals' beliefs about whether they can achieve a given level of successful at a particular task (Bandura, 1997). Students with greater self-efficacy are more confident in their abilities to be successful when compared to their peers with lower self-efficacy. Self-efficacy has proven useful for understanding students' motivation and achievement in academic contexts. Higher levels of perceived self-efficacy have been associated with greater choice, persistence, and with more effective strategy use (Pajares, 1996).

Consistent with the tenets of SCT, self-efficacy is viewed as a product of individuals' own past performances, the observation and verbal persuasion of others in the environment, and individuals' on-going physiological state (Bandura, 1997). Rather than directly affecting their self-efficacy, however, these sources of information are weighed and filtered through a process known as cognitive appraisal. For instance, a prior failure may not be detrimental to self-efficacy if students believe there was some no-longer relevant reason for the poor performance (e.g., prior sickness). Interventions based on SCT and designed to increase self-efficacy in school-aged children have proven effective (Pajares, 1996).

Goal Setting. Goal setting is another central process within SCT (Bandura, 1986; Schunk, 1990). Goals reflect cognitive representations of anticipated, desired, or preferred outcomes. Hence, goals exemplify the agency view within SCT that people not only learn, they use forethought to envision the future, identify desired outcomes, and generate plans of action. Goals are also closely related to other important processes within SCT. For instance, models can provide goals in the form of specific behavioral outcomes or more general standards for acceptable levels of performance. Goals also are intricately related to students' outcome expectations and their perceived self-efficacy. Goals are a function of the outcomes students expect from engaging in particular behaviors and the confidence they have for completing those behaviors successfully. Finally, goals are an important prerequisite for self-regulation because they provide objectives that students are trying to achieve and benchmarks against which to judge progress.

Self-regulation. Research on self-regulation or, when applied to academic contexts, self-regulated learning, blossomed in the 1980s and continued into the early 2000s to expand. Explanations for students' management or control of their own learning behaviors have arisen from within many distinct theoretical perspectives (Zimmerman & Schunk, 2001). Many of the most common models, however, have strong roots in SCT. SCT models of self-regulation assume that self-regulation is dependent on goal setting, in that students are thought to manage their thoughts and actions in order to reach particular outcomes (Schunk, 2001; Zimmerman, 2000). SCT views of self-regulation initially emphasized three sub-processes (Bandura, 1986; 1991). Self-observation reflects students' ability to monitor or keep track of their own behaviors and outcomes. Self-judgment is the process through which students' evaluate whether their actions are effective and allow them to make progress toward their goals. Finally, self-reaction occurs when students' respond to the evaluations they have made by modifying their behavior, rewarding it, or discontinuing it.

Self-regulation is a prominent and increasing aspect of SCT that exemplifies the underlying assumptions regarding agency and the influence of personal factors on behavior and the environment. As noted above, self-regulation is also dependent on other processes within SCT, including goal setting and self-efficacy. Unless students have goals and feel efficacious about reaching them, they may not activate the processes needed for self-regulation. Modeling can also affect students' self-regulated learning. The skills needed to manage one's behavior, as well the beliefs and attitudes that serve to motivate self-regulation, can be obtained through modeling.

TELEVISION: EDUCATOR'S FRIEND OR FOE?

From its inception, television has been considered a behavioral stimulus (Vos Post, 1995). Factors that impact research on the influence television has on behavior include socio economic status and rural versus urban settings, as well as factors that are pertinent to the nature and culture of the local society. Is a "shoot 'em up" cops and robbers television programming any more violent than a news report of a suicide bomber in the Middle East? Should children be shielded from viewing either or both of those programs on television? The social cognitive theory of behavior learned through observation expounded by Bandura (2001) has been related to television as well as to the classroom and home environments. Young children are particularly unable to discriminate between the fiction of television and real life. Research shows that they are likely to apply the aggressive behaviors they have seen on television to the playground as early as nursery school age. According to Ortiz (2007), they internalize behaviors that they observe even though they have not experienced them directly.

In 1995 Aronson defined aggression as "behavior causing harm or pain." In that same year, Vos Post added that "we still have no widely accepted, clear cut, and scientific definition for either the aggressive acts on television or those purportedly caused by television by its audience." In the mid 1990s researchers counted an average of 18 acts of aggression per hour during the Saturday morning cartoons that continue in the 21st century to be popular with young children. George Gerbner has reported that violent acts take place five or six times per hour during prime time and Saturday morning television. In addition, eight of ten television programs include some sort of violence.

Vos Post (1995) stated that programming on U.S. television was no more aggressive than it had been historically. He went on to report that television programming in Japan had a much higher level of violence than television programming in the United States. However, there are considerably lower rates of aggression in Japan than in the United States, which contradicts the argument that aggressive behavior is learned or encouraged by viewing violence on television.

When Bandura's social cognitive theory, which suggests that children learn through observation, is extended to television viewing, it would seem to indicate

that children would learn aggressive behavior through observation of violence on television. It also means that if children observe positive behaviors in television programming, they should emulate those behaviors as well. Bandura's theory states that when children see behavior modeled, they will accept it and use it when they deem it appropriate. It also explains the need for positive role models on television for children.

According to Bandura's social cognitive theory, when children see family members or friends working together on a television situation comedy to resolve a problem, it follows that they will try to resolve problems with their own family members or friends peacefully, by working together, instead of fighting with them. Research on the results of this type of modeled behavior is reported to be difficult, with inconclusive results.

According to Hoffner (1996), Bandura's theory of behaviors learned by observation means that young viewers have to identify with the characters to model either pro social or violent behavior. In other words, if a child observes television characters that she or he perceives as being similar to herself or himself, that child will be more likely to behave in a manner similar to those characters.

Educational programming is based on Bandura's theory of modeled behavior. To be effective with pro social behaviors, television programmers have to conduct extensive research and make sure characters and events portrayed in their shows have a relation to real world situations. They also have to carefully create characters who are positive, with good results from their actions; negative, with undesirable results from their actions; and transitional, who start the show as negative characters but change because of decisions made and actions taken, so they become positive role models by the end of the show.

Violent acts in regular television programming have more of an effect on children's behavior than sports programming. The results of research on the effect that violence on television has on students generally are in agreement that children who observe violence in prime time television or on Saturday morning children's shows that do not include sports programming will behave aggressively whether or not they had were pre disposed to behave aggressively.

A real concern with the effects of television violence and aggressive behavior learned by observation of incidents of violent programming is that this learning has been proven to continue through adolescence and into adulthood. Vos Post (1995) concluded: "Not only because television violence is a reality, and aggression is a fact of life, but because an effective social psychology understanding of the relationship between television and behavior may help to not only reduce socially unacceptable aggression, but may actually enable us to increase socially desirable effects."

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Heidi H. Denler

IMPLICATIONS FOR CLASSROOM INSTRUCTION

One strength of SCT is that it provides a clear foundation for classroom interventions designed to improve students' learning. In this section, several general implications for instruction derived from the key concepts described above are described. More complete treatments of the instructional implications of SCT readers are available elsewhere (e.g., Linares et al., 2005; Paris & Paris, 2001; Zimmerman, Bonner, & Kovach, 1996).

Observational Learning/Modeling. The most basic instructional implication of SCT is that students should be provided frequent access to models of the knowledge, skills, and behaviors they are expected to learn. For example, teachers should model the behaviors and cognitive processes they want students to learn. Effective instruction, moreover, should include multiple types of models (e.g., teacher, peers, parents) and various forms of modeling (e.g. cognitive, verbal, mastery, coping). The inhibitory and disinhibitory effects of modeling, further, necessitate that educators administer rewards and punishments in a careful and consistent manner.

More specifically, instruction based on SCT should support students' engagement in each of the four sub-processes of observational learning. Students' attention can be increased by using models that are viewed as competent, prestigious, and similar to themselves. Students also pay closer attention when the skill or material being demonstrated is considered more personally relevant or interesting. Instruction should support students' retention by facilitating the creation of verbal labels or images through the use of mnemonics, graphic organizers, or other similar learning strategies. Opportunities for

rehearsal, both in the form of repeated exposure to models and in the form of time to reflect on the material or skills also assist retention. The effective use of models depends on providing students multiple opportunities to practice the behaviors or skills they have observed. This process will be improved if students are provided feedback about their efforts that is specific, more immediate, and insightful about what the learner is doing well and what needs improvement. Teachers should support the motivational aspects of observational learning through the purposeful use of rewards and punishments. These consequences, further, should shape students' behavior when they are provided either to the learner or to a model. To improve motivation, teachers should also model attitudes that they want students to adopt such as enthusiasm or interest in the material.

Outcome Expectations. Instruction should help students to see that classroom learning and the demonstration of that learning leads to personally valued or important outcomes. Students must believe that, if they complete learning tasks successfully, the outcomes they achieve are meaningful, useful, or worthy of the effort necessary to reach them. To encourage these beliefs, teachers should create lessons that emphasize real-world applications and the relevance of material to students' own lives. Decontextualized instructional practices that obfuscate the benefits of learning should be avoided.

Perceived Self-Efficacy. Students will be more active, effortful, and effective learners when they are confident in their ability to complete academic tasks successfully. Hence, instruction should be designed in a way that helps them to develop and sustain their self-efficacy for learning. Most simply, tasks should be moderately challenging so

that students do well and make progress when providing reasonable effort. Teachers should ensure that students have the prerequisite knowledge and strategies needed to be successful at more complex and rigorous tasks. In this way, students will develop a pattern of success that fosters positive levels of self-efficacy. Self-efficacy can also be improved when students are exposed to peer models who initially struggle but who ultimately are able to complete tasks effectively (i.e., coping models). Finally, teachers can make direct statements to learners or models as a way to boost their confidence. Such statements, however, must be credible or they will be discounted or ignored by learners.

Goal Setting. Instruction should help students to set effective goals by addressing the properties found in the most effective goals (Schunk, 1990). Instructional practices should promote students' efforts to set attainable goals that are clear, specific, and moderately challenging. In order to show progress and to maintain self-efficacy, learning goals should be attainable with moderate levels of effort. These goals will also reduce disappointment and frustration that students might feel if they fail to reach their goals. Specific goals are more effective than general or vague goals in spurring students to action and in guiding their behavior. Students should have both distal and more short-term goals for their learning in school. However, proximal goals are more effective at guiding behavior because they allow for more immediate feedback about progress. Finally, goals that students set or endorse themselves have a bigger impact on their behavior than goals that are assigned. Hence, instruction should help students develop the ability and willingness to form their own academic goals.

Self-Regulation. According to SCT, all students should be supported in their efforts to be self-regulated learners. In addition to fostering self-efficacy and effective goal setting, teachers should help students become skilled at self-observation, self-judgment, and self-reaction (see Zimmerman et al., 1996). Teachers can promote self-observation by helping students learn how to monitor different aspects of their academic behavior. Practices such as journal writing, checklists, and time for self-reflection help students develop these skills. For self-judgment, students must learn how to evaluate their performance in light of the goals or standards they have set. Teachers can facilitate this process through modeling and by supporting students' own efforts to compare their performance to both absolute and normative standards. Teachers should also help students see the value and relevance of the standards in order to encourage their self-judgment. The self-reaction process depends on students' ability to respond adaptively both when they are making progress and when they are not. For the former,

instructional practices should assist students in learning how to self-administer reinforcements for their own efforts using both concrete and internal rewards. For the latter, instruction should support students in their efforts to evaluate and modify their learning strategies in order to improve progress. As with all skills, students can develop these self-regulatory abilities vicariously and with guided opportunities to practice them firsthand.

SEE ALSO *Bandura, Albert.*

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SOCIAL COMPARISONS

Social comparisons are carried out when a person relates abilities, opinions, or other characteristics of one person or group to abilities, opinions, or other characteristics of another person or group. In academic settings, social comparisons occur (intentionally or unintentionally), for example, when a student compares his own exam grade with the grade of a class mate or when a teacher thinks of the best or worst students in mathematics in his class. Referring to educational theory and research, social comparisons are important and valid predictors of students' self-evaluations and achievement behavior.

FESTINGER'S THEORY OF SOCIAL COMPARISON

The study of social comparison was initiated by the social psychologist Leon Festinger (1954). In his model, Festinger outlines the central processes underlying the formation of the beliefs about one's own abilities and opinions held by a person. Festinger hypothesizes that a motive for self-evaluation triggers social comparisons, in particular when objective means are not available. Following Festinger, people tend to use similar other persons as comparison targets to maximize the information resulting from comparisons. Goethals and Darley (1977) defined similarity in terms of related attributes. Therefore, comparisons are more useful when the comparison target shares relevant attributes (for example, gender or age) with the person carrying out the comparison. Comparing one's math performance with the math performance of a same age student is much more informative than comparing the math performance with a younger or older student.

UPWARD AND DOWNWARD COMPARISONS

Studies on spontaneous comparisons using diary methods revealed insight in the occurrence of social comparisons in daily life. According to Wheeler and Miyake (1992) situations such as school exams actually encourage social comparisons.

When students are free to choose a particular classmate as a comparison target, the majority prefers slightly

higher achieving classmates. This finding corresponds to the "unidirectional drive upward" hypothesis. Such comparisons with slightly better classmates are called upward comparisons. They often seem to be caused by the aspiration to get hints from analyzing the work of better-off students. Therefore, a self-improvement motive may trigger upward comparisons.

If a student chooses to compare with a lower achieving classmate downward comparisons are carried out. Downward comparisons often seem to be caused by the motive to feel good or better; self-enhancement or self-protection motives may trigger downward comparisons.

The frequency of upward and downward comparisons is affected by performance level and pre-comparison affect. Good performance and positive mood predict downward social comparisons whereas poor performance and negative mood predict upward social comparisons (Blanton, Buunk, Gibbons, and Kuyper, 1999).

HOW SOCIAL COMPARISON INFLUENCES STUDENTS' SELF BELIEFS

If a student gets better grades than others, and feels to be more competent in a particular subject in relation to other students, relatively positive self-evaluations may be the consequence. Thus, good grades and downward comparisons lead to a relatively high academic self-concept in that subject. If a student gets worse grades than others, and feels to be less competent in a particular subject in relation to other students, relatively negative self-evaluations may be the consequence. Therefore, bad grades and upward comparisons lead to a relatively low academic self-concept in that subject.

However, each comparison direction may reveal opposite consequences as well. On the one hand, upward comparisons may boost self-concepts when individuals believe that they can improve their own performance and become as good as the comparison target. On the other hand, downward comparisons may reduce self-concepts when people believe that they may become as worse as their comparison target.

Researchers have to distinguish social comparison effects on different kinds of self-beliefs. At first, social comparisons are relevant for the self-concept formation as described above. In addition, they are relevant for more affective evaluations such as self-esteem. For example, in the Wheeler and Miyake study, the direction of comparison had an impact on the affective reaction upward social comparisons reduced, and downward social comparisons enhanced subjective well-being.

Social comparisons are less important for self-efficacy measures which include different questions concerning specific tasks ("How many of these particular

tasks will you solve within 30 minutes?”) Answering these questions does not necessarily require social comparison processes but prior experience with similar tasks.

HOW SOCIAL COMPARISON INFLUENCES STUDENTS' PERFORMANCE

Social comparisons not only influence students' self-concepts but also improve their performance. Blanton et al. (1999) longitudinally investigated the effects of comparison processes on academic performance. They asked students to nominate a particular classmate with whom they typically compared their grades. One of the central results was that students, on average, preferred upward comparisons which improved their grades in longitudinal analyses controlling for prior grades.

BIG FISH IN A LITTLE POND EFFECT

The big-fish-little-pond effect (BFLPE) is based on students' comparisons of their own ability or performance with the abilities of their classmates. This social comparison process leads to a lower self-concept when the class level is high and to a higher self-concept when the class level is low. Therefore, two students with equal performance in a domain may develop different self-concepts when they belong to different classes with different performance levels.

Whereas social comparison research usually analyses the consequences of comparisons with particular other persons, research on the BFLPE assumes that students compare their own ability with the class or school level. Marsh, Trautwein, Lüdtke, and Köller (2007) assume that such a generalized other serves as an (unintentionally chosen) comparison target leading to a self-concept decrease following upward comparisons (small fish in a big pond) or to a self-concept increase following downward comparisons (big fish in a little pond).

Moreover, Marsh et al. (2007) compared results based on comparisons with a generalized other (class-average achievement) and comparisons with a specific classmate. Both sources of social comparison information contributed negatively to self-beliefs with regard to math ability. Selecting higher achieving classmates as comparison targets as well as attending high performing classes reduced self-beliefs. Comparing downward with worse performing classmates as well as attending a low performing class increased self-beliefs.

OTHER TYPES OF COMPARISONS

Clearly, a lot more comparisons take place in schools; students (as well as teachers) can compare their performance, motivation, effort, and other characteristics to each standard they want. Following Skaalvik and Skaalvik

(2002), students use multiple external and internal frames of reference while making self-judgments. They may compare their achievement with goals and aspirations, with effort in those subjects, or with other external standards such as school grades and class rankings.

According to the Internal/External-Frame-of-Reference model (I/E model, Marsh, 1986), students compare their levels of academic ability using two different, but connected, frames of reference: internal (dimensional) and external (social) comparison processes. Within the external frame of reference, students conduct social comparisons: that is, they compare their accomplishments with those of their classmates. If their verbal achievement is higher than their classmates', their verbal self-concept will also be higher. Because achievements in school subjects typically are positively correlated, it would seem reasonable to assume that these social comparison processes will lead to domain-specific self-concepts that are also positively correlated.

Processes of internal or dimensional (Möller & Köller, 2001a) comparison have been drawn on to explain the domain-specificity of academic self-concepts and the often very low correlations observed between verbal and math self-concept. According to this internal frame of reference, students evaluate their achievements in any given subject in relation to their own achievements in other subjects. Therefore, talented students may develop an average self-concept in their worst subject, even though their performance in this subject is well above the average performance of their peers. Hence, social and dimensional comparisons affect the development of domain-specific self-concepts. Based on external comparisons with one's classmates' achievements in mathematics, low math ability tends to lead to low math self-concept. Based on internal comparisons between one's own achievement in mathematics and one's achievement in verbal domains, low math ability seems to lead to an increase in verbal self-concept (see the meta-analyses by Möller, Pohlmann, Köller & Marsh, 2007).

EDUCATIONAL IMPLICATIONS OF SOCIAL COMPARISON RESEARCH

Social comparisons matter in different ways. Teachers can affect the types of social comparisons carried out by themselves and their students. Teachers who overly compare the low performances of their poorer students to the performances of their better students may further reduce the poorer students' self-concepts and self-esteem. In particular, poorer students who did not expect to be able to improve their performance significantly may suffer in a highly competitive class. It may be more useful for teachers to compare students' performance intra-individually and over time. Such temporal comparisons should outline

the progress even poorly performing students reveal. Teachers' encouraging comments particularly following academic failure may reduce the amount and importance of unfavorable social comparisons, which could protect poorly achieving students' self-beliefs and motivation to a certain degree.

Moreover, teachers may use the positive effects of upward comparisons with slightly better-off classmates. If a student is convinced that he is able to reach the comparison target's performance level, it is useful to analyze the better performance of a classmate in order to improve his own performance. In particular, within cooperative learning settings the positive effects of social learning may be fostered when students are taught to cooperate and not to compete.

SEE ALSO *Goal Orientation Theory; Relevance of Self-Evaluations to Classroom Learning; Self-Esteem.*

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Jens Möller

SOCIAL GOALS

Social goals are increasingly being appreciated as important to understanding engagement and achievement in school. In general, social goals refer to what students are

focused on and trying to accomplish with their peers. Three main approaches have been used to investigate students' social goals in relation to academic adjustment: a content approach, an achievement goal approach, and a hybrid social-academic goal approach.

DIFFERENT CONCEPTUALIZATIONS OF SOCIAL GOALS

First, social goals have been conceptualized as how often students focus on or try to do various things with their peers (e.g., have fun, follow rules). This approach is often referred to as a goal content approach and assumes students strive for certain outcomes that direct their behavior (Anderman & Anderman, 1999; Ford, 1992; Jarvinan & Nicholls, 1996). Some of the main social goals that have been identified within this approach are: responsibility goals, prosocial and intimacy goals, popularity goals, and dominance goals. Responsibility goals refer to a focus on conforming to the social and moral rules, meeting obligations, and keeping commitments. Prosocial goals refer to forming friendships as well as helping, sharing, and cooperating with peers. Intimacy goals are similar to prosocial goals but focus more specifically on establishing intimate friendships characterized by mutual support and disclosure of thoughts and feelings. Popularity goals refer to a focus on establishing high social status characterized by visibility and prestige within the larger peer group at school. Dominance goals refer to a focus on having power over peers characterized by getting peers to comply with one's wishes and instilling fear in peers.

Second, social goals have been conceptualized as distinct orientations toward social competence and linked to adjustment in the classroom (an achievement goal approach, encompassing development and demonstration goals; Erdley, Cain, Loomis, Dumas-Hines & Dweck, 1997; Host, Finney, & Barron, 2007; Ryan & Shim, in press). A social development goal concerns a focus on developing social competence with peers. The focus is on learning new material and skills, growth, and improvement. Success would be judged by whether one is improving social skills, deepening the quality of relationships, or developing one's social life in general. A social demonstration-approach goal concerns a focus on demonstrating social competence and gaining from peers positive judgments that one is socially desirable. A social demonstration-avoid goal concerns a focus on demonstrating that one does not lack social competence. The focus is on avoiding doing something that would incur negative judgments from peers and indicate social undesirability. With both social demonstration goals, attention is focused on the appearance of the self, especially in relation to others. For a social demonstration-approach

goal, success is garnering positive feedback from peers, social prestige, and having a good reputation compared to others (e.g., being popular or seen as important), and for a social demonstration-avoid goal, success is avoiding negative judgments from peers compared to others and lack of a reputation as socially awkward or ineffective (e.g., not being seen as a loser or *geek*). These social achievement goals are analogous to those identified in other domains, although described with different terms (e.g., *mastery* and *performance* in the academic domain).

Third, social goals have been conceptualized as the social reasons students have for the pursuit of academic achievement (a hybrid social-academic goal approach; Dowson & McInerney, 2001; Urdan & Maehr, 1995). Social goals identified in this approach are affiliation goals, approval goals, concern goals, and responsibility goals. A social affiliation goal is the desire to do well academically to enhance one's sense of belonging in the group. A social approval goal is the desire to do well academically to gain approval from others (parents, teachers, or peers). A social concern goal is the desire to do well academically so one can help or assist others in their personal or academic development. A social responsibility goal is the desire to do well academically to maintain an interpersonal commitment, fulfill one's obligation, or follow the social/moral rules.

SOCIAL GOALS AND ADJUSTMENT IN SCHOOL

Research on social goals has provided insight into students' academic adjustment in school. Social goals have implications for academic adjustment via the behaviors as well as the types of social relationships they promote (Wentzel, 2005). Responsibility and prosocial goals have been found to be positively related to academic engagement and achievement (e.g., Wentzel, 1996). Similarly, intimacy goals have been found to be positively associated with positive attitudes toward school (Anderman, 1999), engagement and achievement (Kiefer & Ryan, in press). Striving for responsibility, prosocial outcomes, and intimacy with peers are positive orientations towards social relations that also facilitate academic adjustment in the classroom. In contrast, popularity goals are less adaptive for students' academic adjustment. The pursuit of popularity goals has been found to be related to negative attitudes about school (Andermann, 1999) and disengagement in the form of help avoidance (Ryan, Hicks & Midgley, 1997). However, popularity goals are often found to be not related to engagement and achievement at school (Kiefer & Ryan, in press). Finally, social dominance goals seem the most detrimental for academic adjustment as they are negatively associated with effort, positively associated with disruptive behavior, and negatively associated with grades in school (Kiefer & Ryan, in press).

When students are focused on establishing power over their peers (making others do what they want and establishing their toughness) they are more likely to act in ways that disrupts the class and less likely to put effort into their schoolwork, and not surprisingly this undermines their achievement.

The social achievement goal approach to social goals has found that a social development goal is adaptive for classroom adjustment whereas social demonstration-approach and avoid goals are maladaptive, although for different reasons. A social development goal has been associated with prosocial behavior with peers in the classroom (e.g., cooperation and sharing). A social development goal has been negatively associated with disruptive and aggressive behavior (Ryan & Shim, in press).

A focus on developing social competence seems to be a positive orientation towards the social world that sets in motion adaptive beliefs and behaviors in the classroom. In contrast, a social demonstration-approach goal has been found to be positively associated with disruptive and aggressive behavior and negatively associated with prosocial behavior with peers in the classroom. A social demonstration-avoid goal has been found to be positively associated with anxious solitary behavior and worry (Ryan & Shim, in press). Thus, a focus on demonstrating social competence seems to lead to maladaptive behavior in the form of inappropriate actions that are active or external to the student. A social demonstration-avoid goal also has drawbacks but is manifested in actions that are more passive or internal to the student.

Some research suggests that it may be important to consider the fact that students may pursue multiple social achievement goals in the classroom. For example, a social development goal was found to ameliorate the positive relation between a social demonstration-approach goal and aggressive behavior (Ryan & Shim, in press). This suggests that an additional benefit of a social development goal is that it can minimize the aggressive behavior that is associated with a social demonstration-approach goal.

Concerning the social-academic hybrid approach to goals, qualitative research has found that these social goals (affiliative, approval, concern, and responsibility) are intertwined with students' comments about their affect, engagement, and achievement in school (Dowson & McInerney, 2001). A quantitative study found these social-academic goals to be distinct factors from their cognitive and metacognitive strategies for their work (Dowson & McInerney, 2004). An interesting area of future research will be further investigation of the relation of the relation of these social-academic goals to engagement and achievement.

IMPLICATIONS FOR TEACHERS

Teachers need to attend to students' social goals as research has found them to be important to engagement and achievement. When students are not successful in the classroom, part of the explanation may be related to their social goals. Teachers should encourage adaptive social goals (e.g. pro-social and development goals), redirect maladaptive social goals into more appropriate ones (e.g., steer from dominance goals to leadership goals) and vary the opportunities and nature of academic tasks so that social goals do not compete with or undermine academic goals and behaviors (e.g., seating and grouping of students; opportunities to collaborate with peers).

In sum, there are three key perspectives on social goals: (a) a goal content approach, (b) an achievement goal approach, and (c) a hybrid social-academic goal approach. For theory and research related to the social goal content perspective, see Martin Ford (1992), Kathryn Wentzel (1996), and Lynley Anderman (1999). For theory and research related to the achievement goal approach, see Carol Dweck (e.g., Erdley et al., 1997), Allison Ryan (Ryan & Shim, in press), Jeanne Horst (Horst, Finney, & Barron, 2007), and Andrew Elliot (Elliot, Gable, & Mapes, 2006). For theory and research related to a hybrid social-academic goal approach, see Tim Urdan (Urdan & Maehr, 1995) and Martin Dowson and Dennis McInerney (2001; 2004).

SEE ALSO *Caring Teachers; Goal Orientation Theory; Impression Management; Prosocial Behavior.*

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Allison M. Ryan

SOCIAL SKILLS

Children's social skills are important for early school success and later adjustment. Research has documented that children without adequate social skills are at risk for difficulties including peer rejection, behavior problems, and poor academic achievement. Moreover, recent research shows disturbing rates of expulsion in preschool and kindergarten, which has fueled efforts to promote these skills (Gilliam & Shahar, 2006). Broadly speaking, social skills describe how children navigate social and learning contexts and can be conceptualized as including interpersonal skills and learning-related skills. *Interpersonal skills* refers to the ability to perform competently in social situations, including interacting positively with others, cooperating, sharing, and respecting peers. Research has found that interpersonal skills are important for peer acceptance and social adjustment throughout childhood and adolescence (Masten et al., 2005).

In contrast to interpersonal skills, *learning-related skills* are important for learning and achievement in childhood and adolescence. These skills include self-regulation and social competence (e.g., cooperation, independence, and responsibility) on classroom tasks and in learning situations. There is strong evidence that

learning-related skills predict academic achievement in kindergarten and throughout elementary school (McClelland, Acock, & Morrison, 2006). Aspects of learning-related skills are also important for achievement in adolescence (Duckworth & Seligman, 2005).

Although interpersonal skills and learning-related skills fall under the broad social skills construct, they are separate but related constructs with differing relations to outcomes in childhood and adolescence. Whereas interpersonal skills have been mostly linked to children's social development, learning-related skills have been related to doing well in classroom settings and to academic success.

PROCESSES THAT SUPPORT DEVELOPMENT OF SOCIAL SKILLS

One of the most important influences in early childhood is neurological maturation in the areas of the brain that help children control, direct, and plan their actions. Evidence from brain research shows these skills are associated with particular patterns of frontal lobe activity, specifically in the prefrontal cortex (Blair, 2002). Rapid development in the prefrontal cortex between ages 3 to 6 means the preschool period is a crucial time for acquiring social skills (Shonkoff & Phillips, 2000). Children's social skills vary widely, however, which may be related to differences in prefrontal cortex development, as well as other individual and environmental factors throughout childhood and adolescence (Calkins, 2004). For example, recent research has suggested that growing up in poverty is related to increased stress levels for young children, which can alter brain development in ways that are linked to social skill and self-regulation difficulties (Dearing, Berry, & Zaslow, 2006; Gunnar, 2006).

Child temperament, including children's level of reactivity and regulation, also plays a significant role in the social development of children and adolescents. One aspect of temperament, effortful control, helps children regulate their emotions and behavior, and has emerged as being especially important for self-regulation and social competence (Rothbart & Rueda, 2005).

A large body of research has also examined the vital role that parents play in the development of their children (Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). Although many aspects of parenting are important for children's development, parental warmth and sensitivity have emerged as two of the most salient predictors of children's social development (NICHD Early Child Care Research Network, 2006).

The quality of the parent-child attachment relationship also predicts children's social skills. A number of studies have found that having a secure attachment with a parent allows children to express emotion effectively and develop strong self-regulatory skills. Moreover, studies of

attachment highlight the importance of the child's behavior, including reactivity and responsiveness, in helping to shape the attachment relationship (Calkins, 2004).

NORMATIVE DEVELOPMENTAL CHANGES IN SOCIAL SKILLS

From early childhood through adolescence, social skill development occurs through a reciprocal and bidirectional relationship between a child's individual characteristics (e.g., temperament) and the environment (e.g., parent warmth and sensitivity, family factors, and peers). Children begin developing social skills within the context of the parent-child attachment relationship (Rubin, Bulkowski, & Parker, 2006). It is from this relationship that children learn to read emotional cues, regulate their own emotions and behavior, and incorporate the responses of their parents into their own experiences with people and situations; a process known as social referencing (Thompson & Lagattuta, 2006). From observing family members, children learn appropriate social rules and behaviors, which they apply to interactions outside of the family.

In early childhood, children have exposure to other children in childcare settings. As toddlers, children engage primarily in solitary play, but interactions with other children increase with age. Positive interactions with peers help children develop interpersonal skills, communication skills, emotional understanding/regulation, the ability to control aggressive behaviors, and early learning-related skills. A number of developmental changes occur in early childhood that also facilitate the development of social skills, including a significant increase in vocabulary (Thompson & Lagattuta, 2006) and brain maturation in the prefrontal cortex (Blair, 2002). These developmental changes lead to an improved ability to communicate and regulate feelings and behaviors. Children also begin to develop empathy and gain an understanding of the feelings, desires, and beliefs of their peers; skills which continue to impact social development throughout childhood and adolescence.

Friendships become increasingly important in middle childhood and adolescence, especially for the development of social skills. As children improve their ability to understand the emotions of others, they build increasingly mature friendships and strengthen their interpersonal and learning-related skills. Children and adolescents who have difficulty empathizing or self-regulating have few positive social interactions and are likely to be rejected or neglected by peers, which can significantly impact social well-being and academic outcomes (Rubin et al., 2006).

SOCIAL SKILLS DEVELOPMENT AND SCHOOL ADJUSTMENT

A large body of evidence supports the role that children's social skills (including interpersonal skills and learning-related skills) play in social and academic success. In general, children's interpersonal skills have been linked to social outcomes whereas learning-related skills have predicted academic success. Interpersonal skills are especially important for social adjustment in childhood and adolescence. For example, one study found that poor interpersonal skills (e.g., externalizing problems) in childhood, predicted academic problems in adolescence, which in turn led to internalizing problems in adulthood (Masten et al., 2005).

There is also strong evidence that learning-related skills predict early academic achievement (McClelland et al., 2006). For example, one study found that prekindergarteners who had difficulty using learning-related skills to complete goal-directed activities scored lower on a standardized cognitive achievement measure. These children also exhibited more risk factors, such as family problems, lower parental education, and behavioral or emotional problems (Bronson, Tivnan, & Seppanen, 1995). Another study found that the gains in learning-related skills, specifically self-regulation, predicted gains made in early literacy, vocabulary, and math skills over the prekindergarten year in a diverse sample of children across two sites in the United States (McClelland et al., 2007).

Other research in elementary school has demonstrated that kindergarten learning-related skills significantly predicted reading and math achievement between kindergarten and sixth grade, and growth in literacy and math from kindergarten to second grade (McClelland et al., 2006). Finally, in one recent study, aspects of learning-related skills, such as self-discipline, were stronger predictors of academic performance than intelligence test scores in adolescents (Duckworth & Seligman, 2005).

A number of studies also support relations between interpersonal skills and learning-related skills for children's school adjustment. For example, research has shown that children's self-regulation positively relates to social competence, and that strong self-regulation can buffer otherwise negative outcomes (Lengua, 2002). Taken together, research suggests that promoting interpersonal skills and learning-related skills in young children and adolescents is one way to ensure strong social and academic skills.

ASSESSING STUDENTS' SOCIAL SKILLS

A variety of methods are used to assess children's social skills. When determining a method of assessment, it is essential to select instruments that are reliable, valid, and feasible given cost and time limitations. It is also critical

to choose measures that are appropriate for the age, developmental stage, and special needs of the target population (McClelland & Scalzo, 2006).

Naturalistic observations are one of the best methods for assessing interpersonal and learning-related skills. Typically, observations are conducted at school where there is ample opportunity to observe children interacting within social and learning environments. Observers should be objective and trained in how to code and record the frequency, duration, and interval of behaviors that are being assessed. Although observation provides a rich source of information, it is time-consuming and most useful for initial assessments rather than ongoing evaluation (McClelland & Scalzo, 2006).

Behavior rating scales also measure interpersonal and learning-related skills, but are less time-intensive and more cost effective than observations. They have high levels of reliability and validity and can be used to assess children who are too young to report their own behaviors. They do not, however, provide information about the antecedents and consequences of behavior.

Structured and unstructured interviews provide useful information regarding a child's social context, although they lack reliability and validity. Another limitation of interviews is that children often provide biased responses as they can be suggestible and influenced by social desirability.

Role-play, most commonly used by clinicians, allows direct observation of social skills when naturalistic observation is not possible. In role-play, children are asked to respond to a scenario or staged interaction. Although they can be used to elicit low-frequency behaviors that might not otherwise occur, role-play lacks generalizability because children may not respond to role-play as they would to real-world situations (Merrell, 2001).

Sociometric techniques assess peer relationships and interpersonal skills by asking children to rank classmates and identify peers they like/dislike and peers who exhibit specific behaviors, such as aggression. The reliability and validity of sociometric techniques are very strong, but there are many practical constraints. Sociometric techniques often require consent from all parents in a classroom, and parents are often reluctant to consent for fear that participation will reinforce social rejection (Merrell, 2001).

RISK AND PROTECTIVE FACTORS

Research documents that children who are disadvantaged or of minority status may be at risk for having difficulty socially and academically in early childhood. For example, studies have linked growing up in poverty to a number of risk factors, including poor achievement on cognitive and language outcomes, increased behavior problems (both externalizing and internalizing), increased stress levels, and

difficulties with self-regulation and emotion regulation (Dearing et al., 2006). Children from disadvantaged backgrounds also have been found to exhibit poorer learning-related skills and do worse on academic indices throughout elementary school compared to their peers (McClelland et al., 2006). These results suggest that income level and minority status can be risk factors in the development of social skills for children and adolescents.

One protective factor of children's social skills development is parenting. Parents who are warm and sensitive and set appropriate limits for children are more likely to have children with strong interpersonal and learning-related skills. For example, research has found that children's stress levels can be buffered by sensitive parenting, which can enhance children's social and emotional development (Gunnar, 2006). Finally, children of chronically depressed parents are more likely to have lower social skills in early childhood (NICHD Early Child Care Research Network, 2003), making it especially important to work with parents to effectively promote children's social skill development.

A number of studies have found that social skills deficits have been more often documented in boys than girls. Compared with girls, boys are more likely to be suspended and expelled at every grade level, drop out of school, exhibit behavior problems, and have lower education levels (Gilliam & Shahar, 2006). Research also indicates that girls have stronger aspects of learning-related skills and more adaptive classroom behavior than boys. One recent study found that girls had significantly stronger levels of self-regulation in kindergarten than boys, and there were greater numbers of boys scoring at the lowest levels on self-regulation over the school year compared to girls (Matthews, Ponitz, & Morrison, 2007).

Taken together, it is clear that a number of factors contribute to children's positive social skill development. Effective strategies for strengthening social skills involve a multi-faceted approach to working with children and parents.

EFFECTIVE CLASSROOM STRATEGIES

The teacher-child relationship plays a significant role in facilitating social skill development. Numerous studies have found that warm teacher-child relationships are associated with high levels of cooperation, social competence, and learning-related skills in early childhood and elementary school. Teacher-reported negativity, however, has been associated with social difficulties in children. The ratio of teachers to children in the classroom also relates to children's social skills. A smaller teacher-child ratio allows opportunities for children to work with teachers in small groups or one-on-one, and organization of children into smaller groups has been found to pro-

mote positive interpersonal and learning-related skills (Rimm-Kaufman, La Paro, Downer, & Pianta, 2005).

In addition to teacher factors, the classroom environment can facilitate the development of social skills. Classrooms that best promote these skills are child-centered and provide a stimulating, organized environment with ample opportunity for interaction (Cameron, Connor, & Morrison, 2005). Children demonstrate higher interpersonal and learning-related skills in classrooms where teachers provide organization and guidance, such as modeling appropriate social behaviors and problem-solving skills. Teachers can facilitate social problem-solving by demonstrating how to talk through the steps of a problem and by creating opportunities for children to practice social skills.

Children with social skills deficits most often have difficulties with one or more of the following areas: cooperation, communication, emotional understanding and regulation, aggression, and problem-solving (Bierman & Erath, 2006). To effectively help children who have social skills deficits, teachers can provide instruction and modeling of appropriate behaviors and responses. In young children, teachers can also create opportunities for children to practice and generalize social skills through classroom interactions. As children practice social skills, teachers should provide positive feedback to promote appropriate behaviors and redirect inappropriate behaviors.

Social skills (interpersonal skills and learning-related skills) are important for academic success and social well-being from early childhood through adolescence. Children without adequate social skills are at risk of peer rejection, behavior problems, and poor academic achievement. A combination of child, parent, and environmental factors influence the development of social skills and it is therefore essential for teachers and researchers to consider a child's context and use multi-faceted strategies to effectively promote positive social skills development.

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SOCIOCULTURAL THEORIES OF MOTIVATION

For most educators, motivation is central to understanding and improving their students' classroom learning. While there is disagreement over its exact nature, most theories describe motivation as an *individual* phenomenon. Study of motivation has increasingly concerned the contexts in which motivated activity occurs. Of particular concern are specific *social* aspects of contexts (e.g. peers and classmates) and broader *cultural* aspects (e.g., societal values, cultural norms). Motivation theories that focus strongly on context are often described as *sociocultural* theories of motivation. This entry considers socioculturally oriented theories of motivation and, more broadly, the role of context in motivation theories. It contrasts sociocultural theories with more conventional theories, considers the distinctions between different sociocultural theories of motivation, and considers the practical implications of such theories of motivating classroom learning.

PRIOR THEORIES OF MOTIVATION

Most of the well-known individually oriented theories of motivation focus on either the behavior or the cognition of individuals. Following from the ideas of the behaviorist B.F. Skinner (1904–1990), theories that focus on behavior generally do not recognize motivation as something different from learning. Behavioral theories generally describe both motivation and learning in terms of how behavior is or is not reinforced by the environment. Because of this, behavioral theories describe contexts in terms of the patterns and relationships in the environment. Behavioral motivation theories argue that teachers

should structure classroom contexts so that learning can proceed in a very systematic fashion, and that students are appropriately rewarded for mastering very specific learning objectives.

The cognitive development theories of Jean Piaget (1896–1980) and the emergence of cognitive psychology in the 1970s led to very different theories of motivation. While still focusing on individuals, these theories made a clear distinction between learning and motivation. Well-known types of cognitive theories of motivation include social cognitive theories (e.g., *self-efficacy* and *self-regulation*) and intrinsic motivation theories (e.g., *self-determination*, *expectancy theory*, and *personal interest*). Historically, cognitive theories of motivation treated the sociocultural context as one of many factors that influence the motivation of individuals. Concern over the relevance of these theories by leading theorists such as Weiner (1990) led to increased concern with classroom and cultural contexts, particularly among motivation researchers who were concerned with education. This led to increased attention to the ways that classroom contexts, ethnicity, and culture influenced goals (e.g., Maehr & Pintrich, 1995), efficacy (Bandura, 2000), and interests (Hidi & Anderson, 1992). The implication of this trend for teachers was that their students' motivation was much more influenced by the classroom context and by the broader sociocultural context than had previously been assumed. In particular, this trend led away from explanations of motivation that focused on the individuals' genetic inheritance.

SOCIOCULTURAL THEORIES

Increased concern with sociocultural contexts in motivation and education more broadly reflects the influence of the Soviet theorist Lev Vygotsky (1896–1934). This influence began after Vygotsky's earlier works were translated into English (e.g., 1978). Vygotsky used the ideas of the philosopher Friedrich Engels (1820–1895) to understand how history and society impact the way that humans develop and learn. This led him to argue that knowledge originates in the social context. For some motivation theorists, Vygotsky's theories, when compared to theories that focused on individuals, provided a more useful explanation of the way that factors such as poverty and racism interfere with motivation for classroom learning. For example, Sivan (1986) proposed that the individual goals and values that motivate learning originate in the sociohistoric context, just as Vygotsky argued that language originated in the sociohistoric context. The practical implication of these theories is that explanations for differences in motivation should begin with the classroom, home, and sociocultural context, rather than the individual.

One well-known Vygotskian strand of motivational research involved studies of *adaptive learning* (e.g., McCaslin & Murdock, 1991) and *co-regulated learning* (McCaslin & Good, 1996). McCaslin and colleagues studied social and instructional environments found in the home and in the classroom. These studies provided detailed accounts of the way that students' regulation of their own thinking processes originated in the negotiation of goals and norms among students, teacher, and families. These studies were important because they identified the source of motivation as the relationships that students developed. This included relationships with school activities and relationships with the many other participants in school learning. Therefore, motivating classroom learners meant helping them coordinate the goals implied by a range of different relationships, and recognizing that some of the goals will conflict with other goals. This implies that before searching for strategies to motivate individual learners, teachers need to help students learn to negotiate worthwhile goals for themselves and their classmates. In doing so, teachers need to acknowledge the influence of other goals which might interfere with classroom learning, but which have real value for students.

McCaslin's studies helped pave the way for other studies that focused on the relationships that students had with other participants in the classroom and cultural contexts, including Järvelä and Salovaara (2004), Nolen (2007), Turner and Meyer (2000), and Yowell and Smylie (1999). By the start of the 21st century, "motivation in context" had emerged as an important theme among motivation researchers. This is particularly apparent in the treatment of motivation in educational psychology textbooks. While continuing to give ample treatment to motivational strategies that focus on individual learners, many also point out that teachers need to help the classroom community negotiate worthwhile goals, acknowledging that the students themselves help create and change these very goals.

SITUATIVE THEORIES

The most distinctively sociocultural theories of motivation are rooted in the "situative" theories of cognition that began taking shape in the 1990s. Like Vygotskian theories, situative theories assume that knowledge originates in social interaction and in cultural activity. However, situative theories assume that the knowledge primarily resides in these contexts as well. Situativity theorists argue that the abstract concepts that make up knowledge in cognitive theories and the specific associations that make up knowledge in the behavioral theories are "secondary" ways of describing knowledge. From this perspective, strictly behavioral or strictly cognitive

explanations of individual activity reflect the beliefs of particular researchers and the methods they use (Greeno & the MMAP, 1998). Situativity theorists believe that knowledge is “distributed” across tools, technologies, and social rituals that human cultures construct to let them work together. This means that knowledge and meaning are primarily rooted in the actual collective experiences people have in the world. According to Gee (2004), the abstract generalizations that are taken for granted in modern cognitive perspectives come at the end of a long process of socially situated activity if they come at all. Because of this, situative theorists believe that students’ learning is strongly attached to their participation in the construction of situated knowledge in socially meaningful activity.

Situative considerations of motivation for classroom learning first ask whether a particular learning context affords collective engagement in situated learning. In other words, are students and teachers negotiating a shared understanding of the concepts, terms, and rituals of the domain? This leads to a very different approach to motivation than prior approaches that focused on the activity of individuals. In one initial consideration, Hickey (1997) examined the motivational implications of situative instructional approaches that achieved prominence in the 1990s. This included the *cognitive apprenticeship* model defined by Collins, Brown, and Newman (1989). That paper suggested that the negative motivational consequences of competition might be more the result of lack of opportunity to engage in meaningful shared activity, rather than any fundamental consequence of competition.

Likewise, Hickey explored Bereiter and Scardamalia’s 1989 *intentional learning* perspective, which argued that learning environments first need to give students opportunities to participate in the construction of new knowledge in shared activity. They suggested that the widely held distinction between intrinsic and extrinsic motivation was too crude to be of much use in developing intentional learning environments. Both of these seminal considerations of situated learning suggested that the motivational strategies from earlier individually oriented theories of motivation might actually interfere with efforts to motivate engagement in situated learning. Given that situative theorists consider all learning to be socially situated, situative perspectives on learning seemed to have profound implications for motivating classroom learning.

One implication of this trend towards situated theories of motivation is that efforts to improve motivation for classroom learning should focus on *engagement*. This is because focusing on engagement requires being more specific about assumptions about learning. This issue was elaborated in Hickey and McCaslin (2001) who examined the implications of situative theories for motivating engage-

ment in learning. They argued that a situative focus on *learning to* participate in shared discourse (rather than *learning from* that participation) meant that teachers should focus their efforts at motivating that participation. Prior theories would focus on motivating students to encourage them to engage in discourse, and search for individual explanations when they failed to do so. Behaviorally oriented theorists would consider how the environment rewarded or punished individuals for participating in that activity. Cognitively oriented theorists would consider how the goals or values of the individuals affected the desirability of that activity.

In contrast, situative theories focus more directly on fostering worthwhile discourse among their students. This discourse occurs as students work together to make meaning of the terms, representations, and ideas that have already been negotiated by the community of experts in the particular academic domain. For example, the prevailing social norms in a math class should motivate students and teachers to encourage one another to use the mathematical term *vector* rather than the everyday term *point* during a lesson on geometry. Given the limits of human attention, this shift has major implications of teachers. This is because asking teachers to focus directly on such situated considerations of learning draws limited resources away from focusing on the behavior and/or cognition of each of their students.

Hickey and McCaslin (2001) also described the basic tension between earlier behavioral and cognitive views of motivation. As illustrated by the seemingly intractable debate over extrinsic incentives (e.g., prizes, competition, and grades), they argued that these tensions were a major obstacle to educational reform. Reflecting their very different views of learning, cognitive theorists have long argued that incentives interfere with natural learning processes, while behavioral theorists have long argued that incentive are useful for encouraging learning. Hickey and McCaslin argued that a relatively neutral situative view of motivation might offer a more useful lens for studying and comparing behavioral and cognitive strategies for motivating engagement. From a situative perspective, incentives and competition are not inherently good or bad. Rather, all motivational practices should first be analyzed in terms of their impact on students’ success at negotiating meaningfulness of the language and concepts of the particular academic domain. Importantly, a situative theory of motivation assumes that the success of these negotiations is the primary source of individual motivation towards the domain. Therefore it is the collective success of these negotiations that predicts whether or not those individuals will be motivated to engage in the practices of the domain in the future.

The notion of *engaged participation*, which was introduced by Greeno and colleagues (1998) provides a particularly appealing theoretical basis for a situated theory of

motivation. This theory focuses concern with motivation on participation in the rituals and practices of content domains that represent those domains in the activities of classrooms. This viewpoint argues that if the community of learners that makes up the classroom does not value participation in those rituals and practices, it is difficult for a particular individual to participate in them (Hickey, 2003). In contrast to sociocultural views that assume socially constructed goals and values are internalized by individuals, this viewpoint argues that goal and values remain alongside the knowledge practices in the sociocultural environment. While this distinction is philosophical rather than scientific, it has an important practical implication: as one's view of knowledge becomes more situated, the assumption that goals and values are internalized becomes less useful for motivating engagement (Hickey & Granade, 2005).

This raises fundamental questions about the scope of research that might inform teachers' efforts to motivate classroom learning. It argues that the wealth of existing sociocultural research on topics like identity (Holland, Lachicotte, Skinner, & Cain, 1998) and discourse (Gee & Green, 1998) are directly relevant for understanding motivated classroom learning. A particularly useful aspect of this research is that much of it concerns particular content areas, such as mathematics or science. When motivated classroom learning is viewed as engaged participation, this research becomes directly relevant for motivating that learning. Because this perspective assumes that specific motivational practices will have different consequences in different situations, teachers must be able to continually assess collective participation and adjust their practices accordingly. The current focus on individually oriented models of motivation in teacher education programs may be distracting from (or even undermining) the development of this ability.

One potential advantage of situative models of motivation is that they lend themselves well to the design-based research methods advanced by many situative educational theorists (e.g., Barab & Squire, 2004). These approaches build theory within efforts to reform educational practice. This is very different from the building of theory in highly controlled experiments or surveys (as in traditional studies of motivation) or naturalistic investigations of classroom or cultural activity (as in many of the recent study of motivation in context). Design-based methods are particularly relevant to educators because they highlight the value of theories that are developed in specific contexts for improving learning in those same contexts. Hickey and Schaffer (2006) proposed a model for improving classroom motivation over a series increasingly formal design-based studies. This first study would focus on highly situated analyses of motivation, using discourse analytic methods to increase collective partic-

ipation; this would be followed by more experimental studies of individual goals and values. A final cycle would use traditional program evaluation methods to look at the motivated behavior of all of the students. While elements of such an approach have been examined in initial studies (Hickey & Zuiker, 2005), the entire model has yet to be fully implemented or validated. The practical implications of such an approach is that if teachers focus their attention on directly enhancing their students' collective participation in domain-specific discourse, they will indirectly enhance the intrinsic motivation (e.g., goals and self-determination) of their individual students while improving the overall behavior (e.g., disciplinary actions and enrollments in advanced courses) over the student body.

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Daniel Hickey

SOCIOCULTURAL THEORY

The work of *sociocultural theory* is to explain how individual mental functioning is related to cultural, institutional, and historical context; hence, the focus of the sociocultural perspective is on the roles that participation in social interactions and culturally organized activities play in influencing psychological development. While much of the framework for sociocultural theory was put forth by Lev Vygotsky (1931/1997), extensions, elabo-

rations, and refinements of sociocultural theory can be found in writings regarding *activity theory* (Chaiklin & Lave, 1993; Leontiev, 1981) and *cultural-historical activity theory* (Cole, 1996; Cole & Engestrom, 1994).

THE HISTORICAL ROOTS OF SOCIOCULTURAL THEORY

Lev S. Vygotsky, a psychologist in Russia who began his work following the Russian Revolution of 1917, is most closely identified with sociocultural theory. Vygotsky, argued: “The social dimension of consciousness is primary in time and in fact. The individual dimension of consciousness is derivative and secondary” (Vygotsky, 1979, p. 30, cited in Wertsch & Bivens, 1992). From this perspective, mental functioning of the individual is not simply derived from social interaction; rather, the specific structures and processes revealed by individuals can be traced to their interactions with others.

Wertsch (1991) proposed three major themes in Vygotsky's writings that elucidate the nature of this interdependence between individual and social processes in learning and development. The first is that individual development, including higher mental functioning, has its origins in social sources. This theme is best represented in Vygotsky's “genetic law of development”: “Any function of the child's cultural development appears on the stage twice, or on two planes, first the social, then the psychological, first between people as an intermental category, then within the child as an intramental category” (Vygotsky, 1931/1997, pp. 105–106).

From this perspective, as learners participate in a broad range of joint activities and internalize the effects of working together, they acquire new strategies and knowledge of the world and culture. Typically this tenet has been illustrated by examining the interactions between individuals with disparate knowledge levels; for example, children and their caregivers, or experts and novices. However, as Tudge and Scrimsher (2003) note, Vygotsky was not only interested in what more knowledgeable others brought to the interaction, but also in what the child himself or herself brought to the interaction, as well as how the broader cultural and historical setting shaped the interaction.

The second Vygotskian theme that Wertsch (1991) has identified is that human action, on both the social and individual planes, is mediated by tools and signs semiotics. These semiotic means include: “language; various systems of counting; mnemonic techniques; algebraic symbol systems; works of art; writing; schemes, diagrams, maps and mechanical drawings; all sorts of conventional signs and so on” (Vygotsky, 1981, p. 137). Additional semiotic means include: computers, calculators, paint brushes and the like, all of which are

useful in representational activity. These semiotic means are both the tools that facilitate the co-construction of knowledge and the means that are internalized to aid future independent problem solving activity.

Leontiev (1981), a colleague of Vygotsky, used the term “appropriation” to characterize this process of internalization:

[Children] cannot and need not reinvent artifacts that have taken millennia to evolve in order to appropriate such objects into their own system of activity. The child has only to come to an understanding that it is adequate for using the culturally elaborated object in the novel life circumstances he encounters. (Quoted in Newman, Griffin, & Cole, 1989, p. 63)

The third theme that Wertsch (1991) proposes from Vygotsky’s writing is that the first two themes are best examined through genetic, or developmental, analysis:

To study something historically means to study it in the process of change; that is the dialectical method’s basic demand. To encompass in research the process of a given thing’s development in all its phases and changes from birth to death fundamentally means to discover its nature, its essence, for it is only in movement that a body shows what it is. Thus the historical study of behavior is not an auxiliary aspect of theoretical study, but rather forms its very base. (Vygotsky, 1978, pp. 64–65)

In contrast to prevailing views of his time, in which learning was regarded as an external process and development an internal process, Vygotsky was concerned with the unity and interdependence of learning and development. For example, he was critical of Piaget’s theory in which “maturation is viewed as a precondition of learning but never the result of it” (Vygotsky, 1978, p. 80). In contrast, Vygotsky proposed:

Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and with his peers. . . . learning is not development; however, properly organized learning results in mental development and sets in motion a variety of developmental processes that would be impossible apart from learning. Thus learning is a necessary and universal aspect of the process of developing culturally organized, specifically human, psychological functions. (p. 90)

In support of this perspective, Vygotsky (1978) introduced the construct of the *zone of proximal development* (ZPD) as a fundamentally new approach to the problem that learning should be matched in some man-

ner with the child’s level of development. He argued that to understand the relationship between development and learning, two developmental levels must be distinguished: the actual and the potential levels of development. The actual refers to those accomplishments a child can demonstrate alone or perform independently; in contrast to potential levels of development as suggested by the ZPD what children can do with assistance: “The distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 85). The ZPD was regarded as a better, more dynamic and relative indicator of cognitive development than what children accomplished alone. In summary, productive interactions are those which orient instruction toward the ZPD; otherwise, instruction lags behind the development of the child. “The only good learning is that which is in advance of development.” (Vygotsky, 1978, p. 89). Hence, from a Vygotskian perspective, cognitive development is studied by examining the processes that one participates in when engaged in shared endeavors and how this engagement influences engagement in other activities. Development occurs as children learn general concepts and principles that can be applied to new tasks and problems; whereas from a Piagetian perspective, learning is constrained by development.

Vygotsky was a prolific writer; he advanced a vast number of ideas in his brief life as a scholar (he died when he was but 37), some of which are appropriately characterized as underspecified and emergent. One of the most frequently criticized facets of Vygotsky’s theory is its model of internalization. For example, Cobb and Yackel (1996) have argued that this aspect of Vygotskian theory constitutes a transmission model in which “students inherit the cultural meanings that constitute their intellectual bequest from prior generations” (p. 186). There is an alternative model, the *participation model of cultural development* (Lave and Wenger, 1991; Rogoff, 1990), which seems useful to overcoming dualisms, such as the society and the individual. The participation model represents development as the transformation of individual participation in sociocultural activity. Transformation (rather than internalization) occurs as participants in the activity assume increasing responsibility for the activity; in essence, redefining membership in a community of practice, and, in fact, changing the sociocultural practice itself. These ideas are elaborated on below.

THE CONCEPT OF GUIDED PARTICIPATION

The concept of guided participation highlights that cognitive development occurs in a social context while extending sociocultural theory beyond language-based dialogue. Importantly, guided participation builds on and extends Vygotsky's notion of ZPD. Rogoff (1990) writes, "Children's cognitive development is an apprenticeship—it occurs through guided participation in social activity with companions who support and stretch children's understanding of and skill in using the tools of the culture" (p. vii). While this sounds very similar to ZPD, Rogoff explicitly states that guided participation focuses more centrally on the interrelatedness of children and caregiver interactions and the fact that the "guided" does not necessarily mean face to face. For example, a student working on a research report in isolation is still "guided" by the teacher, librarians, classmates, the publishing industry, and parents who help shape the writing of the research report as a cultural activity. Emphasis on tacit, distal, and non-verbal forms of communication stands in contrast to Vygotsky's emphasis on didactic dialogue. This helps broaden the lens of sociocultural theory beyond language-based interactions as the primary source of learning culture. Finally, socioculturally oriented research, generally, and research on guided participation, specifically, have played important roles in bridging research on in-school and out-of-school learning.

HOW SOCIOCULTURAL THEORY DIFFERS FROM CONSTRUCTIVIST THEORY

Similar to sociocultural theory, constructivism emerged as a theory of knowledge in response to behaviorism. Immanuel Kant (1724–1804) and Jean Piaget (1896–1980) are two theorists whose thinking and research significantly shaped constructivist theory. Kant (1951) significantly influenced Piaget's thinking when he proposed that it is the mind that provides the categories of knowing, while experience yields the content. Piaget (1955) argued that it is through the child's experiences manipulating and changing the world that the child acquires knowledge about relations within and between people and objects.

Both constructivism and sociocultural theory, when applied to learning, are concerned with the activities that children engage in to learn. However, constructivist theory suggests one should attend to the learning and mental representations of the individual while sociocultural theory is more concerned with the ways in which learning is an act of enculturation. Many learning situations attempt to accommodate both, for example, the mathematics teach-

ing of Ball (1993). Cobb (1994), in looking at Ball's dilemma of attending to students' individual knowledge (math as an active construction) and the traditions that have grown out of centuries of mathematics as a discipline (math learning as enculturation), notes that the dual presence of both sociocultural and constructivist theory can act as competing aims for teachers.

The lens of sociocultural theory is considerably wide when compared to constructivist theory. A sociocultural theorist, when interpreting a learning situation, might attend to the broader social system in which the learning is happening and will draw interpretations about an individual's thinking and development based on his or her participation in culturally organized activities. An account of learning and development through the lens of constructivist theory, in contrast, is concerned with the individual and the ways in which sense making happens through the individual's accommodation of experience (Cobb, 1994).

Giyoo Hatano was most skillful at bridging sociocultural perspectives on learning with constructivist theories of learning that resulted in a "mixed" theory of conceptual knowledge that successfully accommodated both perspectives (Cole & Miyake, 2006). In an attempt to understand whether cognitive development proceeded along a predetermined innate set of principles, Hatano and Inagaki (1994) explored the long-held theory, first put forth by Piaget (1929) that children come to develop theories of biology rather late in the course of development. Through experimental work with Japanese schoolchildren, they demonstrated that theories of cognitive development must also account for the role that experience plays in advancing development, thus accommodating Vygotskian ideas about the social nature of learning.

THE EDUCATIONAL IMPLICATIONS OF SOCIOCULTURAL THEORY

Given the comprehensive nature of sociocultural theory, its educational implications for assessment, curriculum, and instruction are broad-ranging, and only a glimpse of them can be provided in this entry. For example, sociocultural theory—in particular the notion of zones of proximal development—would suggest that the goals of educational assessment should be to: (a) identify abilities that are in the process of developing, and (b) attempt to predict what the learner will do independently in the future. A line of inquiry consistent with these assessment goals is *dynamic assessment*. Dynamic assessment is a term used to characterize a number of distinct approaches that feature guided learning for the purpose of determining a learner's potential for change. In contrast to traditional and static procedures that focus on the products of assessment, dynamic assessment is concerned with the different ways in which individuals who earned the same score

achieved that score. Furthermore, while traditional measures reveal only those abilities that are completely developed, dynamic measures are concerned with how well a learner performs when provided assistance. Initial inquiry into the design and use of dynamic assessment used domain-general types of problem-solving tasks (e.g., Campione & Brown, 1984; Feuerstein, 1980). These studies suggested that dynamic assessment measures did indeed reveal a different picture of competence than do static measures, which typically underestimate children's ability to learn in a domain in which they initially performed poorly.

More recent research suggests that the principles of dynamic assessment can also be applied within academic contexts. For example, Magnusson, Templin, and Boyle (1997) conducted research on the use of dynamic assessment to determine students' conceptions regarding the flow of electricity. They devised a context in which students could test out their conceptions and revise their thinking based upon the outcomes of their investigations. In this context, the researchers determined that students were, indeed, able to understand more about electrical behavior than had been determined on static measures used in previous research.

Instructional Implications. Informed by a sociocultural perspective, learning is thought to occur through interaction, negotiation, and collaboration. While these features are characteristic of "cooperative learning," what sets instruction that is informed by sociocultural theory apart is that there is also attention to the discourse, norms, and practices associated with particular discourse and practice communities. The goal of instruction is to support students to engage in the activities, talk, and use of tools in a manner that is consistent with the practices of the community to which students are being introduced (e.g., scientists, mathematicians, historians).

These tenets are consistent with inquiry-based approaches, in which teachers and students are co-inquirers, but with teachers mediating among students' personal meanings, the meanings emerging from the collective thinking and talk of the students, and the culturally established (scientific, mathematical, historical, literary) meanings of the wider society. Examples of research of this kind can be found in mathematics (Ball, 1993; Cobb, Wood, & Yackel, 1993; science (Engle & Conant, 2002; Magnusson & Palincsar, 2005; Wells & Chang-Wells, 1992), history (Bain, 2006), and literary studies (Smagorinsky & O'Donnell-Allen, 2000; Lee, 2007).

Sociocultural theory has also been called upon to advance instructional practice that might redress disparities in the current educational system. Forty-two percent of school-aged children in the United States struggle to advance beyond basic levels of reading comprehension.

Minority students and children living in poverty disproportionately perform in the lowest quartile on standardized measures of reading ability (Perie, Grigg, & Donahue, 2005). Given these distressing statistics, the increasing diversity in U.S. classrooms, and the proliferation of literacy technologies (e.g., multimedia and information and communications technologies), teachers have been challenged to reconsider the canonical approach to literacy instruction (e.g., Lee, 2007). A view of literacy instruction through the lens of sociocultural theory helps educators understand the situational specificity of literacy practice. From this perspective, educators would consider literacy as a tool for use in specific contexts; thus, children would be taught how to negotiate multiple literacies for use in multiple contexts.

Some researchers (Bhaba, 1994; Gutiérrez, Baquedano-Lopez, & Tejada, 1999; Moje et al., 2004; Soja, 1996) have advanced the idea that educators work to develop a *third space* in which students' primary discourses (those used in the home, community, and informal social interactions) and students' secondary discourses (those endorsed in school and other formal institutions) intersect to form this third space, where primary and secondary discourses are merged. Were educators to be more attentive to the creation of these third spaces in school, greater attention would be paid to incorporating students' prior knowledge and experience, as well as current literacy practices in the school curriculum. Research conducted by Varellas and Pappas (2006) illustrates the productive instructional use of discourse in third spaces to promote science learning. Working in primary-grade classrooms in an urban school, teachers encouraged their students to draw upon: (a) their own explorations of scientific phenomena (such as the water cycle) in classroom, home, and community settings; (b) prior conversations, and (c) other books read in and out of school in the course of read-aloud sessions. Varellas and Pappas documented numerous examples of young children bringing their own funds of knowledge to the classroom setting, but they also documented how the teachers made facile use of these funds and promoted the children's learning of scientific language and concepts.

Use of New Technologies. With the proliferation of information and communication technologies in educational and everyday settings, scholars, working from a sociocultural perspective, are working to expand concepts, such as distributed cognition, to include not only people and artifacts, but also digital technologies. For example, Shaffer and Clinton (2006) introduce a new category of tool, which they call, *toolforthoughts* and, in doing so, challenge the idea that humans occupy a privileged position in psychological analyses. They argue that media, such as video games, word processors, and analytical tools

create new skills and habits of mind, in addition to shifting the focus from reading and writing the printed word to multimodal literacy.

Recently, sociocultural theory has been taken into consideration in the design of online distance education technologies. Research on the social context of learning has provided ample evidence that traditional teacher-centered approaches would be inappropriate in an online setting. It is less clear, however, how to design online learning environments in which students feel connected to peers and professors in a virtual classroom community. Community building in asynchronous learning networks poses a particular challenge from the perspective of sociocultural theory because students are often not together physically or even virtually. Brigham Young University (BYU), a large provider of accredited online distance education in the United States, has adopted a model of online distance learning that is designed with sociocultural theory in mind. ProfessorsPlus™ carefully integrates social interaction among participants, substantive and interactive assistance from the course facilitators, and dynamic course content that is responsive to student learning (Teemant, 2005).

Research Applied to Institutional Settings. Research conducted from a sociocultural perspective has focused traditionally on the interactions of individuals and groups of individuals. However, research has also applied this lens to much larger institutional settings. For example, Cobb and McClain (2006) illustrate how efforts toward a mathematics reform effort need to be analyzed at a teacher, classroom, school, district, and indeed state and federal policy levels, to provide a more complete accounting of the reform effort.

Broad-scale use of assessments represent another approach to educational reform, and similarly, must also attend to the larger institutional settings in which the assessment instrument is positioned. Moss and her colleagues (Moss, Girard, & Haniford, 2006), in their work on validity theory, describe educational measurement as a cultural tool situated within a larger institutional, social, and national context. Applying the lens of sociocultural theory, they urge that interpretations of student performance on these tests must be made with attention to the local context, the purposes for which the test was written, and the larger policy context in which the test is situated.

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SOCIOECONOMIC STATUS

Socioeconomic status (SES) is the measure of the influence that the social environment has on individuals, families, communities, and schools. In many ways SES is related to the concept of social class. Both have financial stability as a foundation for classification. Both are important to a child's optimal development and an adult's satisfaction with life. However, the concept of social class is considered to be continuous throughout one's lifetime and from one generation to the next. The SES classifications are established in an effort to find the means of identifying and changing inequalities. In addition, social class has economic differences as a primary influence. The concept of SES considers other influences such as the chance for social or economic advancement, influence on policy, availability of resources, and prestige of the primary occupation.

DEFINITION

The definitions of SES emphasize that, as a construct, (1) it is conditional, (2) it is imposed on people, (3) it is used for comparisons, (4) it is based on economics, opportunity, and means of influence. Santrock (2004) defines it as “the grouping of people with similar occupational, educational, and economic characteristics” (p. 583). Woolfolk (2007) calls SES “the relative standing in society based on income, power, background and prestige” (p. 165). Santrock (2004) adds that an important qualification is “the ability to control resources and participate in society's rewards” (p. 583). Woolfolk (2007) also notes that every researcher will define it differently based on the nature of the study. In most discussions, there are three levels of SES: low, moderate, and high. Because most problems associated with low SES are related to poverty, sometimes poverty level is used as a similar concept to low SES. Race may also be considered a factor because Blacks and Latinos are disproportionately represented in the low SES.

MEASUREMENT OF SES AND VARIOUS COMPONENTS

The factors that are usually considered in establishing SES are income, occupation, education, neighborhood, and political power. For each of these five factors, the consideration of how fixed each one is also contributes to SES. For example, if a family is considered low income because one of the parents is in school to eventually get a better job, then the family is not really in the same SES as their neighbors who have little hope of a better job.

Individuals' SES is usually determined by the SES of their family. The SES of the family is calculated based on the measure of the five factors noted above. How well can the family members meet their financial responsibilities?

What prestige is associated with the occupation of the head of the household? What level of education have the parents achieved? What is the safety and upkeep of the neighborhood in which the family lives? What hope do the family members reasonably have to influence the government and community policies that affect their lives? A school's SES is determined by the neighborhood in which it is located and by the SES of the families whose children attend the school.

SCHOOL OUTCOMES AND PERSONAL SES

The negative effects of low SES can interfere with a child's cognitive development. Among families of low SES, there are more occurrences of lead poisoning, fetal alcohol syndrome, and premature birth. Lead poisoning, caused by the child ingesting bits of the lead paint found in old buildings, produces neurological disorders. Children born to women who drink alcohol during pregnancy develop fetal alcohol syndrome, a condition that includes mental retardation. The child from a premature birth experiences a diminished brain development. All of these problems lead to language delays, attention problems, and learning disabilities.

Observed family differences based on SES include those constituting parenting styles. Comparing high SES parents to low SES parents, the high SES parents tend to be less directive and more conversational in their communication with their children. Low SES parents are more likely than the high SES parents to expect obedience without question from their children. Low SES parents encourage their children to conform to society's expectations, while the high SES parents encourage creativity and exploration. These differences foster self-confidence in the high SES students and an uncertainty about life in the low SES students.

Young people in the low SES neighborhood report as many pleasant experiences as the young people in high SES neighborhoods. However, children growing up in a low SES neighborhood are more likely to experience distressing events than their counterparts in the higher SES neighborhoods. These include physical punishment in the home, domestic violence in their home building, and serious crime in the neighborhood. Such demoralizing experiences lead to higher rates of depression, low self-esteem, and juvenile delinquency among children from the low SES neighborhoods.

Some children are resilient and able to develop normally under difficult conditions. However, for most children long-term problems are associated with the amount of time living in poverty.

RELATIONS BETWEEN SCHOOL OUTCOMES AND SCHOOL SES

Schools in low SES neighborhoods tend to have fewer resources. Their students, beginning school with little preparation, require an educational system with a more skillful and focused approach. However, the teachers in the low SES schools are often less paid and less trained than the teachers in the higher SES schools. The results are low achievement rates for the students. Few high school students in the low SES schools plan to attend college; therefore, the graduation rate is low.

One of the big problems in school for children of low SES is the self-fulfilling prophecy of failure. If the children do not dress well or are too shy, the teacher may not feel they are very bright. The teacher will call on these students less often and not regularly engage them in class discussion. These students are then left feeling as if they do not belong in school and as if they do not have hope of doing well. If learned helplessness builds in the students' self-concept, they will look for experiences that confirm this self-concept. This process is especially strong if the students are from an ethnic minority and face discrimination.

In mixed SES schools, the practice of tracking can negatively affect the low SES student. Tracking involves assigning students to classes in one grade based on their achievement level in the previous year. There are different expectations for the hierarchy of tracks; the high tracks set higher academic priorities and offer more encouragement than the lower tracks. Tracking disproportionately assigns low-SES students to low-achieving classrooms. Thus, the students who need the most stimulation and motivation are given the least. The original disparity between the achievement levels of the high-track students and the low-track students widens as tracking continues.

The schools in low SES neighborhoods suffer from the lack of support from the students' homes. The home environment contributes substantially to the development of academic skills. Enriching experiences in the home can contribute up to one-half of the measured achievement in verbal skills, reading, and mathematics. Three main factors distinguish the home environment of the high SES student from that of the low SES student. The high SES student is likely to do more reading, more skill building, and less television watching in the home than the low SES student, even during summer vacation (Woolfolk, 2007).

These factors are most closely associated with the educational level of the mother. The mother in the high SES family can be expected to have graduated from college. The college-graduate mother recognizes the need for home enrichment; the low-education mother likely does not. However, these problems can be resolved if the

low SES schools help the parents recognize ways to improve the home learning environment, such as turning off the television. As a passive activity, watching television discourages critical thinking. Parents have to recognize that television is an educational medium that does not always present accurate information.

There are examples of low-SES students keeping up with (or even surpassing) the higher SES students. There are two serious conditions that have to be considered regarding these cases. Often, the achievement is only seen during the school year. During the summer the low SES student is likely to fall behind. The other condition occurs when the achievement level is continuous. There is usually one or both parents making the necessary sacrifices to ensure that the home life provides enrichment for (and prevents interference with) the child's academic achievement.

The detrimental effects of low SES on early childhood can be ameliorated by quality preschool programs. One such program, Head Start, has existed since the 1960s. Its goal is to give children of low SES families a chance to be better prepared for school. Similar programs include the High/Scope Preschool in Michigan, Abecedarian Intervention program in North Carolina, and Child-Parent Center in Illinois. These programs have been shown to have longitudinal effects on the cognitive development of the children attending. The results are higher reading and math scores than other children of low SES families. Furthermore, the programs' attendees are more likely to finish high school and less likely to commit a crime than their peers.

SEE ALSO *At-risk Students.*

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SOCIOMETRIC ASSESSMENT

Sociometric assessment can be defined as the measurement of interpersonal relationships in a social group. Sociometric measurement or assessment methods provide information about an individual's social competence and standing within a peer group. School-based sociometric assessment often focuses on a child's relationships with regard to social popularity, peer acceptance, peer rejection, and reputation. Some sociometric assessment methods derive

information on social relationships by assessing children's positive and negative social perceptions of one another, whereas other methods involve adult (teacher, parent) and self perceptions of children's social competencies or standing. Sociometric assessment methods were introduced in the 1930s and advanced in the journal *Sociometry*. In the 1950s, several books were published on the topic and sociometric measurements often were part of research and school-based assessments of social relationships. The use of classic sociometric procedures declined in the following decades, due to the advancement of social behavior rating scales and ethical concerns regarding the use of peer nomination methods with children.

SOCIOMETRIC ASSESSMENT METHODS

There are a variety of what can be referred to as classic sociometric assessment techniques derived from the work of the 1930s, including peer nomination, peer rankings, and sociometric rankings. In the peer nomination technique, children in a social group or school classroom anonymously identify social preferences for their classmates. For example, children may be asked to provide a list of the three classmates with whom they would most like to play and the three with whom they would least like to play. Another peer nomination technique (see Figure 1) is to provide a list of the names of the children in a classroom along with social acceptance items (e.g., "Who do you like to play with?" "Who is most likely to be alone during recess?" "Who gets into trouble the most?"). The children are asked to identify perhaps one to three classmates who they perceive best fit the item description.

An alternative peer nomination method for early readers is to use photographs with an adult reading the items aloud in either an individual or classroom setting while the children provide a nomination for a child, perhaps by assigning a smiling or frowning face to the photograph that applies. Another variation of the peer nomination method is the class play. In this procedure children cast their peers in positive and negative roles in an imaginary play. The class play has the potential advantage of being more acceptable in school settings because the positive and negative role assignments may be perceived as a more discreet method for identifying children's social standing. For each of the methods described, the nominations may be summed for each child and the results are used to identify those children who are perceived as most socially positive or negative by their peers.

Two other sociometric techniques can be described as peer ratings and sociometric rankings. Peer ratings are conducted by providing a list of children's names in the social group or classroom along with a rating for social acceptance items such as "The most fun to play with,"

Example of a peer nomination technique									
Place an X under the name of one classmate in answer to each question below	Alma	Bart	Carl	Dave	Edna	Fayd	Gigi	Holz	Inez
Who would you most like to play with?		X							
Who would you least like to play with?							X		
Who gets into trouble the most?				X					
Who is most likely to be alone during recess?		X							
Who gets along best with others?	X								

Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

“The least fun to play with,” and “Has the most friends.” The rating methods that are used may vary, typically ranging from three- to five-point Likert-type responses (e.g., Agree, Neutral, Disagree). In contrast to peer nominations and ratings, sociometric rankings are completed by an adult, most often the classroom teacher who has had the opportunity to observe the children in multiple social settings such as the classroom, playground, and cafeteria. In this method, teachers rank the children on social dimensions similar to those provided by peers.

Each of these sociometric assessment methods has strengths and limitations. Researchers have found that each method appears to be valid for identifying children’s social standing. Peer ratings and adult rankings appear to provide the most reliable or stable measurements and, as such, may be more useful than the peer nomination method. A major issue that arises with each of these methods is the concept of social validity, which refers to the acceptance, usefulness, and potential harm of an assessment procedure. The applications of sociometric assessment methods have resulted in controversy and ethical concerns regarding their use. These concerns center on the use of negative peer nominations and the possibility that children will compare responses which may result in negative social and emotional consequences for children who are not positively perceived by their peers. These concerns contributed to the decline in the acceptance and use of sociometric assessment methods, particularly in school settings. However, researchers have found no strong evidence that negative consequences occur for either the children who are rating or those being rated; therefore, sociometric assessment continues to be used as a research tool for understanding children’s social relationships.

RELATED ASSESSMENT METHODS

Although the term sociometrics has been most often applied to the assessment methods described above, in a broader context the term can be applied to related assessment measures of social functioning. These methods tend

to focus on children’s social competencies and skills rather than measuring only social standing or peer acceptance. Because these methods are more often used in practical applications in school settings, they are briefly described here.

Social Behavior Rating Scales. Social behavior rating scales represent one of the most frequently used measures of social competence. These rating scales are designed for gathering data on the frequency of occurrence of specific skills or behaviors. Some rating scales focus on social problem behaviors and others are designed specifically to assess children’s social skills. For example, a social skills rating scale may contain items such as “Appropriately invites friends to play” or “Controls temper in conflicts with adults” which are rated on a frequency scale (e.g., Never, Sometimes, Always). Depending on the measure, ratings can be gathered from parents or parent surrogates, teachers, and when appropriate from the children themselves. Rating scales in essence provide summary observations of a child’s social behavior. Gathering data from these multiple sources can facilitate understanding different perspectives regarding a child’s social skills in home and school settings. Well designed social skills rating scales have been found to be reliable and valid measures.

Observation Methods. Observation methods are used to gather information about a child’s social skills in natural settings, such as in the classroom, in the cafeteria, and on the playground. Observation methods can be highly structured wherein defined behaviors are measured for frequency of occurrence or measured for occurrence during specified time periods or intervals. For example, a child’s play behavior may be observed during recess by a school psychologist who records every 30 seconds whether the child was playing alone or with others. Other observation methods are less structured and rely on a narrative approach for describing a child’s social interactions. Observation methods often include focus on the

environmental variables that may increase or decrease a child's social skills, such as the reactions of peers and adults to a child's attempts at initiating conversation. Observations also can be conducted in what is known as analogue assessment, which involves having a child role-play social scenarios and observing the child's performance. Whereas rating scales provide summary measures that rely on some level of recall, observations have the advantage of directly sampling a child's behavior in actual social contexts or settings, thereby increasing the validity of the assessment. The limitations of observations are that multiple observers are required to ensure reliable assessment (interobserver agreement) and observations are more time intensive. Thus in applied settings they may provide limited information due to time constraints.

Interview Methods. Interview methods are used to gather information about a child's social skill strengths and weaknesses, and to aid in the identification of specific skill deficits for intervention. Interviews can be used separately with children, parents or parent surrogates, and teachers, or conjointly with multiple sources. Interviews can be structured, with a focus on the identification and treatment of specific social skills, or interviews can be less structured, with a greater focus on feelings and perceptions about a child's social skills. As with rating scales, interview data can be viewed as summary recall information which should be validated with direct observation.

The assessment methods described often are combined in a comprehensive social skills assessment that may include rating scales, observations, and interviews. Using multiple methods of assessment is considered best practice because the use of more than one assessment method increases the likelihood that the behaviors which are targeted for classification or intervention are valid, and that specific social skills strengths and deficits are clearly defined. It is also important to use multiple assessment methods to monitor a child's progress and to assess the effectiveness of an intervention.

IMPLICATIONS OF SOCIOMETRIC ASSESSMENT FOR EDUCATIONAL PRACTICE

In educational practice, sociometric assessment most often is used to determine eligibility for special education and for intervention for adaptive behaviors or socio-emotional problems. Children identified with special education needs, such as learning problems, mental retardation, attention deficit disorders, and autism spectrum disorders, including Asperger's syndrome, may benefit from assessment and intervention toward enhancing their social skills. In the general education population, children may benefit who are shy, rejected, or engage in bullying or aggressive

behaviors or who simply have limited social skills. Most of the classic sociometric assessment methods are not used in educational practice, partly due to issues with acceptability. Furthermore, although these methods have been found to be useful in research, they may not be viewed as being useful in school settings because they do not lead to specific classification for special education nor do they provide specific data that can directly assist in the intervention process. Related sociometric assessment measures such as rating scales often are used because these methods provide more specific information that can be linked to classification and intervention.

One classic sociometric assessment method that has been shown to be effective in educational practice is sociometric rankings. In this procedure teachers rank the children in their classroom who the teacher views as having social behavior problems, sometimes in relation to internalizing and externalizing problem behaviors. (Internalizing behaviors refer to problems such as depression, anxiety, and social withdrawal; externalizing behaviors refer to problems such as aggression, conduct problems, and hyperactivity.) The use of teacher rankings serves as an initial screening device for identifying children who may need additional assessment and intervention. Once identified, the children are screened further with a rating scale or related method to determine the extent of their social difficulties. Those children who are found to have problems are then referred for more assessment intended to specify their problems and provide an intervention, such as social skills training. Researchers have found this method of assessment, known as a multiple gating procedure, to be acceptable and effective in applied settings.

Assessing and understanding children's and adolescents' peer relations is important in educational settings for several reasons. From a developmental standpoint, it is important to understand how children develop social skills as they mature. Researchers have found that sociometric assessment can be useful in identifying children's social standing and predicting positive or negative social outcomes for children. The establishment of friendships and positive social interactions are important for children's social development and for interacting in the social world, including the school setting. Children with poor peer and adult relationships often experience negative social and emotional consequences that can continue throughout adulthood. These negative consequences can include lower academic achievement, higher rates of school dropout, depression, anxiety, low self-esteem, poor self-concept, social withdrawal, fewer positive employment opportunities, and anti-social behaviors such as aggression and criminality. Researchers have estimated that at least 10%, or one in ten children experience consistent negative peer relationships. Therefore, a large number of children with inadequate social relationships may be at-risk for developing

behavioral and emotional difficulties. Children with poor or limited social skills also are at risk for becoming victims of bullying and other aggressive behaviors. Children with disabilities often have social skills deficits and negative peer perceptions that put them at heightened risk.

Given these potentially negative outcomes, social skills assessment is important in educational settings. In research, the identification of the development of social standing and social skills can facilitate understanding the behaviors of socially successful and unsuccessful children. In research settings, both classic sociometric assessment and social skills assessment methods are used to achieve better understanding of social types and behaviors. These behaviors can in turn be used to understand children's and adolescents' social skill deficits and can aid in the design and study of social skills assessments and interventions.

SEE ALSO *Classroom Assessment; Social Skills.*

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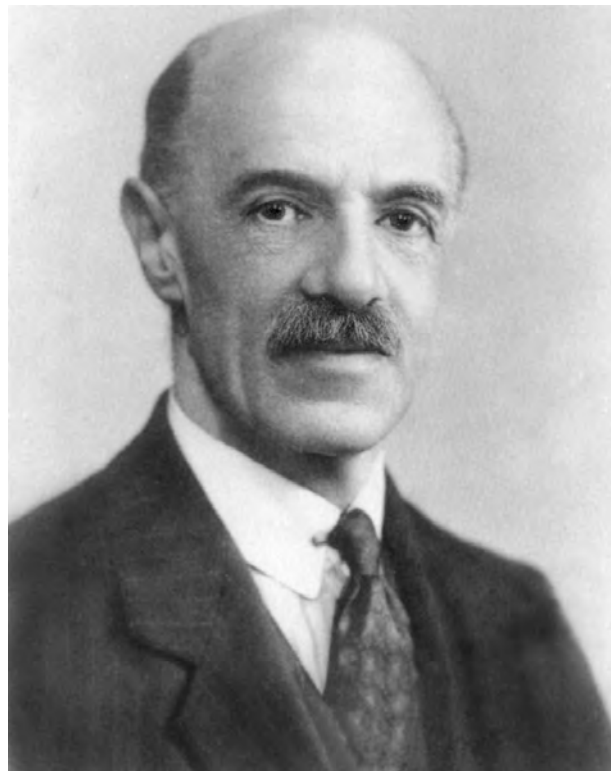
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SOCIOMETRIC STATUS

SEE *Peer Relationships; Sociometric Status.*

SPEARMAN, CHARLES EDWARD 1863-1945

Charles Edward Spearman was born in London on September 10, 1863, into a respected family. As a student, he demonstrated a superb mastery of mathematics and



Charles Spearman ARCHIVES OF THE HISTORY OF AMERICAN PSYCHOLOGY. THE UNIVERSITY OF AKRON.

science but held a "secret devotion to philosophy" that would last his entire life (1930, p. 299). Following graduation from college, Spearman secured a commission as an officer in the Royal Engineers of the British Army. Spearman was assigned to a post in Burma, where he served honorably and rose to the rank of major. During this time, his continued interests in philosophy led to the belief that many of the debated issues of philosophy could be resolved successfully by applying the empiricism of psychology. So at the age of 34, Spearman abandoned a successful military career and began study in the Leipzig laboratory of Wilhelm Wundt. Despite his obvious military success, Spearman later portrayed his 14 years of service as "the greatest mistake of my life, [based on] the youthful delusion that life is long." (1930, p. 300).

Although Wundt is considered a founding father of psychology, Spearman's greatest influence came from Sir Frances Galton (1822-1911). After reading Galton's *Hereditary Genius* (1869) and *Inquiries into Human Faculty and Its Development* (1883), Spearman seized on two principles that guided the remainder of his life's work. First, individual differences in sensory, motor, and cognitive abilities may be measured precisely using

standardized techniques. Second, there exists a biologically based general mental ability that enters into every kind of mental activity.

At his own personal expense and without the support of Wundt, Spearman conducted a study to test the Galtonian notion that individual differences in sensory discrimination and modality were positively correlated with varied measures of cognitive ability. As the logic goes, positive correlations among the variables would demonstrate the existence of a common source of variation (i.e., the presence of a general ability). To accomplish his aim, Spearman invented the statistical technique of factor analysis to analyze the matrix of correlations among variables. Spearman published this study as a 1904 article titled "General Intelligence, Objectively Determined and Measured." The article garnered considerable scientific interest, both for its surprising support of Galton's theory of general ability, as well as its innovative statistical methodology. Following further military service in the Boer War, Spearman finally completed his doctoral study in experimental psychology in 1906. By that time he was 42 years of age but with "more distinguished scientific accomplishments to his credit than probably any other new Ph.D. in the history of psychology" (Jensen, 2000, p. 4).

Spearman joined the Department of Experimental Psychology at University College, London, where he was promoted to full professor in 1911. He continued his research into general ability and expanded investigations to include group differences, psychometrics, eugenics, and learning. Spearman retired in 1931, but continued to play an active role in field of educational psychology. After retirement, Spearman taught in North America at Columbia University, where his students included David Wechsler and Raymond B. Cattell.

During his esteemed career, Spearman received numerous honors, including Fellow of the Royal Society and membership in the United States National Academy of Science. In 1945, with failing health at age 82, Spearman reportedly committed suicide by jumping from a window of the London University Hospital, where he was a patient.

Spearman is credited with offering the first truly tenable psychometric definition of intelligence and is, therefore, considered to be the founding father of classical test theory. This approach, which considers an individual's observed score as consisting of a *true score* plus *error score* has been particularly influential in test development and conceptions of reliability. Spearman's best known contribution to statistics is the rank-order correlation coefficient, a nonparametric index of association between two ordinal variables. Additionally, Spearman's development of factor analysis is the first direct application of latent trait theory, which advances that individual

differences in observed test scores serve as reflections of some smaller number of hypothetical, or latent, variables. This technique is routinely used to determine the construct validity of tests. Undoubtedly, Spearman's most important discovery was the identification of a general factor of mental ability (i.e., Spearman's *g* or *g factor*). A century of research finds that Spearman's *g* is the largest singular source of individual differences in mental ability and learning, regularly accounting for approximately half of the variance in test scores (Jensen, 1998).

Since its explication in Spearman's seminal 1904 article, the *g factor* has garnered considerable support and controversy. The continued interest and influence of Spearman's research can be traced to a number of developments, including the spread of universal public education, an increased range in the intelligence and scholastic achievement of the school population, and the rising cognitive demands of a complex modern society and workplace. In the early 2000s, one of the liveliest and most productive lines of research in cognitive neuroscience and biogenetics is the search for the physiological/genetic provenance of Spearman's *g* (Brand, 1996; Meisenberg, 2005). As testimony to his originality and continued influence, Spearman is one of the few psychologists showing an increasing rate of citations since his death.

SEE ALSO *Intelligence: An Overview.*

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SPECIAL EDUCATION

As defined by U. S. law, special education is: “specially designed instruction, at no cost to parents, to meet the unique needs of a child with a disability, including instruction conducted in the classroom, in the home, in hospitals and institutions, and other settings; and instruction in physical education” (Individuals with Disabilities Education Improvement Act, 2004) 20 U.S.C. § 1401 (29). The law also stipulates that students with disabilities are entitled to related services, as needed. Related services include such services as transportation, occupational and physical therapy, and psychological, counseling, speech/language pathology, audiology, and interpreting services.

SPECIALLY DESIGNED INSTRUCTION

For most students with disabilities, “specially designed instruction” is defined as involving intensive, relentless, structured, appropriately paced instruction, in small groups in which each student’s progress is monitored frequently (Kauffman & Hallahan, 2005). According to Kauffman and Hallahan, all of these characteristics should usually be more evident in special education than is typically the case in general education. Intensive instruction translates into more teacher instructional time and more opportunities for students to respond to the instruction and more time to practice and review what they have learned. Relentless instruction involves repeating this sequence or parts of this sequence more often than is typically done with non-disabled students. Structured instruction refers to teachers being more directive, instituting more explicit rules, and providing more frequent consequences for appropriate or inappropriate behavior. The pace of the instruction in special education is tailored more to the needs of the student and is often slower, with teachers waiting for a longer period of time for a response after querying the student. Instruction in small groups facilitates the intensity, relentlessness, structured nature, and the individualized pace of instruction. Moreover, specially designed instruction means that a student’s progress in learning is monitored frequently, often several times per week.

In addition to these general principles of instruction that apply to most students with disabilities, there are some that apply to specific categories of special education students. For example, for students with blindness or low vision, the “specialized designed instruction” may take the form of reading materials in Braille, large print, or audio recordings, and instruction in the use of a cane for mobility. For students who are deaf or hard of hearing, the instruction may involve sign language or hearing aids. Additionally, for students with emotional or behavioral disorders, instruction may require highly structured classrooms and teaching routines and use of functional behav-

ioral assessment (FBA) and positive behavioral intervention and support (PBIS). FBA involves determining what factors help to set off and maintain inappropriate behaviors. And PBIS emphasizes “rewarding positive behavior, to make problem behavior less effective, efficient, and relevant and to make desired behavior more functional” (Hallahan, Kauffman, & Pullen, 2009, pp. 163–164).

SPECIAL EDUCATION CATEGORIES

Students served by special education fall into 13 disability categories. In order of prevalence they are learning disabilities, speech or language impairments, mental retardation, emotional disturbance, other health impairments (including attention deficit hyperactivity disorder), multiple disabilities, autism, orthopedic impairments, hearing impairments, developmental delay, visual impairments, traumatic brain injury, deaf-blindness. The federal government has provided definitions for each of these categories in order to give guidance to schools in finding students eligible for special education services.

Learning Disabilities. Students with learning disabilities are by far the largest category of special education, comprising between 5 and 6 percent of the school-age population and nearly half of all students identified for special education services. Although its historical roots can be traced back to work done in the 1800s in Europe (Hallahan & Mercer, 2002), learning disabilities as a condition and as a discipline was not formally recognized until the 1960s and 1970s. A major reason for the eventual recognition of learning disabilities as a condition warranting special education services came from parents and professionals who pointed out that there were many students who, although not scoring low enough on intelligence tests to qualify as mentally retarded, were nevertheless still displaying learning problems, especially in reading.

The federal definition of learning disabilities is as follows:

General The term “specific learning disability” means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations.).

Disorders Included Such term includes such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia.).

Disorders Not Included Such term does not include a learning problem that is primarily the result of visual, hearing, or motor disabilities, of

mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage (Individuals with Disabilities Education Act Amendments of 1997, Sec. 602(26), p. 13.).

Speech or Language Impairments. Speech impairments include disorders of articulation, fluency, and/or voice (American Speech-Language-Hearing Association, 1993). Articulation disorders often result from neuromuscular abnormalities resulting in omission, substitution, or distortion of speech sounds. Fluency refers to being able to produce smooth speech flow. Disorders of voice include such characteristics as abnormal pitch, loudness, or resonance.

Language impairments can include problems in production and/or comprehension that violate the rules of language pertaining to phonology, morphology, syntax, semantics, or pragmatics. Phonology rules govern how speech sounds are sequenced. Morphology refers to parts of words that indicate such factors as verb tense and plurals. Syntax involves word order that reflects proper grammar. Semantics refers to the meanings of words and sentences, and pragmatics involves using language for social purposes.

Mental Retardation. Most professionals use the definition of mental retardation provided by the American Association on Intellectual and Developmental Disabilities (AAIDD): “Mental retardation is a disability characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills. This disability originates before age 18” (AAMR Ad Hoc Committee on Terminology and Classification, 2002, p. 1). The AAIDD considers the following five points as crucial to understanding the context of the definition:

1. Limitations in present functioning must be considered within the context of community environments typical of the individual’s age peers and culture.
2. Valid assessment considers cultural and linguistic diversity as well as differences in communication, sensory, motor, and behavioral factors.
3. Within an individual, limitations often coexist with strengths.
4. An important purpose of describing limitations is to develop a profile of needed supports.
5. With appropriate personalized supports over a sustained period, the life functioning of the person with mental retardation (intellectual disability) generally will improve. (AAMR Ad Hoc Committee on Terminology and Classification, 2002, p. 1).

Emotional Disturbance. There is considerable controversy concerning the definition of emotional disturbance, which stems from the relatively subjective nature of the condition. In fact, even though the federal government uses the term emotionally disturbed, there are many professionals who prefer the term *emotional or behavioral disorders* because it more accurately conveys the socialization problems these students exhibit.

With respect to definition, many authorities agree on the following three features of emotional or behavioral disorders:

Behavior that goes to an extreme that is not just slightly different from the usual;

A problem that is chronic one that does not quickly disappear; and

Behavior that is unacceptable because of social or cultural expectations (Hallahan et al., 2009).

Other Health Impairments. According to the federal definition, other health impairments (OHIs) are medical conditions, such as asthma, diabetes, epilepsy, sickle cell anemia, which impair to such a degree that they adversely affect a student’s educational performance. The key to the definition is that the condition must interfere with the student’s educational performance. For example, not all students who have asthma have it to such a degree that it affects their ability to function in school.

Students with attention deficit hyperactivity disorder (ADHD) are also included in the federal government’s category of OHI. The American Psychiatric Association (2000) recognizes three types of ADHD: (1) ADHD, predominantly inattentive type; (2) ADHD, predominantly hyperactive-impulsive type; (3) ADHD, combined type.

The reason behind the decision to place ADHD in the OHI category is an interesting lesson in disability advocacy and politics (Hallahan et al., 2009). In the late 1980s and early 1990s, parents of affected children lobbied intensely for ADHD as a new category of special education. Many surmise that the U. S. Department of Education was worried about creating yet another category, especially one that could potentially attract large numbers of students. Therefore, in 1991, they came up with the compromise of stating that students with ADHD could receive special education services if they were identified as having OHI, i.e., had a condition that interfered with their educational performance, thus leaving open the possibility that some students with ADHD would not meet the criteria of OHI because their educational performance was not adversely affected.

Multiple Disabilities. The multiple disabilities category consists of students who have two or more disabilities, “the combination of which causes such severe educational problems that they cannot be accommodated in special education programs solely for one of the impairments” (34 CFR, Sec. 300 [b](6)).

Autism. Many authorities in the early 2000s consider autism to be one of several similar conditions that fall on a spectrum, hence the term *autism spectrum disorders*. The conditions on the spectrum share impairments in three areas: (1) communication skills, (2) social interactions, and (3) repetitive and stereotyped patterns of behavior (Strock, 2004). Classic autism and Asperger syndrome are the most common conditions. Whereas students with autism have relatively severe deficits in all three areas plus severe cognitive deficits, those with Asperger syndrome generally have less severe deficits in all three areas, with their major problem lying in the area of social interactions and some having very high intelligence.

Orthopedic Impairments. Orthopedic impairments include physical disabilities of the muscles and/or bones that negatively affect school learning. Two examples are muscular dystrophy (a hereditary condition resulting in muscle fiber degeneration) and juvenile rheumatoid arthritis.

Hearing Impairments. Students with hearing impairments fall into two categories: those who are deaf and those who are hard of hearing. How one differentiates between the two depends on whether one adopts a physiological or an educational orientation. A physiologically based definition relies on the measurable degree of hearing loss, with those having an impairment of 90 decibels or greater being deaf (0 dB is the level at which the average person can hear the faintest sound). An educationally based definition focuses on the ability to process linguistic information, with deafness indicating that the person cannot process linguistic information through audition even with a hearing aid (Brill, MacNeil, & Newman, 1986).

Developmental Delay. For many infants and preschoolers, it is often difficult to determine whether they have a true disability or have a temporary delay in maturation. In addition, it is sometimes difficult to determine the exact nature of very young children’s disability. For these reasons, professionals are often reluctant to make a clinical diagnosis and, instead, refer to them as having a developmental delay.

Visual Impairments. Like hearing impairments, visual impairments are divided into two groups based on severity: blindness and low vision. Additionally, like hear-

ing impairments, these two groups are defined differently according to whether one uses a physiological versus an educational approach. A physiological orientation (also referred to as the legal definition because it is used to determine certain government benefits) relies on measurement of visual acuity and field of vision. Visual acuity of 20/200 (normal acuity is 20/20, being able to see at 20 feet what a person with normal vision sees at 20 feet) or less in the better eye, even with correction (e.g., eyeglasses), or visual field of less than 20 degrees qualifies an individual as legally blind. Those having visual acuity between 20/70 and 20/200 are referred to as having low vision or being partially sighted. The educational definition focuses on mode of reading, with those needing to use Braille being considered blind, and those who can read print, even with magnifying devices or large-print books, being considered as having low vision or being partially sighted.

Traumatic Brain Injury. In 1990, the federal government added students with traumatic brain injury (TBI) to the list of those eligible for special education services. This decision was in recognition of the fact that TBI occurs much more frequently than was previously thought. For example, estimates are that about one million children and adolescents receive head injuries each year, with 15,000 to 20,000 incurring lasting effects (Council for Exceptional Children, 2001). TBI refers to trauma to the brain caused by an external force that results in behavioral dysfunction. Such injuries can be open head injuries (i.e., penetrating head wounds) or closed head injuries (i.e., damage caused by internal compression or shearing motion inside the head) (Adelson & Kochanek, 1998).

Deaf-Blindness. Basically, students with deaf-blindness meet the educational definitions of both deafness and blindness. The vast majority of students with deaf-blindness also have one or more other disabilities, such as mental retardation. Deaf-blindness can result from (a) prenatal causes, such as rubella, (b) postnatal causes, such as meningitis, or (c) genetic/chromosomal syndromes (Hallahan et al., 2009).

HISTORY OF SPECIAL EDUCATION

The history of special education reveals a pattern characterized by alternating periods of progress and optimism and regress and pessimism. In spite of these fluctuations, overall special education has progressed from a relatively primitive state to its present-day robust status as a viable service option in public schools and as a field of scientific inquiry. Special education history is presented below in four time periods, starting with its birth in the late eighteenth and early nineteenth centuries.

LATE EIGHTEENTH AND EARLY NINETEENTH CENTURIES.

Historians of special education usually trace its roots back to the end of the eighteenth century and beginning of the nineteenth century (Hallahan et al., 2009; Kauffman, 1981). Prior to the French and American Revolutions, care for people with disabilities came largely in the form of asylums, created almost as much to protect the larger society from those considered *idiotic* or *insane* as to protect those housed within the institutions. With the revolutions, however, came principles of democracy and egalitarianism. Fueled by this idealism, many European and American physicians, clergymen, and other reformers tackled the issue of rehabilitating and educating children with a variety of disabilities.

Jean-Marc-Gaspard Itard (1775 1838) is generally credited as being the creator of many of the basic instructional principles upon which special education is built. A French physician, Itard was a specialist in deafness. In fact, it was his specialization in deafness that serendipitously led to his groundbreaking work with Victor, the “wild boy of Aveyron” (Lane, 1984). Found wandering in the forest in 1801, Victor was brought to the National Institution for the Deaf because he was thought to be deaf. Itard, who worked at a nearby hospital was called to the Institute to attend to a resident who had broken his leg on the very day that Victor arrived. Itard saw in Victor the opportunity to demonstrate that intensive instruction could ameliorate even the most intractable learning difficulties. Although Itard was not able to cure Victor and, in fact, considered his efforts largely a failure, others after him considered Victor’s progress to be quite remarkable.

Eduoard Seguin (1812 1880), along with other students of Itard, carried forward many ideas that served as the foundation of special education: individualized instruction, careful sequencing of instruction, stimulation of the senses, careful structuring of the educational environment, immediate reward for correct performance, instruction in functional skills for independence, and an assumption that all children can make some progress (Hallahan et al., 2009). Seguin established the first known school to serve mentally retarded children in France in 1839 before immigrating to the United States. In 1866, he published *Idiocy* and its treatment by the physiological method, which is often cited as the first textbook on instruction for persons with mental retardation.

In addition to Seguin, several other reformers were influential in establishing educational programming for students with disabilities in the United States. The physician Samuel Gridley Howe (1801 1876), who had been the one inviting Seguin to the United States, helped establish the first school for the blind in 1832 in Water-town, Massachusetts, the Perkins School for the Blind.

The minister Thomas Hopkins Gallaudet (1787 1851), after visiting European educators of the deaf, founded the first residential school for the deaf in the United States in 1817 in Harford, Connecticut. In 1841 the social crusader Dorothea Dix (1802 1887) lobbied state and federal legislatures to provide funding for asylums for the insane.

LATE NINETEENTH CENTURY

Much of the optimism and interest in quality care that characterized the early part of the century began to wane in the late nineteenth century (Kauffman, 1981). Depressing economic conditions in the aftermath of the American Civil War (1860 1865), combined with an influx of immigrants and rapid industrialization and urbanization, led to a decrease in interest in educating and rehabilitating those with disabilities.

But even in the face of dwindling interest and resources, several positive developments occurred, including Congress establishing a U. S. Department of Education, special classes and day schools for children who were deaf, the addition of a Department of Special Education in the National Education Association, and special education teacher training programs usually housed in institutions for those with disabilities. It was during this time, too, that numerous professional organizations sprung up for those working with students with disabilities.

But counteracting these positive developments, the close of the nineteenth century witnessed a growing pessimism about what could be done for students with disabilities, especially those who were mentally retarded. The prevailing professional opinion was that mental retardation was incurable and that the most that could be done was to provide protection from and for retarded individuals by housing them in large institutions.

EARLY TWENTIETH CENTURY

The early twentieth century brought mostly positive developments for students with disabilities, with a smattering of negativism, especially toward those with mental retardation. During this time, the eugenics movement gained influence. Henry H. Goddard’s *The Kallikak Family: A Study of the Heredity of Feeble-mindedness* in 1912, purportedly showing the hereditary spread of mental retardation, fueled the passage of legislation in several states to sterilize residents in institutions of mental retardation. Interestingly, later examination revealed strong evidence that he fabricated or altered much of his so-called data (Smith, 1985).

During this time, some of the more progressive public schools began to offer special education classes and resource rooms for students with various disabilities. Elizabeth Farrell (1870 1932), a New York City special education teacher, advocated for the establishment of

classes for students with disabilities. In 1922 she helped found the Council for Exceptional Children, which remained into the early 2000s as the major professional organization for educators of students with disabilities. With the spread of these programs, special education began to be recognized as part of the curricular offerings in school systems.

This period also saw the emergence of many issues concerning education of students with disabilities that persist into the 21st century. For example, there were vigorous debates in the professional literature about segregation versus mainstreaming of students with disabilities, early identification and prevention of disabilities, more federal aid for special education services. In short, the stage was being set for special education to become a discipline of study.

LATE TWENTIETH CENTURY

One of the most, if not the most important development of the late 1900s was the emergence of parent groups and organizations. For example, the National Association for Retarded Children (subsequently called The Arc) was founded in 1950 and the Association for Children with Learning Disabilities (later called the Learning Disabilities Association of America) was founded in 1963. Such organizations were instrumental, along with professional organizations, in lobbying for legislation and services for students with disabilities.

The end of the 20th century was a time of increased expansion of special education research and services. In the research domain, the federal government funded research that generated an expanding body of literature on best practices in identification and intervention for students with disabilities. These competitive research grant programs focused on individual researchers or small teams of researchers as well as large, interdisciplinary research centers. Additionally, personnel preparation grants helped fill the growing need for pre-service and in-service special education teachers, as well as university-level teacher educators.

During this time, too, several pieces of landmark legislation were passed that mandated special education as a civil right for children with disabilities and their families. This legislation, discussed in the following section, established special education as a major piece of the educational landscape in U.S. K-12 schools and universities.

RELEVANT LEGISLATION

Beginning in 1975 and continuing into the 21st century, federal legislation has worked to define the needs of special students and through laws to design ways of serving this population.

Public Law 94-142. The 1975 Education for All Handicapped Children Act (PL 94 142) was a groundbreaking law that established the fundamental parameters of how special education services are defined and implemented in the United States. Key provisions such as a free appropriate public education (FAPE), individualized education programs (IEP), least restrictive environment (LRE), and procedural safeguards (such as due process procedures) defined in the original statute remained primary to the law in subsequent reauthorizations.

Prior to the passage of PL 94 142, many children and youth with disabilities were excluded from public schooling. For the majority of those students, that meant lack of access to appropriate assessment, education, rehabilitative services, and community support. Other federal legislation laid the groundwork for PL 94 142, but these statutes did not wield the same power in terms of firmly establishing the rights of individuals with disabilities access to public education. Notable legislation includes the Training of Professional Personnel Act of 1959 (teacher training for working with individuals with mental retardation), Teachers of the Deaf Act of 1961 (teacher training for working with individuals who are deaf or hard of hearing), the Elementary and Secondary Education Act of 1965 (funding for the education of children with disabilities), and the Handicapped Children's Early Education Assistance Act of 1968 and the Economic Opportunities Amendments of 1972 (establishment of early childhood programs for children with disabilities). These laws helped to articulate instructional practices specific to the needs of students with disabilities and establish models for teacher training that would be included in PL 94 142.

Since 1975 several substantive changes have been made to the law through the reauthorization process. The 1986 reauthorization extended FAPE to include children ages 3 to 5 and established Early Intervention Programs (EIP) and the Individualized Family Service Plan (IFSP) for children ages from birth to 3 years.

More significant changes occurred in the 1990 reauthorization. First, the law was renamed the Individuals with Disabilities Education Act (IDEA). The title change reflected three important points. First, the reach of the law expanded (birth to age 21) with the term "individuals" replacing "children." Second, people-first language "individuals with disabilities" replaced "handicapped children" to emphasize the individual nature of disability—people with disabilities should not be defined by their disability and individuals with the same disability will demonstrate great diversity. Third, the term "disability" replaced "handicapped" to more accurately define the population served. The 1990 reauthorization also included the provision of transition services for students,

created new categories of autism and traumatic brain injury, and re-crafted the language of LRE to place greater emphasis on the need for students with disabilities to receive education with their non-disabled peers.

The 1997 reauthorization extended this LRE position by including specific language that students with disabilities should have “access to the general education curriculum” (PL 105 17). The 1997 reauthorization also included more explicit guidelines regarding disciplinary procedures for students with disabilities. Specifically, the law recommended the use of FBA, discussed earlier, in order to provide preventative instruction or conditions to promote pro-social or desired behaviors. Taken together the reauthorizations of IDEA that occurred between 1986 and 1997 served to strengthen the core mission of the law and provide increased clarity on who is served under the law and what practices should surround the development of special education.

The Role of the Federal Government in Education. To understand how IDEA and other federal statutes affect local educational decision-making, it is important to examine the relationship between the federal government and the fifty states. The U.S. Constitution does not allocate specific power to the federal government in terms of education. As a result, states determine the policies, procedures, and requirements school districts must follow. The federal government does not possess the power to establish a national curriculum or set national standards for performance. From time to time, however, the federal government passes legislation that allows for the provision of funds to states for the purpose of improving education. Examples include grants to build infrastructure (e.g., land grants) or grants to improve educational outcomes for children in poverty (e.g., Head Start). When states accept these funds, they must also uphold the specific requirements associated with that funding stream. Even though the funding provided by the federal government has historically not exceeded 10% of a state’s education budget, states do rely on these funds (Yell & Drasgow, 2005). This relationship supplies the power to the federal government to shape and influence education.

Standards and Special Education. In 1983, under the leadership of the Secretary of Education, the Commission on Excellence in Education issued the *Nation at Risk* report. Many viewed the report as a wake-up call to the mediocre levels of student achievement in the country. One recommendation contained in the report urged the development of challenging, measurable academic standards. The push for standards came again in 1989 when President George H. W. Bush convened the fifty governors at the first National Education Summit. Many of the goals and priorities established as a result of the

summit became a part of the educational plans of President Bush and then of President Clinton.

In 1994 President Clinton reauthorized the Elementary and Secondary Education Act of 1965 (ESEA). The reauthorized act, renamed Improving America’s Schools Act, reflected the standards framework recommended by the *Nation at Risk* report and articulated in President Bush’s America 2000 and President Clinton’s Goals 2000: Educate America Act. This reauthorization established a precedent for an expanded role of government in education and lay the groundwork for the next reauthorization, which would prove to be both controversial and far-reaching.

No Child Left Behind Act. The 2001 reauthorization of ESEA brought yet another title change for the law. The No Child Left Behind Act of 2001 (NCLB), under President George W. Bush, adopted many of the principal features (e.g., academic standards, accountability, and adequate yearly progress) included in the 1994 reauthorization of ESEA (Yell & Glasgow, 2005). The departure from prior educational legislation came in the form of demands to bring all students up to standards within a certain time frame and the establishment of sanctions for schools that did not perform. In essence, NCLB was the first instance of federal educational legislation that had the power to enforce itself. NCLB passed by an overwhelming bipartisan majority in both the House and Senate, yet shortly after its passage political schisms in regard to implementation of the law occurred.

The confluence of standards/accountability represented in NCLB and the increasing emphasis on access to the general education curriculum in IDEA resulted in a federal position on the education of students with disabilities that looked more similar to general education policies than ever before in the history of special education. Several provisions in NCLB had direct influence on the reauthorization of IDEA in 2004 and on the ensuing instructional practices for students with disabilities. Specifically, NCLB required (a) accountability for results, including the results of students from identified subgroups (i.e., students with disabilities, ethnic and racial minorities, students who are economically disadvantaged, and students who are limited English proficient); (b) the use of instructional practices based upon scientifically based research; and (c) that necessity that all students be taught by a teacher who meets the federal definition of “highly qualified.” The 2004 reauthorization of IDEA included NCLB’s definition of highly qualified special education teacher and a similar requirement for the use of materials and practices based upon scientifically based research.

Under NCLB, states were required to report disaggregated data on the various sub-groups, including students with disabilities. Although these data led to greater transparency in regard to the educational outcomes of students with disabilities and greater accountability for demonstrating educational progress, the fact that at least 95% of students with disabilities were required to participate in the state-wide assessments caused concern for some. In addition, only 2% of students with disabilities could participate in modified achievement standards or alternate tests. Questions related to which assessments (grade-level or ability-level), accommodations or supports, and populations of students under IDEA should be selected challenged states' initial implementation of the law. NCLB's highly qualified teacher requirement also proved challenging in its implementation.

In addition to incorporating the language and fundamental principles of NCLB, IDEA 2004 included several other important provisions that would have direct influence on the identification of and instructional practices for students with disabilities. For example, the concept "universal design" was used throughout the amendments to underscore the importance of selecting materials, methods, and assessment techniques and technologies that allow for access by a wide-range of students. For teachers, universal design means selecting instructional strategies that provide benefit to a range of learners—from students with disabilities to high-achieving students—or creating assessments that allow a range of students to demonstrate knowledge of high academic standards.

Two other changes to IDEA 2004 reflected the trend towards unifying general education and special education practices. These changes included providing more flexibility to schools in terms of the discipline of students with disabilities and the removal of short-term objectives on the IEP for the majority of students with disabilities. In terms of discipline, the law shifted the burden of proof in manifestation determination reviews to the parents and made it easier for schools to remove children for disciplinary infractions other than weapons, drugs, or dangerous behavior. The removal of short-term objectives for all students, except those who participate in alternate assessments and follow alternate standards (less than 1% of students with disabilities), reflected the increasing emphasis on participation in general education standards and accountability.

Perhaps the most significant addition to IDEA 2004, though, was the inclusion of additional procedures for the identification of students with specific learning disabilities. States were no longer required to use a "severe discrepancy" between achievement and intellectual ability as an identifying factor. In addition, states could now allow processes that measured a "child's response to

scientific, research-based interventions" as a gauge for identification. Commonly referred to as *response to instruction* or RTI, this provision dramatically changed the language (and some would argue, practice) of special education. Special educators would differentiate between "core instruction," the instruction received by the majority of students in general education, and "levels of intervention," the qualitatively different instruction that was delivered to students not making progress in the core program. These levels of intervention were not necessarily delivered in settings outside the general education classroom but could be.

Other Influential Laws. Two other laws directly influence the education of students with disabilities: Section 504 of the Rehabilitation Act of 1973 (Section 504) and the Americans with Disabilities Act (ADA) of 1990. Both Section 504 and ADA are civil rights acts that protect qualified individuals with disabilities from discrimination of benefits or services on the basis of disability. These nondiscrimination laws apply to any organization receiving federal financial assistance, which would include public schools. Although 504 and ADA have much in common with IDEA, the fundamental purposes of these laws differs from the charge of IDEA.

The purpose of Section 504 is to create equal opportunity for students with disabilities through the elimination of barriers or the provision of accommodations for equal access. In other words, for students who can be successful the general education classroom with the provision of minor instructional accommodations or structural changes, Section 504 may be the only law these students need. In contrast, the intent of IDEA is to provide specialized services and supports that differ in some way from the education received by students without disabilities. Students with disabilities who require more intensive instructional modifications or supports (regardless of placement in the general education setting or in a more restrictive setting) would benefit from the protections and services provided under IDEA.

To qualify under Section 504, students must (a) have a physical or mental impairment that substantially limits a major life activity (e.g., learning, walking, seeing, hearing), (b) have a record of an impairment, or (c) be regarded as having an impairment. Some students with disabilities who would not qualify under one of IDEA's 13 disability categories may qualify under Section 504's broad definition of disability. Section 504 protections can be important for students with communicable diseases, chronic health conditions, and students with ADHD who would not or choose not to qualify under IDEA but are in need of instructional supports. Unlike IDEA, schools do not receive funding for Section 504 services, but schools are under the same federal obligation

to comply with the law. As such, some schools are hesitant about offering such services or making Section 504 information widely available to parents. Yet, Section 504 protections must be in place and available for interested parents, teachers, and student advocates.

The Americans with Disabilities Act reflects similar language (e.g., definition of disability) and objectives as Section 504 but applies to a broader spectrum of organizations—public transportation, employment, and state and local government. Basic provisions under ADA require organizations to provide “reasonable accommodations,” physical access (e.g., ramps for individuals who use wheelchairs), and freedom from discrimination based upon disability status. Both ADA and Section 504 are administered by the Office of Civil Rights and are considered identical for the purposes of compliance monitoring.

RESPONSE TO INTERVENTION IN SPECIAL EDUCATION

In the context of increased accountability, greater emphasis on the use of scientifically based practices, and a focus on high standards for students with disabilities, the landscape of special education has become simultaneously more uncertain and more articulated. One example of this contradictory position occurred in the introduction of the concept of responsiveness to intervention (RTI). With the passage of the 2004 amendments to IDEA, RTI was established as an alternative to the use of ability-achievement discrepancy as a means for identifying learning disabilities. The law also positioned RTI practices as a tool for ensuring the systematic delivery of research-based interventions to all students not making appropriate gains in the general curriculum. Many heralded the inclusion of RTI in the 2004 statute, yet questions remained regarding issues of implementation and scale (Hallahan & Cohen, *in press*; Fletcher, Lyon, Fuchs, & Barnes, 2007). Specifically, some in special education have questioned whether the distinction between specialized services and general education practices would be blurred and result in less intensive supports for students with disabilities, while others felt that the move would result in even clearer articulation of levels of instruction and the identification of specific interventions for students with disabilities.

In 2005 the National Joint Committee on Learning Disabilities (NJCLD), consisting of representation from the major professional organizations devoted to learning disabilities, issued a report on RTI in which it identified potential strengths and highlighted areas of future research. In underscoring the potential of RTI methodologies, the NJCLD noted the promise of early and/or preventative remediation, the application of high-quality interventions, and the ability to yield a “true population”

of students with learning disabilities. The underlying assumption of RTI is that the application of effective instructional methodologies will result in the majority of students making satisfactory gains while other students will fail to respond to the instruction. These students who continue to struggle while receiving high-quality instruction are students with learning disabilities. Therefore, these students require the more intensive, specialized instruction provided under IDEA.

One example of an RTI model is as follows:

Implementation of Tier 1 (high-quality general education instruction) with universal screening to identify at-risk students and the use of regular progress monitoring.

The provision of Tier 2 interventions (typically 8–12 weeks in duration) provided within the general education classroom for the identified at-risk students.

Continual progress monitoring is provided in order to determine responsiveness to the intervention.

Finally, students failing to respond to Tier 2 are referred for eligibility for special education in Tier 3, which consists of more individualized, intensive tertiary interventions, thus defining Tier 3 interventions as special education.

RESPONSE TO INSTRUCTION IN SPECIAL EDUCATION

Instructional practices for students with disabilities take into consideration (a) the unique characteristics of the learner, (b) the nature of the content or skill to be taught, and (c) the intersection of those characteristics and content. Given the fundamental role both learner and content play in the development of special education practices, special educators need to be well-versed in both the characteristics of the students they serve and the nature of the content to be taught. Some characteristics may be unique to a category of disability identified under IDEA, such as social impairments associated with autism, or the characteristics may cut across a range of categories, such as difficulty with memory and information processing associated with students with learning disabilities and students with mental retardation.

Fundamental to the practice of designing specialized instruction is task-analysis—breaking down the content of instruction to all the requisite skills and constructs. Identification of requisite skills and constructs allows teachers to select appropriate strategies, scaffolds/supports, and accommodations or modifications to meet the unique needs of the individual student. Three common elements to the implementation of effective special education instruction are: (a) explicit, systematic instruction, (b) continual progress monitoring, and (c) behavioral analysis and supports.

As stated previously, the hallmark of special education instruction is the delivery of intensive, relentless instruction with frequent opportunities for student response. Research on effective practices in special education has demonstrated the power of explicit instructional practices such as direct instruction fast-paced, well-sequenced, highly focused instruction with high student responses rates and strategy instruction that focus on organization, elaboration, or generative thinking for students with disabilities (Gersten, Schiller, & Vaughn, 2000). Key features of explicit instruction include careful sequencing and organization, enhancing student motivation through early and frequent success, and scaffolding (decreasing levels of support to foster mastery). Specific instructional strategies that reflect these principles and have been demonstrated as effective for students with disabilities include: structured peer-tutoring (Fuchs, & Fuchs, 1998), direct instruction (Adams & Engleman, 1996), mnemonic instruction (Mastropieri, Sweda, & Scruggs, 2000), and learning strategies (NICHY, 1997).

Progress monitoring was first introduced in the field of special education in the 1970s as data-based program monitoring and later as curriculum-based measurement (Deno, 2003). The underlying concept was that teachers would use repeated measures of student performance in order to determine the effectiveness of instruction and then make needed changes to their teaching if students were not responding. Incarnations of curriculum-based measurement/progress monitoring as of 2008 involve tracking student performance over time and instructional decision-making using predetermined targets or benchmarks. Decades after its inception the fundamental constructs of progress monitoring and instructional decision-making based upon data have become paramount in the field of special education. Further, what began as a special education practice came in time to influence the conceptualization of effective instruction for all students.

Another component of effective special education is the application of behavioral analysis for the purpose of determining appropriate supports, frequently referred to in special education as *positive behavioral supports*. Meta-analyses, statistical procedures that measure the overall efficacy of a strategy or approach, have demonstrated the power of positive behavioral supports to reduce undesirable behaviors and increase pro-social or desired behaviors (Gersten, Schiller, & Vaughn, 2000). The development of positive behavioral supports begins with an analysis of environment and student behavior. The environment includes all elements associated with the delivery of instruction (e.g., instructional methods or strategies used, materials selected, physical design), and student behavior includes communication, social interactions, and maladaptive responses. Special educators or IEP teams collect data on the behavior(s) of concern in an attempt to

determine the function or purpose of the behavior. Analysis of the data leads to the development of a hypothesis of the function of the behavior. The educator or team then identifies teaching procedures intended to (a) reduce the undesirable behavior and (b) teach a more acceptable or adaptive behavior. Data continue to be collected in order to determine the efficacy of the supports and instruction selected.

In summary, the basic principles that served as the foundation of special education remain a vibrant part of the instruction of students with disabilities today. Research in the field of special education has served to refine and improve specific practices such as progress monitoring, the delivery of instruction, cognitive strategy instruction, functional behavioral analysis and positive behavioral supports, and the identification of a range of disabilities. Legislation in the early 2000s and to come will continue to influence and shape the context of the education of students with disabilities, but fundamental principles of individualization, remediation, and measured-growth will remain an essential part of what special educators do.

SEE ALSO *Attention Deficit Hyperactivity Disorder (ADHD); Deaf and Hard of Hearing; Gifted Education; Individualized Education Program (IEP); Learning Disabilities; Mental Retardation; Speech and Language Impairments; Visual Impairments.*

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SPEECH AND LANGUAGE IMPAIRMENTS

According to the U.S. Department of Education, in 2006 there were 1,486,960 children with diagnoses of speech and language impairments in U.S. public schools. Even greater numbers of children had speech and language

impairments associated with other diagnoses such as learning disabilities, autism spectrum disorders, or hearing impairment. The school-based speech and language pathologist (SLP) works to promote the functional skills of children affected by speech and language impairments and “to provide support in the general educational environment for students with communication handicaps to facilitate their successful participation, socialization, and learning” (American Speech-Language-Hearing Association, ASHA, 2000, p. 11). The impact of the impairment on the child’s educational functioning is the paramount consideration.

DEFINITIONS

Speech and language impairments may be classified by *symptomology*, the particular aspects of speech or language that are affected; *specificity*, whether or not the impairment is part of a broader deficit; and *etiology*, whether the impairment is developmental or acquired. In the following sections, these classifications are defined.

Speech. Children affected by speech impairment most often have deficits in producing the sounds of the language as compared to their same-age peers. They may leave out sounds (e.g., tar for star) or substitute one sound for another (e.g., cawot for carrot). In some cases the child does not understand the rules that govern the production and combination of speech sounds, which is commonly referred to as phonological impairment. In other cases, the root of the problem is motoric, which is commonly referred to as articulation impairment. Often, because the roots are not completely understood, the terms are used interchangeably. Articulation/phonological impairment is the single most frequent diagnostic category represented on the caseload of the school SLP (ASHA, 2006).

Speech impairments broadly defined also include abnormal voice, nasal resonance, and fluency (ASHA, 1993). Children with voice problems present with deviations in pitch, quality, or loudness of their speech as compared to other children of their same sex and age. Nasal resonance problems involve either hypo- or hypernasality. The former results when a blockage (e.g., swollen adenoids) prevents air from resonating within the nasal cavity during speech. The latter results when the soft palate does not make adequate closure with the pharyngeal wall during production of the oral sounds of the language. The speech of children who stutter is characterized by disruptions in rate and rhythm as well as repetitions of sounds, syllables, words or phrases. Affected children may struggle or tense when they stutter.

Language. Children affected by language impairments have deficits in understanding or expressing words, sentences, or extended discourse in either spoken or written modalities. This deficit may involve problems with semantics, the meaning of language (e.g., understanding the meaningful relationship between the words *animal*, *cat*, and *Tabby*); morphology and syntax, the grammar of language (e.g., inflecting verbs with *ed* to indicate past tense); or pragmatics, the social use of language (e.g., judging the right amount of information to convey to a listener). Childhood language impairments may be referred to as language delays or language disorders. The term *delay* implies slow but typical development whereas *disorder* implies atypical development.

Primary or Secondary Impairment. Developmental speech and language impairments may be primary or secondary diagnoses. Children with primary impairments are otherwise normally developing. The cause of the impairment is usually unknown though central nervous dysfunction is presumed (ASHA, 1997) and, according to Bruce Tomblin and colleagues (1997), such impairments run in families. Children with primary language impairments affecting the oral modality are often said to have specific language impairment; those with primary impairments affecting the written modality are often said to have language learning disabilities, but either diagnostic category can encompass impairments in both modalities. Other children have speech and language impairments that are secondary to another deficit. For example, children with attention deficit hyperactivity disorder may have difficulty planning and organizing discourse as well as problems using language in a pragmatically appropriate manner, whereas children with cerebral palsy may have difficulty pronouncing speech sounds.

Developmental or Acquired Impairment. Most speech and language impairments exhibited by school children are developmental, that is, roots of the problem exist from birth and manifestations of the problem emerge as the child develops and it becomes obvious that the child is slower or atypical compared to peers. In a minority of cases, speech and language impairments are acquired when a child suffers an illness or accident that affects brain function. In these cases, the impairment may be referred to as aphasia. Rhea Paul (2001) summarizes these aphasias as follows. In cases of stroke and traumatic brain injury, children tend to be initially mute but have generally good recovery over time. A stroke, especially one that results in focal damage to the left hemisphere, typically results in long-term but subtle deficits in verbal memory, grammatical complexity, word finding, and reading. Traumatic brain injuries, such as those sustained from falls or car accidents, may result in long-term problems with word

finding, discourse, and pragmatics. Speech motor control may also be compromised. A seizure disorder known as Landau-Kleffner syndrome has its onset in childhood and usually results in permanent impairments in the comprehension and expression of language.

DIAGNOSIS AND ASSESSMENT OF SPEECH AND LANGUAGE IMPAIRMENTS

In school settings, diagnosis and assessment are typically accomplished by teams of professionals who collaborate to make decisions regarding a given child's strengths and weaknesses. When speech and language development is a potential area of weakness, the SLP will be part of that team. The diagnosis of speech and language impairments is, in general, a two-pronged process. First, the child is referred for diagnostic testing, usually because a family member or teacher is concerned about his or her ability to function successfully in situations that demand verbal performance. Such situations include expressing basic needs, making friends, communicating in the classroom, taking tests, and learning to read and write. The SLP explores these concerns as well as the child's developmental and educational history via parent and teacher interviews.

Second, via standardized norm-referenced testing, observations in natural settings, and descriptive criterion-referenced assessments (e.g., review of classroom work portfolios, probes of response to intervention) the SLP determines whether the child is functioning more poorly than peers of the same chronological age in one or more domains (e.g., speech, semantics, morpho-syntax, pragmatics) and whether the child is apt to improve functioning in response to various supports. There is no universally agreed upon cut-off score on standardized tests for identifying speech and language impairments. Instead, the decision varies with the extent of the real-life impact, the number of domains affected, and the resources available for intervening on the child's behalf. State codes may establish eligibility criteria as well as recommended amounts of service and service delivery options in school settings (ASHA, 2000).

In cases of secondary impairments, speech and language problems may be one symptom leading to the diagnosis of the primary impairment. For example, late talking may be the first sign that a child is affected by a hearing impairment. In other cases, the primary impairment is diagnosed first and speech and language is monitored because the child is known to be at risk. This situation is illustrated in Down syndrome, an impairment typically diagnosed *in utero*. Children with Down syndrome are known to have particular difficulties with speech-motor control and expressive language development; therefore, they are frequently placed in speech and

language intervention programs as babies. In cases in which speech and language problems are secondary to a deficit that involves mental retardation, the extent of the speech and language problem may be determined relative to mental-age peers (i.e., younger normally developing children) rather than chronological-age peers. In cases of acquired language impairments, the child may also be compared to his or her own previous level of functioning, if that is known.

CHARACTERISTICS OF SPEECH AND LANGUAGE IMPAIRMENTS BY DIAGNOSTIC CATEGORY

Implicit in the above definitions is the enormous variability between children with speech and language impairments. One child may have a very mild deficit affecting only a few speech sounds whereas another may have a very severe deficit that prevents oral language altogether. In between are numerous other profiles, some of which are predictable if the roots of the impairment are known. For example, Laurence Leonard (1998) notes that children with specific language impairment are typically late to acquire first words. Their acquisition of grammar lags even further behind (in English this is often manifested as omission of inflections on verbs across an extended developmental period). Abbeduto and Hagerman (1997) note that children with fragile X syndrome, especially boys, often present with variability in rate of speech, delays in the development of words and word inflections, and perseverations of words during discourse. Finally, Krista Wilkinson (1998) notes that children with autism spectrum disorders have difficulty establishing and maintaining joint attention with communicative partners. Their speech may sound monotonous and the information that they convey via speech may strike the listener as odd or tangential. Although researchers can make generalizations like these for almost any diagnostic category, the value of the exercise is questionable. Two children who share a diagnosis may be less similar than two children with different diagnoses. Moreover, knowing the child's diagnostic category is of limited help in designing an intervention. Instead, the SLP typically meets with more success by selecting goals and strategies based on what is known about the child rather than the diagnosis.

CURRENT INTERVENTIONS AND INSTRUCTIONAL PROCEDURES

In school settings, interventions for children with speech and language impairments are specified by an Individual Family Service Plan (IFSP) for children younger than three or an Individual Educational Program (IEP) for children who are three or more years of age. These plans are mandated by the Individuals with Disabilities Educa-

tion Act of 1997 (IDEA). In the case of a child with or at risk for speech and language impairments, either plan will specify goals for speech and language development and the services and program accommodations necessary to reach those goals. Typically the SLP will set both long-term and short-term goals. If, for example, a long-term goal for the child is to master new grammatical forms, a more intermediate goal might be to learn to use helping verbs and the short-term targets of focus might be *will*, *can*, and *does*.

According to Rebecca McCauley and Marc Fey (2006), to approach these goals, the SLP must determine the context for the intervention (e.g., classroom-based, pull-out group, pull-out individual, self-contained classroom), the intervention agent (e.g., SLP, teacher, peer, parent), and the dosage (e.g., minutes per week). These decisions are made with consideration of the needs of the child, the wishes of the parents, and state codes. The SLP then determines the activities and strategies that will work best for a given child. Activities may include picture naming drills, joint book reading, dramatic play, computerized language comprehension exercises, and writing assignments, to name a few. During those activities, the SLP employs strategies that may include asking the child to listen to or imitate models of correct target productions, to correct mistakes when given feedback, or to respond when given scaffolds such as cues and simplifications of the task. The SLP chooses materials that will provide focused stimulation, that is, those which will allow many opportunities for the child to experience and to practice the target. The SLP may recast, revise, or expand the child's spontaneous utterances as a way to further model targets. When the SLP is not the primary agent of intervention, she serves as a collaborative consultant to teachers, parents, or peers by explaining the goals, activities, and strategies to be used with the child. An additional important component of intervention is on-going reassessment to ensure that the child is making progress; if not, program modification is necessary.

Best practice requires that decisions made about the intervention program are guided by the expertise of the SLP in light of the needs and values of the child and family and the research evidence that demonstrates the utility of various program options. Learning about the child and family is an on-going process that begins with the case-history interviews and observations, continues during the IFSP or IEP process, and grows as the SLP manages the child's intervention. SLPs who adhere to evidence-based practice seek independent confirmation and converging evidence for clinical decisions from the research literature. They evaluate research evidence to ensure that it is characterized by adequate experimental control and that it is free from bias. They determine whether the effects of any reported clinical procedure

are sizeable, relevant to the child in question, and feasible in the school setting (ASHA, 2004).

ISSUES RELATED TO ASSESSMENT AND INTERVENTION

As in any profession, the state-of-the-art in speech and language pathology is dynamic. A number of issues have prompted important changes in service delivery to children with speech and language impairments. Three issues are highlighted below.

Inclusion. The IDEA amendments of 1997 encouraged the participation of children with special needs in the general education curriculum. As a result, children with speech and language impairments are now often assessed and treated, at least in part, within the regular classroom. According to Rhea Paul (2001) and Carol Westby (2006), during curriculum-based assessment, the SLP analyzes the spoken or written features of the student's school work (homework, tests, projects), observes the child's successes and failures during school activities, and tests the utility of various scaffolds for the child's verbal performance during such activities. Curriculum-based intervention requires the SLP to move away from contrived exercises outside the classroom and towards consultant or collaborative roles within the classroom. As consultants to classroom teachers, SLPs suggest modified verbal instructions that enhance comprehension and verbal responding in the moment as well as strategies, materials, and activities that promote improvements in speech and language development over time. As collaborators, SLPs plan and implement lessons along with teachers. In either role, the SLP is concerned with supporting the child's communication in the classroom as well as his or her performance on language-related academic tasks whether they are taking a spelling test or comprehending a social studies text. Curriculum-based practice in schools is highly compatible with a broader emphasis in the field of speech pathology on intervening via purposeful and functional activities in naturalistic settings.

Diversity. According to a 1994 report from the U.S. General Accounting Office, bilingual students learning English as a second language were common in nearly every state. SLPs recognize that differences between communities in dialect or language are to be cherished, not pathologized or stigmatized (ASHA, 1983). Therefore, one of the key roles played by the SLP in increasingly diverse school settings is to help assessment teams distinguish speech and language patterns that reflect the learning of English as a second language from those indicative of true impairments. To make this distinction effectively, IDEA mandates that the child's native language development be assessed. Such assessment is complicated by a

lack of professionals who are familiar with more than a mere handful of the 311 languages reported by the National Virtual Translation Center to be spoken in the United States as well as a lack of standardized tests that are normed for students who are bilingual. The limited availability of appropriate standardized tests represents yet another impetus in the movement towards curriculum-based assessments in naturalistic classroom settings. In cases in which true impairments have been discerned in the bilingual child, intervention is also complicated. For example, as noted by Celeste Roseberry-McKibben (2007), cultural and linguistic differences between the parents and the SLP may impede effective involvement of the family in the intervention. Such challenges may increase as the diversity of the U.S. population continues to grow; however, that growth will surely motivate useful changes in the design of tests and the education of SLPs and other professionals.

Evidence-based Practice. SLPs have long been aware that collecting data from individual children is important for planning interventions and monitoring their success. They have known that keeping current with research in the field is important. What changed with the advent of the evidence-based practice movement in the early 2000s was the emphasis on finding high levels of evidence, evaluating the quality of that evidence, and applying that evidence in decision making for individual children. Various guidelines exist for determining levels of evidence and evaluating quality (ASHA 2004). The SLP can also make use of published systematic reviews and meta-analyses and searchable online databases that summarize findings over multiple studies and include quality appraisals for each. Evidence-based practice is the joint responsibility of clinicians and scientists. As school-based SLPs retool to master evidence-based decision making; scientists must continue to fill gaps in the quantity and quality of available evidence. These joint efforts stand to further enhance the assessment and intervention services provided to school children with speech and language impairments.

SEE ALSO *First (Primary) Language Acquisition; Second Language Acquisition; Special Education.*

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STANDARDIZED TESTING

Standardized testing involves using testing instruments that are administered and scored in a pre-established standard or consistent manner. There are two types of standardized testing instruments: *norm-referenced tests* and *criterion-referenced tests* (IRA/NCTE Joint Task Force on Assessment, 1994). The former testing instruments yield scores that compare the examinee's scores to that of a representative sample (the normative group) of same-age or grade peers. The latter type of testing instrument involves comparing an examinee's score to a pre-determined criterion (such as a school curriculum).

Norm-referenced Tests. Academic achievement tests and cognitive tests, commonly referred to as IQ tests, are well known examples of norm-referenced, standardized tests given to individuals. Most norm-referenced test batteries include a manual and/or computerized scoring program that (1) provides information regarding the normative, or standardization, sample; (2) provides information on reliability and validity, (3) provides language and presentation of items administration and scoring information, and (4) provides guidelines for the interpretation of the test results. Norm-referenced test performance is generally summarized as one or more types of scores such as age-equivalence, grade-equivalence, percentile rankings, stanine, scaled scores, indexes, clusters, or quotients (Mercer, 1997). Newer editions of test instruments follow an item-response-theory procedure in their development which can allow for a new type of scores. These scores (called W-, Growth, Change-Sensitive, Growth-Score-Value) allow an examinee's performance to be measured against themselves by establishing the difficulty level of the items.

Criterion-referenced Tests. Criterion-referenced tests are similar to norm-referenced tests in terms of administration, scoring, and format; however, they differ in terms of interpretation. Criterion-referenced test interpretation involves evaluating an examinee's performance in relation to a specific criterion. For instance, if a criterion were "the ability to subtract single digit numbers," the interpretation would involve indicating simply whether or not the student answered the administered subtraction problem items correctly. A norm-referenced test interpretation, however, would involve whether this student

correctly answered more questions compared to others in the normative group. Generally, criterion-referenced performance is summarized as percentage correct or represented as a grade-equivalent score (Weaver, 1990; Witt, Elliot, Daly, Gresham, & Kramer, 1998).

Criterion-referenced tests are sometimes misunderstood. Although these types of test can involve the use of a cutoff score (e.g., the point at which the examinee passes if the score exceeds this number), the cutoff score is not the criterion. Rather, the criterion refers to the content area domain that the test is intended to assess (Witt et al., 1998).

QUALITY OF STANDARDIZED TESTING INSTRUMENTS

The quality, or adequacy, of any standardized testing instrument, whether norm-referenced or criterion-referenced, is directly empirically supported by both reliability and validity studies. Professional testing associations or organizations often publish standards that practitioners can refer to when evaluating the quality of a testing instrument. For instance, in the field of psychometrics, there is a set of standards titled, "Standards for Educational and Psychological Testing" which psychologists and other related practitioners can refer to when interested in the standards of test development or construction, fairness in testing, and testing applications. Additionally, practitioners can learn about the psychometric properties (e.g., reliability, validity) of tests by consulting sources such as *Mental Measurements Yearbooks* and *Tests in Print*, both available from the Buros Institute of Mental Measurements and housed within most major libraries (Mercer, 1997) or *Test Critiques*, available from Pro-Ed Publishers.

ADVANTAGES OF STANDARDIZED TESTING

Using standardized tests to conduct assessments is advantageous for several reasons. First, because standardized tests yield quantifiable information (scores, proficiency levels, and so forth), results can be used in screening programs (e.g., identifying those students in need of further assessment). Second, standardized test results provide information regarding an examinee's areas of strength and weakness. Third, standardized test results allow a student to be compared to age- or grade-peers. Finally, standardized tests can be used to assess students' progress over time (e.g., readministering tests after the application of an intervention or following the institution of a remedial program) (IRA/NCTE Joint Task Force on Assessment, 1997; Witt et al., 1998). The most important advantage of results from a test administered in a standardized fashion is that the results can be documented and empirically veri-

fied. This then allows for the results to be interpreted and ideas about an individual's skills generalized.

DISADVANTAGES OF STANDARDIZED TESTING

Although standardized testing is beneficial in some situations, its use has been criticized, specifically because such measures fail to inform instruction adequately. Standardized administrations may not be possible for some students with disabilities. Some disabled students can take some test in the established standardized way with some accommodations. Some accommodations, however, can become modifications to the trait or concept attempting to be measured. Some other common criticisms or disadvantages of standardized tests are as follows: (1) standardized test items frequently are unrelated to those tasks and behaviors required in the classroom setting, (2) standardized test results reflect behavior or ability that has been measured during a single point in time and, as such, are greatly influenced by noncognitive factors (e.g., fatigue, attention, and so forth); (3) standardized test results do not provide the type of information required for making curricular modifications or instructional change, and (4) standardized administration procedures often prevent the examiner from obtaining useful information regarding the conditions under which the examinee may be able to improve performance (e.g., could a student with a language deficit benefit from clarification of test directions?) (Fuchs & Fuchs, 1986; Haywood & Tzuriel, 1992; Quinto & McKenna, 1977; Tzuriel, 2001; Tzuriel & Samuels, 2000).

ALTERNATIVES TO STANDARDIZED TESTING

Partly due to the criticisms of standardized testing and the need to generate information that can more directly guide instruction, alternatives to standardized testing have arisen. While there are various alternatives, three of the most commonly used alternatives are curriculum-based assessment, dynamic assessment, and alternative, or portfolio-based, assessment approaches.

Curriculum-Based Assessment. Although *curriculum-based assessment* (CBA) falls under the umbrella of criterion-referenced testing, it is thought of as an alternative to traditional, standardized norm-referenced academic testing. Curriculum-based assessment refers to a measurement method that relies on "direct observation and recording of a student's performance in the local curriculum as a basis for gathering information to make instructional decisions" (Deno, 1987, p. 41). CBA has also been referred to as *direct assessment* of the mastery of academic skills, and although models of CBA may differ,

all share the common foundational assumption that one should assess what is taught, or more simply, “test what one teaches.” Typically, CBA approaches involve repeated assessment of specific academic skills (Lentz, 1988). In each academic area, *probes* are developed (e.g., short reading passages, samples of math computation items, and brief spelling word lists, and so forth) and used to collect student performance data. The curricular materials from the examinee’s immediate learning environment are used to develop CBA probes. Given this, CBA provides a structured method for evaluating students’ performances on curricular assignments used in their actual academic setting.

Generally, a student’s responses are evaluated in terms of speed or proficiency, as well as for accuracy. Performance criteria are then developed to determine acceptable levels of student performance or mastery (Witt et al., 1998). Normative sampling is one procedure employed for establishing mastery criteria (Idol, 1993). This procedure involves collecting samples of average or acceptable student performance in the general education setting and using such samples to decide what the absolute mastery criteria should be. In some cases, a referred student may be so far below the levels of acceptable performance that a type of changing criterion design might have to be implemented. This type of design, which would allow the mastery criteria to reflect the classroom average, would permit a lowering of the criteria for subsequent instruction, and then allow the criteria to be made more stringent until the student reached the changed classroom average.

Overall, the basic assumption of a CBA approach is that in evaluating students’ progress in reading and writing, researchers should observe them reading and writing in their academic environment, and should collect such data often so that they can efficiently ascertain whether a student is progressing adequately or falling behind. The ability to generalize from the results of CBA tests is limited.

Dynamic Assessment. *Dynamic assessment* refers to a particular type of learning assessment that involves the use of an active teaching process (Lidz, 1987). The goal of this teaching process is to “modify” an individual’s cognitive functioning and to observe subsequent changes in the examinee’s learning and use of problem-solving strategies. The primary goals of dynamic assessment are to (1) assess a student’s ability to understand principles underlying a problem and to use that understanding to generate a solution, (2) assess the type and amount of teaching necessary to teach a student a specific rule or principle, and (3) identify any cognitive deficits and non-cognitive factors that assist in explaining performance failures and to determine whether such factors can be modified by teaching alone (Lidz, 1987).

Dynamic assessment directly contrasts with static assessment procedures (i.e., standardized assessment), which involve examiners presenting items to examinees without any guidance, assistance, or any other intervention designed to change or improve the examinee’s performance. A static test is usually based on a “question, record, and score” format wherein the examiner presents the question, records the examinee’s response, and awards a prescribed number of points, based on the examinee’s given response.

The difference between static and dynamic assessment approaches stems from the paradigms from which they emerged. Static assessment generally involves “passive acceptance,” wherein a child’s deficits or disabilities are accepted and the environment is modified to help the child work within any identified limitations (Haywood, 1997). In contrast, dynamic assessment is based on “active modification,” wherein a concentrated effort is made to remediate any identified deficit or at least provide the child with compensatory strategies to circumvent the impact of any identified weakness (Haywood & Tzuriel, 1992).

The inherent limitations or inadequacy of standardized tests has motivated, in part, the development of dynamic assessment approaches. Static assessments have been criticized widely. Major criticisms involve the fact that (1) static tests do not provide important information about a child’s learning processes or mediational strategies that can facilitate learning, (2) they do not result in clear recommendations for prescriptive teaching or remedial activities, and (3) they do not focus on noncognitive factors that influence an examinee’s performance on standardized, cognitive assessments. Compared to static assessment, dynamic assessment is intended to provide information about (1) examinees’ overall learning ability and information regarding how they learn, (2) specific cognitive factors that can assist in problem solving and can help the examiner understand potential factors related to academic successes and failures, (3) teaching strategies that seem to work for a given examinee, and (4) non-cognitive factors that exert beneficial or negative influences on cognitive performance (e.g., heightened anxiety can impact performance on tests of perceptual speed).

The zone of proximal development (ZPD) developed by Lev Vygotsky (1896–1934) and Reuben Feuerstein’s theory of mediated learning experience (MLE) served as the primary foundations for most of the dynamic assessment approaches (Feuerstein, Rand, & Hoffman, 1979; Tzuriel, 1999). It is important to note that dynamic assessment is intended to supplement, not replace, standardized testing. It is a broad assessment approach, rather than a particular test. Some standardized test batteries have features of dynamic assessment (e.g., KABC-II contains

teaching items that can be used with examinees before the administration of sample items).

Disadvantages of dynamic assessment include: (1) the time and skill required to implement a dynamic assessment approach, (2) the extent to which cognitive modifiability can occur across all cognitive domains is largely unknown, and (3) the validation of DA is far more complex than validating static assessment approaches because dynamic assessment has broad goals (e.g., assess initial performance, assess cognitive functions, identify any deficit functions, determine the nature and amount of remediation needed to address the deficit, identify noncognitive factors and the role they play in cognitive performance, and identify the parameters or goals for future change). By allowing the examiner to administer a test instrument in a non-standardized way, the ability to replicate the test results is more limited due to the potentially inconsistent nature of test administration. Overall, to validate dynamic assessment approaches, one needs to develop criteria variables that measure changes that are directly relatable to any applied cognitive intervention.

Alternative, or Portfolio-Based Assessment. Another type of assessment is *alternative assessment*, or *portfolio-based assessment*. This type of assessment is often longitudinal and very idiosyncratic in nature, as teachers, students, and even parents at times, select pieces from a student's work over several years (four years, on average) to demonstrate what learning progress has occurred over the years. Alternative assessments encourage all relevant individuals (teachers, students, parents) to become active participants in the documentation of the learning process (Quinto & McKenna, 1977). Although the terms portfolio-assessment and performance assessment sound similar, the latter involves looking at actual student work produced over time and the processes by which the students produced such work, be it individually or collaboratively. In contrast, the former involves focusing on the products and processes of learning as well as other factors, such as the students' interest in learning, their concept of themselves as readers and/or writers, and their ability to evaluate their own work and set learning goals for themselves. Examples of portfolio- or performance-based assessment include such things as tape-recorded samples of students' oral reading, results of reading interviews focused on identifying students' understanding of the reading process (e.g., strategies they used to decode problem words or comprehend text), records of students' reading lists to gain information regarding reading interests, and so forth.

Overall, alternative assessment is derived from student's daily classroom work. Minimally, it involves collecting student work samples, recording observations of learning processes, and student and/or teacher evaluation

of students' processes and products. While such information can be summarized quantitatively for grading purposes, the primary goal of such assessment is to improve both teaching methods and students' learning.

Other Forms of Assessment and Testing. While static assessment approaches such as norm-referenced testing and criterion-referenced testing, curriculum-based assessment, and dynamic assessment approaches are used to varying extents in academic settings, other assessment techniques are also used, including interviews, anecdotal records, rating scales, classroom quizzes and tests, observation, and self-report techniques (Mercer, 1997; National Commission on Testing and Public Policy, 1990).

Each form of testing gathers information regarding a student or group of students and allows for a different type of interpretation and usage of data applied. Like the sides of a cut diamond, each shines in areas in which it is strong but is only a limited facet of the whole.

SEE ALSO *Norm-Referenced Testing*.

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STANDARDS FOR EDUCATIONAL AND PSYCHOLOGICAL TESTING

The appropriate development and use of assessments are essential requirements for responsible professional practice in educational testing and measurement. The American Educational Research Association (AERA), the American Psychological Association (APA), and the National Council on Measurement in Education (NCME) have collaborated on the development of Standards for Educational and Psychological Testing (hereafter referred to as the Standards) since 1966. There have been four revisions to these joint standards since they were first issued as separate technical recommendations for achievement tests and psychological tests by AERA and NCME in 1955, and APA in 1954. A subsequent edition of the Standards was published in 1999, and another revision was scheduled to begin in 2008.

When the Standards were developed the test user was assumed to be a trained professional who generally had some graduate training and supervised experience in assessment. These *primary test users* would include test developers, testing contractors, state and district assessment directors, and school counselors who develop or use tests for decision making purposes (Camara, 1997).

In the early 2000s, the term *test user* encompasses a much broader group of *secondary test users*, including individuals with little or no training in measurement

and assessment such as teachers, parents, policymakers, and the media (Camara, 1997). Policymakers and educational administrators may have great influence over the use of assessment results and may misuse assessments in the 21st-century accountability environment (Berliner & Biddle, 1995). The further the test users are from the assessment, the less familiar they may be with the intended use of the assessment, evidence supporting the validity of inferences concerning the use of assessment results, and test content and characteristics of the test-taking population, which increases the likelihood of test misuse (Camara and Lane, 2006).

PURPOSE AND USE OF THE STANDARDS

The Standards have continued to emphasize that their primary purpose is to provide criteria for evaluating tests and testing practices and to encourage test developers, sponsors, publishers, and users to adopt the Standards, but there is no requirement on members of the professional associations or testing organizations and users to do so. They also note that the Standards do not attempt to provide psychometric answers to policy or legal questions. In 1999 the Standards abandoned the former designations of each standard as primary (required for all tests before operational use), secondary (desirable, but not required), or conditional (applicable in some instances and settings) (AERA et al., 1999). This change met with some criticism and controversy because it appeared to remove any absolute criteria or requirements for testing and test use and relied more on professional judgment in adherence to each standard.

The Standards also apply broadly to a wide range of standardized instruments and procedures which sample an individual's behavior that can include tests, assessments, inventories, and scales, for example. The main exceptions in applying the Standards are for unstandardized questionnaires (e.g., unstructured behavioral checklists or observational forms), teacher-made tests, and subjective decision processes (e.g., teacher evaluating classroom participation over the semester). The Standards apply equally to standardized multiple-choice tests as they do to performance assessments (including tests comprised only of open-ended essays) and hands-on assessments or simulations.

There is no mechanism to enforce compliance to the Standards on the part of the test developer or test user. As of 2008, many tests are sold and marketed that do not provide documentation required concerning their appropriate use, validation evidence to support such uses, and basic technical documentation such as the reliability of the score scale or a description of the normative or standard setting samples used for score reporting. Some

publishers have ignored requests for technical manuals or validation studies, citing the proprietary nature of their clients, while some test users have used tests for unintended and multiple purposes with no concern for collecting additional evidence to support such uses. Requests for proposals from states and local educational departments nearly always refer to the Standards and frequently include a broad statement to the effect that vendors responding to the RFP must comply with the Standards; yet few states have conducted detailed audits of their assessment programs in direct reference to all the applicable standards.

Wise (2006) describes how technical advisory committees (TACs) and the peer review process used by the U.S. Department of Education for assessment systems under No Child Left Behind (NCLB) are efforts to improve the quality of testing but do not base reviews on all relevant components of the Standards. Madaus, Lynch, and Lynch (2001) and Kortz (2006) have described the need for some independent mechanisms to interpret, encourage compliance with, or even enforce the Standards. However, the Standards have been referred to in law and cited in Supreme Court and other judicial decisions, lending additional authority to the document. For example, they have been cited in Goals 2000: Educate America Act¹ and Title I (Elementary and Secondary Education Act)². They were also cited in several major court decisions involving employment testing, including a Supreme Court case in 1988³.

ADDITIONAL STANDARDS AND GUIDELINES IN TESTING

The APA adopted the first formal ethics code for any profession using assessments in 1952. Eighteen of approximately 100 principles in that Code (APA, 1953) addressed issues such as qualifications of test users, security of testing materials, documentation required in test manuals, and responsibilities of test publishers and test users. Ethical standards for assessment are one of nine areas addressed by the current code (APA, 2002). Many other professional associations with members involved in assessment similarly adopted ethical standards and professional codes between the mid-1980s and 2005. Increased public awareness of ethical issues, the variety of proposed and actual use of assessments, and the increased visibility and importance placed on assessments for accountability have resulted in greater attention to ethical and professional responsibilities by many professional associations (Eyde & Quaintance, 1988; Schmeiser, 1992).

In the early 1990s the American Counseling Association (ACA) and AERA each approved ethical standards that cover a broad range of standards for behavior in counseling and educational research but make only passing reference to assessment. Ethical standards of ACA

(1998), APA, and the National Association of School Psychologists (NASP, 1997; 2000) are unique in that these associations support formal enforcement mechanisms that can result in suspension and expulsion of members, respectively (Camara, 1997)⁴. Ethical standards were first adopted by AERA in 1992 and revised twice thereafter. The standards as of 2008 (AERA, 1999) are designed to guide the work of educational researchers but are not enforceable.

In contrast to laws and regulations that are designed to protect the public from specific abuses, ethical standards and codes attempt to establish a higher normative standard for a broad range of professional activities and behaviors. For example, APA's Ethics Principles state: "if this Ethics Code establishes a higher standard of conduct than is required by law, psychologists must meet the higher ethical standards" (2002, p. 1062). ACA, AERA, APA and the Society for Industrial and Organizational Psychology (SIOP) have followed up the development of ethics codes with casebooks that attempt to guide users in interpreting and applying their standards.

The increased use of tests for accountability has also increased the urgency of informing and educating secondary users of their responsibilities in the appropriate and ethical use of tests and test data. In 2000 the U.S. Department of Education's Office of Civil Rights drafted a resource *Guide on High Stakes Testing* for educators and policy makers (2000) that attempted to interpret the technical and professional testing standards and legal principles and apply them to high stakes uses in schools, but as of 2008 the guide had not been disseminated following a change of administrations. Standards for Educational Accountability Systems (CRESST, 2002), which attempt to apply professional standards to accountability systems for a broad group of educators, were developed after passage of educational reform law.

The Code of Fair Testing Practices in Education (Joint Committee on Testing Practices, 2004) attempts to condense the most salient statements concerning the responsibilities of test users and test developers from existing codes and standards in four areas: (a) development and selection of tests; (b) administration and scoring of tests; (c) reporting and interpretation of test results; and (d) informing test takers. The Code has been endorsed by most of the major test publishers and is frequently reproduced on Web pages and publications in an attempt to guide educational professionals in appropriate practice and use of assessments. Most other technical and professional standards have a much more limited distribution, primarily to members, while the Code encourages reproduction and dissemination. A similar document, *Responsibilities of Users of Standardized Tests* (Association for Assessment in Counseling, 2003),

was developed to enhance ethical standards and assist counselors in the ethical practice of testing.

TEST DEVELOPMENT

Ethical and professional issues relating to the development of assessments is a broad area that includes test construction (the technical qualities of assessments, evidence supporting the validity of inferences made from test results, and norms and scales) as well as modifications to the test, technical documentation, statements and claims made about assessments, and appropriate use of copyright materials. Technical competence in the development and selection of assessments is an ethical issue. APA's Ethics Code states that persons who develop tests "use appropriate psychometric procedures and current scientific or professional knowledge for test design, standardization, validation, reduction or elimination of bias and recommendations for use" (2002, p. 1072). Test developers are responsible for ensuring that assessment products and services meet applicable professional and technical standards and should be familiar with the Standards and other applicable requirements. They also have a responsibility for providing technical documentation on their tests, including evidence of reliability and validity that supports inferences that will be made from test scores. Technical qualities for many educational tests also include construct representation and curriculum relevance (Messick, 1989). Educators who select among *off-the-shelf* tests should ensure that the content specifications of the tests align with the curriculum and that assessment formats are relevant. The Standards reiterate the importance of construct relevance as a central requirement in the validation argument (AERA et al., 1999).

Test developers need to employ appropriate processes for item development, review, and test assembly to ensure potentially offensive (or biased) content or language is avoided and test content is relevant for the intended use. Evidence that differences in performance across major subgroups are related to the construct being measured and not due to construct irrelevant variance is also a professional responsibility of developers (Joint Committee on Testing Practices, 2004). Test development also includes obtaining appropriate permissions when copyrighted texts or art work are used for an assessment. The Standards reiterate that tests should be developed on a sound scientific basis (AERA et al., 1999).

A number of potential dilemmas may arise for test developers who produce off-the-shelf, as well as those who purchase these tests. For example, a test contract may require a developer to produce many more items in a short period of time than the organization is capable of developing while meeting acceptable quality standards. The increased assessment demands from local, state, and

federal arenas may require test developers to take actions to meet scheduling and economic constraints that can threaten the technical quality of an assessment program. Sometimes the demand of test production may outstrip the resources of a test publisher and result in errors that may have been prevented with a more reasonable schedule (Phillips and Camara, 2006).

Test users who attempt to use a test for multiple purposes must provide evidence to support the use of the test for each proposed purpose unless existing evidence has been provided by the publisher or other sources. Educators often propose using the same test for both formative and summative purposes or to provide student, teacher, and school accountability functions as well as instructional, diagnostic, and placement purposes for the student. Evidence to support each specific use should be provided according to the Standards.

Rhoades and Madaus (2003) report on several instances in which insufficient piloting and pretesting led to spurious results, and time schedules for accountability tests did not allow for all the quality control procedures needed to detect and correct errors prior to test administration. In some situations, the desire to have tests drive the curriculum may conflict with any accountability uses for test results. For example, math teachers recruited to determine test specifications for a state accountability test may insist that a new eighth grade assessment require the use of graphing calculators to send a signal to students and all teachers about the need to introduce students to this technology and to compel the state to support the purchase of graphing calculators and appropriate professional development. However, if students are required to take the test before they are proficient in the use of graphing calculators, then the assessment is measuring construct irrelevant variance. Opportunity to learn is an important component of tests designed to measure achievement. In each of these instances, the technical quality of the assessment raises professional and even ethical issues that are more serious when the stakes associated with the testing program are higher.

The development of standardized administrative procedures and appropriately modified forms of tests and administrative procedures is also a responsibility of test developers (AERA et al., 1999; Joint Committee on Testing Practices, 2004; NCME, 1995). Modifications in test forms, response format, and test setting or content for students with disabling conditions or diverse linguistic backgrounds should be clearly described so that test users can reduce potential misuse of assessments.

Finally, technical documentation is a major requirement of any testing program. The first technical recommendations and standards produced by a professional association (APA, 1954) were largely developed to

address the concern that tests were often released without adequate supporting documentation and research (Novick, 1981). NCME's Code (1995) notes that current technical information to support the reliability, validity, scoring and reporting processes, and other relevant characteristics of the assessment should be made available to the appropriate persons. The *Code of Fair Testing Practices in Education* (2004) and Standards (AERA et al., 1999) add that technical information provided to users should also include the level of precision of test scores, descriptions of test content and skills assessed, and representative samples of test items, directions, answer sheets, and score reports.

The increased importance placed on the use and results of high stakes assessments has not only placed enormous pressure on students, teachers, principals, school boards, and other parties inside the educational system; it has created additional professional and ethical demands on measurement and testing professionals. The increased stakes associated with educational testing has led to a variety of unintended consequences that impact curriculum, teacher training, and professionalism in areas not directly tied to assessment as well as errors in the testing process itself (Cizek, 2001; Phillips and Camara, 2006). The Standards (AERA et al., 1999) and other professional, technical, and ethical guidelines that address assessment professionals provide guidance on many of the issues measurement professionals have long encountered in test development, test use, and test reporting.

NOTES

1. PL 103-227 Goals 2000: Educate America Act Sec. 211 Purpose States "the National Education Standards and Improvement Council shall. (5) certify State assessments submitted by States or groups of States on a voluntary basis, if such assessments (A) are aligned with and support State content standards certified by such Council; and (B) are valid, reliable, and consistent with relevant, nationally recognized, professional and technical standards for assessment when used for their intended purposes." The Federal Register, 43, pp. 38290-38315.) defines assessment under Goals 2000 act as, "ASSESSMENT Any method used to measure characteristics of people, programs, or objects. (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. [1985]. Standards for educational and psychological testing. Washington, DC: American Psychological Association.)"
2. Title I ESEA (Guidance on Standards, Assessments, and Accountability) "Title I requires that the assessment system be used for purposes that are valid and reliable and that it meet nationally recognized professional and technical standards. . . The primary reference for technical quality of educational assessments is *Standards for Educational and Psychological Testing* (1985), developed by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education." (see <http://www.ed.gov/policy/elsec/guid/standardsassessment/guidancepg4.html>).
3. *WATSON v. FORT WORTH BANK & TRUST*, 487 U.S. 977 (1988) 487 U.S. 977
4. The National Association for College Admission Counseling (NACAC) has developed standards of practice and other policy guidelines that are enforceable to its institutional members.

SEE ALSO *Reliability; Validity.*

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Wayne J. Camara

STANFORD-BINET INTELLIGENCE SCALES

The Stanford-Binet Intelligence Scales: Fifth Edition (SB-5; Roid, 2003a) is a test of intelligence/cognitive abilities for individuals 2 to over 85 years of age (child, adolescent, and adult). It is a major revision of the Stanford-Binet Intelligence Scales: Fourth Edition (SB-4; Thorndike, Hagen, & Sattler, 1986) and took seven years to complete. The complete SB-5 takes between 45 and 75 minutes to administer while the Abbreviated Battery takes between 15 and 20 minutes to complete. The Abbreviated Battery was included to allow for quick estimation of general intellectual abilities for screening purposes and includes the Nonverbal Fluid Reasoning and Verbal Knowledge subtests. These subtests are also used as routing subtests to provide estimates of intellectual functioning for placement into the appropriate level of test items better matching the individual's abilities. Use of the SB-5 may be for assessing mental retardation,

learning disabilities, developmental disabilities, and intellectual giftedness, although diagnosis of mental retardation also requires assessment of and significant deficits in adaptive behaviors. The SB-5 examiner's manual articulates test user qualifications, including college and/or graduate training in statistics and measurement for understanding test scores; thorough understanding of standardized administration, scoring, and calculation of standardized scores; and supervised training in administration via training workshops and/or graduate school testing courses.

HISTORICAL BACKGROUND AND DEVELOPMENT

The SB-5 evolved out of the original pioneering work of Alfred Binet (1857-1911), Victor Henri, and Théodore Simon in France during the late 1800s and early 1900s. Binet and Henri (1895) defined intelligence in terms of complex mental abilities (i.e., memory, abstraction, judgment, and reasoning) whereas Sir Francis Galton (1822-1911) had previously relied primarily on measuring physical and sensory abilities in assessing individual differences. Binet and Henri also developed tasks to measure these complex mental abilities. In 1904 the Minister of Public Instruction in Paris established a committee charged with finding a means to differentiate mentally retarded from normal children, and Binet was appointed to this committee. Earlier work by Binet and Henri and collaboration with Simon evolved into the first practical test of intellectual abilities for the diagnosis of mental retardation: the Binet-Simon Scale of Intelligence (Binet & Simon, 1905). Revisions and improvements of the Binet-Simon Scale of Intelligence were published in 1908 and 1911. Due to the success of the Binet-Simon Scale in France; Henry H. Goddard, Frederick Kuhlmann, J. E. Wallace Wallin, and Robert M. Yerkes each created translations of the Binet-Simon Scale of Intelligence for their use in the United States (Kaufman, 1990), but these different translations were not comparable and proved problematic. It was Lewis M. Termin who provided the most comprehensive translation and adaptation of the Binet-Simon Scale of Intelligence and provided better standardization. Termin's measure has survived to the present day through numerous revisions.

STANFORD BINET INTELLIGENCE SCALES FIFTH EDITION (SB 5)

The Stanford-Binet Intelligence Scales: Fifth Edition, (SB-5; Roid, 2003a), is a major revision and restructuring based on the hierarchical model of intelligence measurement illustrated by John B. Carroll (1993) and previous work by Raymond B. Cattell (1943, 1963) and John L. Horn (Cattell & Horn, 1978). The Cattell-Horn-Carroll

Factors	Domains	
	Nonverbal	Verbal
Fluid reasoning	Nonverbal fluid reasoning <i>Object series/matrices*</i>	Verbal fluid reasoning <i>Early reasoning (Levels 2–3)</i> <i>Verbal absurdities (Level 4)</i> <i>Verbal analogies (Levels 5–6)</i>
Knowledge	Nonverbal knowledge <i>Procedural knowledge (Levels 2–3)</i> <i>Picture absurdities (Levels 4–6)</i>	Verbal knowledge <i>Vocabulary*</i>
Quantitative reasoning	Nonverbal quantitative reasoning <i>Quantitative reasoning (Levels 2–6)</i>	Verbal quantitative reasoning <i>Quantitative reasoning (Levels 2–6)</i>
Visual-spatial processing	Nonverbal visual-spatial processing <i>Form board (Levels 1–2)</i> <i>Form patterns (Levels 3–6)</i>	Verbal visual-spatial processing <i>Position and direction (Levels 2–6)</i>
Working memory	Nonverbal working memory <i>Delayed response (Level 1)</i> <i>Block span (Levels 2–6)</i>	Verbal working memory <i>Memory for sentences (Levels 2–3)</i> <i>Last word (Levels 4–6)</i>

Note: *Routing subtests. Subtests presented in bold. Table adapted from Roid (2003b) Figure 2.1.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

(CHC) model of the structure of intellectual abilities is hierarchical with 50 to 60 narrow abilities at the bottom (Stratum I), 8 to 10 broad ability factors in the middle (Stratum II), and the general (g) ability factor at the top (Stratum III). The SB-5 activities and subtests measure a number of Stratum I dimensions, SB-5 Factors measure five Stratum II dimensions, and the Full Scale IQ measures Stratum III (g [general intelligence]). A number of subtests from the SB-4 were eliminated while new subtests were created and included in the SB-5.

The SB-5 (Roid, 2003a) includes ten subtests selected and designed to measure five CHC factors (fluid reasoning, knowledge, quantitative reasoning, visual-spatial processing, and working memory) within verbal and nonverbal domains. A global, Full Scale IQ score is provided in addition to Verbal IQ, Nonverbal IQ, and five composite factor scores. All scores are based on a mean of 100 and standard deviation of 15. Table 1 presents the SB-5 subtests (in bold) and the activities within subtests (in italics) used to measure the subtests specific to the different levels. Performance on the two routing subtests (nonverbal fluid reasoning and verbal knowledge) place individuals into the level appropriate for assessment. Recommendations for interpretation of SB-5 scores include the Full Scale IQ, comparisons of the Verbal and Nonverbal IQs, and the five factor scores (Roid, 2003b, 2003c).

Full Scale IQ scores range from 40 to 190, covering a wide range of intellectual abilities (± 4 SDs). This allows for assessment to the lower levels of moderate

mental retardation to the higher levels of intellectual giftedness. Verbal IQs range from 43 to 156 and Nonverbal IQs range from 42 to 158, providing a wide range. Factor scores also have wide ranges of possible scores (fluid reasoning: 47 153, knowledge: 49 151, quantitative reasoning: 50 149, visual spatial processing: 48 152, working memory: 48 152).

The standardization sample of the SB-5 was stratified to closely match the 1998 United States Census data on key demographic variables of geographic region, race/ethnicity, age, and socioeconomic level for generalizing performance to the population. Socioeconomic level was estimated by the number of years of education completed or in the case of children, their parent's education level. Other technical characteristics, such as reliability (internal consistency, stability, and interrater agreement) and validity of SB-5 scores were generally considered positive in two independent reviews (Johnson & D'Amato, 2005; Kush, 2005). Both reviews noted improvements over the SB-4 but both also noted some problems.

INDEPENDENT RESEARCH WITH STANFORD BINET INTELLIGENCE SCALES FIFTH EDITION

Gale H. Roid (2003a, 2003b, 2003c) claimed the Stanford-Binet Intelligence Scales-Fifth Edition (SB-5) measured five CHC intelligence factors within verbal and nonverbal domains based on the test design and on use of confirmatory factor analysis (CFA) procedures. Factor analysis includes several approaches to investigate

how a variety of measures relate and thus, how they define underlying dimensions. Generally, CFA procedures examine competing structural models to see which fits the data best while exploratory factor analysis (EFA) examines a correlation matrix to determine how many factors or dimensions should be extracted and retained to reflect the underlying structure.

Independent studies have seriously challenged the claim that the SB-5 measures five-factors using SB-5 standardization data. Christine DiStefano and Stefan C. Dombrowski (2006) recognized the problem of not using, or reporting, EFA and set to rectify this in their study of the SB-5 standardization data. They used both EFA and CFA procedures to determine the underlying structure of the SB-5. None of the analyses (EFA or CFA) performed by DiStefano and Dombrowski on the SB-5 standardization sample data found evidence for a five-factor model and only modest support was found for two-factors (verbal and nonverbal) and only with the two youngest age groups. The verbal and nonverbal dimensions were so moderately (EFA) to highly (CFA) correlated, DiStefano and Dombrowski concluded that the SB-5 was probably best explained as a unidimensional test of intelligence.

Gary L. Canivez (2007a, 2007b), like DiStefano and Dombrowski (2006), also failed to find empirical evidence for a five-factor model and further investigated the viability of the two-factor (verbal & nonverbal) SB-5 model for the child and adolescent subsamples from the SB-5 standardization sample. Using a hierarchical exploratory factor analysis method (Schmid & Leiman, 1957), which is a recommended procedure to understand how variance is apportioned at different interpretive levels (Carroll, 1993; Carretta & Ree, 2001), Canivez (2007a, 2007b) found that the overwhelming majority of variance measured by the SB-5 was at the general intelligence factor level (Carroll's Stratum III) and little variance seems to be measured at the lower level (verbal and nonverbal, Carroll's Stratum II). Failure to find support for Roid's (2003c) five factors and limited support for even two factors (Canivez, 2007a, 2007b; DiStefano & Dombrowski, 2006) may be the result of Roid extracting too many factors due to not considering exploratory factor analyses and multiple factor extraction criteria (Frazier & Youngstrom, 2007). As a result, clinical interpretation of the SB-5 should primarily reside at the global, general intelligence level until research adequately supports interpretation of lower-order (Stratum II) dimensions.

In summary, the SB-5 appears to be a very good measure of general intelligence across a wide age range, and the standardization sample appears to be a close match to the population on key demographic variables.

IQ scores also cover a wide range of ability from the lower levels of moderate mental retardation to the higher levels of intellectual giftedness. As such, they will be helpful in assessing students with mental retardation, learning disabilities, and intellectual giftedness, and interpretation of the global Full Scale IQ appears to have strong empirical support. However, as of 2007 much more research is required before interpretation of two- or five-factor models can be supported or recommended.

SEE ALSO *Intelligence Testing.*

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Gary L. Canivez

STEREOTYPE THREAT

According to Steele and Aronson (1995), stereotype threat is defined as a “socially premised psychological threat that arises when one is in a situation or doing something for which a negative stereotype about one’s group applies” (Steele, 1997, p. 614). Another description of stereotype threat suggests that individuals are at risk of confirming a negative stereotype about their group. Here, individuals who experience stereotype threat are 1) acknowledging that a negative stereotype exists (i.e., salient in a given context or is explicitly stated) about the capabilities of their social group (i.e., race/ethnicity, gender, age, socioeconomic status) and 2) demonstrating apprehension about confirming the negative stereotype by engaging in particular activities.

An example of stereotype threat is a member of a stigmatized group (i.e., African American students, women) feeling apprehension about performing on an academic task because the individual is afraid that a possible poor performance may confirm a pre-existing negative stereotype about the individual’s group (i.e., intellectual capabilities of African Americans or perceived underperformance of women in science and mathematics). For Steele, it is unnecessary for the group member to believe the stereotype to be true for stereotype threat to produce negative psychological consequences for the individual. That is, the psychological reactions to stereotype threat—exposure to contexts in which negative stereotypes about the capabilities and behaviors of a given group are or have been salient—are enough to alter

the attitudes and behaviors of individual group members and produce maladaptive psychological functioning.

TASK PERFORMANCE SUBVERSION

Much of the research on stereotype threat has shown that the task performance of otherwise capable individuals is hindered when such a social-psychological threat is presented at the time of the performance (Aronson et al., 1999; Steele & Aronson, 1995; Steele, 1997). Steele (1997) and Aronson (2002) write that, for many stigmatized groups—namely women and ethnic minority populations—stereotype threat is a common reality. In particular, low-income African American and Latino students are often exposed to academic contexts in which, historically, negative beliefs regarding their perceived intelligence have been held. The awareness and salience of the belief regarding their intelligence can disrupt academic performance for these students.

The consequences of stereotype threat have been noted. For example, in a review, Aronson (2002) notes that perceptions of negative stereotypes lead many individuals to engage in activities such as self-handicapping (Smith, 2004), challenge avoidance (Good, Aronson, & Inzlicht, 2003), self-suppression (Steele, 1997; Pronin, Steele, & Ross, 2002), and disidentification or disengagement with the task or the context in which the task is to be performed (Steele, 1997; Aronson, 2002; Major et al., 1998). In addition to these poor academic performance correlates, stereotype threat has also been linked to high blood pressure among African Americans (Blascovich et al., 2001), altered career and/or professional aspirations and belonging (Steele, James, & Barnett, 2002), and social distancing, particularly from the stigmatized social group of which the participants are members (Pronin, Steele, & Ross, 2002).

These psychological and behavioral outcomes found among low-income African American and Latino and women students are not typically the result of negative stereotypes being communicated directly to them from others within the given social context. Rather, these behaviors typically result from exposure to a context in which historically 1) the performance of a given group is evaluated and compared with that of others, 2) such performance has been valued by the group and the larger society, and 3) the performance of one’s group has been consistently negatively evaluated and thus stereotyped more than other groups.

MAJOR FINDINGS ON STEREOTYPE THREAT IN ACADEMIC DOMAINS

Much of the support for the presence and effects of stereotype threat has been garnered through experimentally designed studies that have been based on the

research of Claude Steele and Joshua Aronson (Steele & Aronson, 1995; Steele, 1997). In each study, participants were primed toward greater awareness of a negative stereotype either about their group or a group believed to be superior to their group. The psychological effects of this priming were the major dependent variables of interest across their works.

For example, Steele and Aronson (1995) first tested the effects and corollaries of stereotype threat with African American college students. In the first of four experimentally designed studies, Steele and Aronson (1995) gave a 30-minute GRE verbal exam to 114 undergraduates. Using a 2 (race) x 3 (threat condition) factorial design, Steele and Aronson (1995) created and analyzed the effects of race (African American and White) and testing condition on students' performance on the graduate records exam (GRE). Similar to the research on stereotype threat and women's math performance, Steele and Aronson (1995) noted that African American and White students were matched on verbal ability prior to being recruited for participation in the study.

In the first testing condition, African American and White students were exposed to the stereotype threat condition in which the GRE exam was described by the researchers as a test to determine diagnostic ability on verbal competence. The second condition, non-stereotype threat, consisted of communication by the researchers that the students' test taking and performance were not diagnostic of ability and was only considered to be a routine laboratory task. Finally, the third condition consisted of communication by researchers indicating that the non-diagnostic task should be considered a challenge, but not indicative of their fixed intelligence. Results from the first study indicated that, after controlling for differences in SAT scores, African American students in the diagnostic (stereotype threat) condition fared worse on the GRE verbal examination than their White counterparts in the same condition and also African American students in the non-diagnostic and challenge conditions.

In study two, 40 undergraduates were recruited to participate in the study in which the same experimental conditions and procedures were employed. Here, a significant interaction emerged, with African American students in the diagnostic (stereotype threat) condition performing significantly worse than all other students in the remaining experimental conditions. Also noted were the findings that African American students in the stereotype threat condition yielded lower response accuracy and had more incomplete responses than their African American counterparts in the non-diagnostic condition. White students in both conditions also had higher response accuracy than African American students in the diagnostic, stereotype threat condition.

In addition to research with African American students, Steele and colleagues also carried out research on stereotype threat with another stigmatized group: women. Throughout these studies, stereotype threat was operationalized by stating a phrase that would evoke knowledge of and reactions to negative stereotypical beliefs about a particular group's ability on an academically premised experimental task. For example, Spencer, Steele, and Quinn (1999) tested the belief that women generally perform less well on standardized mathematics examinations as a result of stereotype threat. The study sample included undergraduate males and females deemed equally competent in mathematics performance. The criteria for such included completion of one semester in calculus with a grade of B and a score above the 85th percentile on the math subsection of the Scholastic Aptitude Test or American College Test (Steele, 1997).

To operationalize stereotype threat for the participants, students were told that the test had shown gender performance differences in the past. This would "explicitly evoke the stereotype about women's math ability" (p.11). In the other condition, students were told that the math examination did not yield gender performance differences. In this study, women in the stereotype threat condition were outperformed by men in the same condition, even though students from both gender groups had equitable ability and exposure to mathematics. In the non-stereotype condition, women performed equally to the men. A significant interaction between gender and test condition (gender difference/stereotype threat and no gender difference/non-stereotype threat) found that women in the stereotype threat condition scored the lowest on the math exam whereas no other significant differences among the four conditions emerged.

While much research on stereotype threat has shown that many persons from low-income and ethnic minority and gender minority statuses can experience the psychological threat of negative stereotypes, research has also shown that virtually any member of any group can experience stereotype threat (Aronson, 2002; Smith, 2004; Steele, 1997). For example, some research has shown negative or maladaptive effects of stereotype threat on a variety of groups, including the elderly (Levy, 1996), White males (Aronson et al., 1999), elementary and middle grade school students (Ambady et al., 2001), and low-income French and American students (Croizet & Claire, 1998; Spencer & Castano, 2007). In one study, elderly participants performed significantly worse on a short-term memory task when they were exposed to negative stereotypes regarding societal perceptions of old age and senility than their counterparts who did not receive such messages (Levy, 1996). Another study showed that White male mathematics majors could fall victim to stereotype threat,

even though this population is typically not viewed as being stigmatized or marginalized.

In particular, Aronson and colleagues (1999) had White male undergraduate mathematics majors complete math tasks in one of two conditions: a stereotype threat condition and a non-stereotype threat condition. The stereotype threat prompt that they read suggested that they were participating in a study designed to determine why Asians seem to perform better on math examinations. Findings from this study showed that White male math majors in the stereotype threat condition performed significantly less well than their counterparts in the non-stereotype threat condition.

WAYS TEACHERS CAN STRUCTURE CLASSROOMS TO REDUCE STEREOTYPE THREAT

These studies and others by Steele and his colleagues have affirmed the idea that many students, but particularly low-income African American and female students, face added stressors in testing situations. These psychological stressors have little to do with students' sense of competence regarding intellectual tasks, but rather they stem from the societal-premised, negative stereotypes associated with African Americans' performance in testing situations. Given these findings, Steele (1997) and Aronson (2002) have noted that the challenge for minimizing the effects of stereotype threat often relies in the ability of educators to successfully counter societal-premised group stereotypes.

One solution, proposed formally by Steele, is the creation of "wise schooling." Through wise schooling, Steele and others have sought to replace the intangible, yet omnipresent stereotype of academic difficulty and cognitive and intellectual inferiority with instructor-based behaviors and activities that express the idea that such stigmatized students can and are fully expected to fare well in general and successfully meet the high academic standard found in and across various academic domains and settings (Cohen, Steele, & Ross, 1999). In addition, wise schooling for Steele and colleagues duly includes communicating to and believing that the stigmatized students are capable of achieving high standards and expectations.

Some research has empirically supported the use of wise schooling to reduce the effects of stereotype threat. Using experimental methods, Cohen, Steele, and Ross (1999) studied White and African American college students, all of whom were matched on language arts/writing ability. These individuals were given an essay assignment to complete under one of three feedback conditions, each of which was characterized by written feedback to the students' essays to indicate condition. The first condition, unbuffered criticism, was believed to be typical of the

college performance evaluation experience. Here, feedback was largely directive and provided in a neutral, disaffected voice/manner that did not consider the emotional impact such an evaluation may have on students. A sample statement from the unbuffered criticism letter to students in this condition is as follows: "Your letter needs work in several areas before it can be considered for publication" (1999, p. 1306).

Another condition was the wise criticism condition, which included language that communicated high and tangible achievement standards. The first line of the wise criticism letter to students in this condition stated: "It's obvious to me that you've taken your task seriously and I'm going to do likewise by giving you some straight forward, honest feedback." Additional wording in the feedback letter stated: "I wouldn't go to the trouble of giving you this feedback if I didn't think, based on what I've read in your letter/essay, that you are capable of meeting the higher standard" (p. 1307). Finally, in the positive buffer condition, the same feedback was present as that in the wise criticism condition. However, the feedback was preceded by a paragraph that offered the student some praise for the work, prior to the revisions it needed. A sample sentence there was: "Overall, nice job" (p. 1307).

The independent variables in the study were student race and criticism condition whereas the dependent variables included task motivation and perception of teacher/instructor bias. The authors found that African American students in the unbuffered criticism condition were significantly lower in their task motivation and significantly higher in their reports of perceived instructor bias than White students in the same condition. The researchers state that the difference in task motivation and bias perception between White and African American students was virtually removed in the wise criticism and positive buffer conditions.

In addition to wise schooling techniques to reduce stereotype threat effects, Aronson (2002) identified several ways in which teachers can work to minimize stereotype threat in the elementary and secondary classrooms. Teachers should reframe how standardized tests, evaluations, and even grades are presented to students. This can be done by shifting the emphasis of assessment from a measure of ability to what Aronson refers to as a non-evaluative task. For example, a teacher can suggest to students that a test is actually examining how well the teacher has instructed the students rather than how well the students have learned and retained the material. Teachers can reduce stereotype threat by dispelling the idea that ability, skill, and intelligence are static characteristics. For Aronson, communicating to students that their skills and intelligence can be further developed and are, therefore, malleable rather than unalterable or fixed

can minimize the threat of stereotypes. Additional research has shown that teachers can deemphasize stereotype threat by emphasizing self-affirmation among the students and providing same-sex, same-gender role models to students in the classroom prior to their participation on an academic task (Cohen et al. 2006; McIntyre, Paulson, & Lord, 2003).

SEE ALSO *Cultural Bias in Teaching: Gender Bias in Teaching.*

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STERNBERG, ROBERT J (EFFREY)

1949-

Robert Jeffrey Sternberg was born on December 8, 1949, in Newark, New Jersey. He received his B.A. in psychology from Yale University in 1972, under the mentorship of Endel Tulving; and his Ph.D. in psychology from Stanford University in 1975, where he worked with Gordon Bower. After completion of his dissertation, Sternberg began his professional career at Yale University, where he remained for 30 years. Sternberg's career at Yale was extremely productive and resulted in the publication of more than 1,200 scientific and popular works and the establishment of the Center for the Psychology of Abilities, Competencies, and Expertise (PACE Center) in



Robert J. Sternberg, March 1, 2005. AP IMAGES.

2000. In 2005 Sternberg and the PACE Center relocated to Tufts University, where Sternberg accepted the positions of dean of the School of Arts and Sciences and professor of psychology.

Sternberg held many elected offices in professional organizations, including president of the American Psychological Association. He led as editor two major professional journals of the American Psychological Association, and served as associate editor, consulting editor, or member of the editorial board of more than 30 other psychological and educational journals. Sternberg's work has been recognized by honorary doctoral degrees from eight universities throughout the world and by 25 scholarly prizes and awards.

Sternberg has collaborated and published with a number of distinguished scientists, both senior (Endel Tulving and Gordon Bower) and peer (e.g., Douglas Detterman, Paul Ackerman and Howard Gardner). He also has a remarkable track record of publishing with his numerous current and former students, enhancing, stimulating, and promoting their careers.

The research of Robert Sternberg is extremely diverse, spanning the fields of cognitive, educational, personality, abnormal, and organizational psychology. In educational psychology, the main focus of his research has been the implications for teachers and students of individual differences in cognition and learning. For educators, the two most important theories are the theory of successful intelligence (also known as the triarchic theory of intelligence) and the theory of mental self government (also known as the theory of thinking styles).

The theory of successful intelligence defines intelligence as the ability of individuals to succeed in life by capitalizing on their strengths and compensating for their weaknesses.

According to Sternberg, abilities cannot be reduced to a single general measure of intelligence but should be developed and assessed in a multi-faceted manner. He defines three fundamental cognitive abilities; hence the original name triarchic theory of intelligence. Analytical abilities are needed for analyzing, evaluating, judging, comparing, and contrasting. Creative abilities are called for when there is a need to generate new knowledge. Practical abilities are required for the application and use of knowledge. The psychological building blocks of these abilities are the same, but individuals may demonstrate both integrated and uneven profiles across these dimensions. The theory of successful intelligence has been the subject of a wide range of studies. These range from the development and validation of the theory (see, for example, Sternberg, 1980) to application of the theory to college admission policies (e.g., Sternberg et al., 2006).

The theory of mental self-government postulates the presence of styles of thinking (or mental government) that form psychological bridges between individuals' intelligence and personalities. Sternberg differentiates 13 different styles of thinking. The primary types of styles are legislative, judicial, and executive, matching the three major functions of government. There are also four forms of styles (anarchic, oligarchic, monarchic, and hierarchic); two levels (liberal and conservative); two focuses (extra- and intro) and two dimensions (local and global). His empirical work validates the importance of recognizing the existence of different styles of thinking among both teachers and students to maximize the effectiveness of teaching and learning.

At the later stages of his career, Sternberg became interested in wisdom and developed an all-encompassing framework that embraces various components of his work; this framework is referred to as Wisdom, Intelligence, and Creativity Synthesized (WISC).

Sternberg's work has penetrated and influenced the field of education at all levels—research, practice and policy. His prolific writing has generated widespread attention and all contemporary textbooks in psychology and education mention his theoretical and empirical research.

SEE ALSO *Intelligence: An Overview; Triarchic Theory of Intelligence.*

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Elena L. Grigorenko

STRATEGIES INSTRUCTION

A strategy is a plan of action for achieving a purpose (Harvey & Goudvis, 2007). With respect to classroom learning, purposes for employing strategies include the need to comprehend, compose, problem solve, remember, reason, evaluate, and decode. Students who have been taught strategies for accomplishing these purposes

have a distinct advantage over the uninstructed (Pressley, Graham, & Harris, 2006; Torgesen, 2004). Yet, researchers have found that most teachers do not teach the strategies students need to comprehend and learn (Durkin, 1978–1979; Pressley, Wharton-McDonald, Mistretta, & Echevarria, 1998). Neglecting to teach strategies for accomplishing classroom tasks is a serious oversight, especially when people realize that the learners who are most successful are also the ones who are able to, and do, employ many strategies (Bransford, Brown, & Cocking, 2000; Trabasso & Bouchard, 2002). Strategies put students in control of their mental processes (Duffy, 2002); thus, it would be in students' best interest if teachers in all areas of the curriculum taught strategies.

Appropriate strategies for accomplishing learning tasks vary depending on the desired outcomes and structure of the domain. In the domains of history, mathematics, and science, Donovan and Bransford (2005) note that students benefit from strategies which enable them to access and evaluate their preconceptions, develop a deep foundation of factual knowledge, understand facts and ideas in the context of a conceptual framework, and organize knowledge in ways that facilitate retrieval and application. In conducting science investigations, strategies include generating a research question, designing a study, and explaining the results. In literature, strategies for detecting theme, analyzing character traits, and recognizing different genres are important (Gaskins, 2005; Harmon, Martinez, & Deckard, 2004). Common to the domains of history, mathematics, science, and literature are the basic skills of reading and writing. In these two areas researchers suggest that students be taught strategies for decoding and encoding words, as well as for comprehending and composing. Research-based comprehension strategies include accessing background knowledge, predicting, self-questioning, constructing mental images, and summarizing (Pressley, 2006). In writing, a meta-analysis suggests that students need to learn strategies for planning, drafting, reflecting, and revising (Graham, 2006). In all areas of the curriculum, researchers recommend that students be taught strategies for taking control of their thinking (Donovan & Bransford, 2005; Schunk & Zimmerman, 1997).

This entry on strategy instruction is divided into three sections: (1) major approaches to strategies instruction, (2) characteristics of explicit, teacher-led strategies instruction, and (3) effective instructional supports for strategies instruction.

MAJOR APPROACHES TO STRATEGIES INSTRUCTION

There is little debate in the 21st century about the benefits to be gained from teaching students strategies

that will allow them to read, write, and learn independently (Deshler, Palincsar, Biancarosa, & Nair, 2007). The debate, with respect to strategies instruction, centers on which instructional approaches and contexts work best for which students and whose responsibility it is to teach strategies. This question is particularly relevant for students in grades 4 through 12, when the density of texts and concepts dramatically increase, and for students in all grades who have learning and reading difficulties (Alexander & Winne, 2006). There are at least three broad categories into which approaches to strategies instruction can be divided: (1) stand alone, in which strategies, heuristics, and/or study skills are taught as a separate course, usually with texts that are not part of the mainstream curriculum; (2) teachable moment, in which strategies are taught as students demonstrate a need for them; and (3) explicit, teacher-led instruction, in which teachers explain, model, scaffold, and guide practice regarding strategies that will be of immediate use in the completion of specific learning tasks that are part of the mainstream curriculum.

Different approaches may be beneficial for different people, depending on their backgrounds of knowledge in a domain, their learning strengths and challenges, and the context for learning. For students who read and write at levels significantly below their grade-level placement, particularly students who lack basic decoding and encoding strategies, stand-alone courses are sometimes needed as a supplement to the mainstream curriculum. For students with strong backgrounds in a domain, teachable-moment approaches may better meet their needs. Explicit, teacher-led instruction is the approach documented to be successful with students who demonstrate learning problems (Deshler, et al., 2007; Pressley & Harris, 2006; Swanson, 1999). There are also possible combinations and variations of the three main approaches described below.

Stand-alone Approach. In stand-alone approaches, strategies are taught outside the authentic situation in which they are expected to be applied. For example, students participating in a study skills course may be explicitly taught strategies for identifying main ideas, taking notes, and studying for tests, followed by teacher-directed, scaffolded practice in content-area materials. Often, however, the practice materials are not the same as those the students use in their content-area classes. For students who are motivated to learn these strategies and who also are aware of the appropriate occasions to apply them, a stand-alone course can be beneficial. The chances for application are increased if the students' regular classroom teachers are aware of the strategies that have been taught in the study skills course and can cue students when it is appropriate to use those strategies. The likelihood of transfer to authentic classroom situations is less

likely, unfortunately, for struggling students who most need to apply these strategies (Pressley & Harris, 2006).

Teachable-moment Approach. Those who favor the teachable-moment approach assert that teachers should wait until a student encounters a problem in completing a task or asks for clarification, and then coach the student in his or her application of appropriate strategies. A classic debate regarding teachable-moment interventions has for decades surrounded the teaching of strategies for decoding. There are those who believe that decoding strategies should not be explicitly taught, but rather students should be taught to problem solve when they encounter an unknown word. For example, when a student encounters the unknown word “turtle,” the teacher might ask: “What would make sense in the sentence and begins with *t*-?” If this clue is not helpful, the teacher might continue, “Do the pictures give you any clues that you could combine with the sense of the sentence and the sound for the first letter?” The goal of the teacher’s questioning is to model questions students might ask themselves when they encounter an unknown word.

Similarly, when students are stuck solving a math problem or understanding a science experiment, the teacher might mediate the application of the needed strategy by asking questions the students could ask themselves on another occasion when they are perplexed. Two possible concerns about using this approach are that it relies on teachers being skillful in asking mediating questions (rather than telling too much) and on teachers having a deep understanding of the developmental sequence of strategies that would be beneficial for students to employ in completing classroom learning tasks. Another consideration is that the teachable-moment approach can be labor intensive; thus it may work best in small classes and one-on-one tutoring.

Explicit Teacher-led Approach. The approach to strategies instruction most frequently supported by research, especially for children with learning problems, is the approach that features explicit teacher explanations of the what, why, when, and how of using strategies, accompanied by teacher modeling, scaffolding, and guided practice (Lipson, 2007; Gaskins, 2005). As noted earlier, explicit explanation of strategies is not practiced in most classrooms; however, two such programs that have received empirical support are Project CRISS (Santa, Havens, & Valdes, 2005) and Transactional Strategies Instruction (Pressley, El-Dinary, Gaskins, Schuder, Bergman, et al., 1992). These are examples of programs in which direct and explicit instruction in the reading, writing, and thinking strategies needed for success in content-area courses are taught as essential parts of the courses. Both programs emphasize professional develop-

ment. In part, explicit teacher-led approaches are not commonplace in classrooms because they are dependent on excellent pre-service and in-service professional development. The explicit approach has also been found to be difficult for teachers to put into practice (Hilden & Pressley, 2007). Explicit teacher-led instruction is discussed in greater detail in the next section.

CHARACTERISTICS OF EXPLICIT, TEACHER LED STRATEGIES INSTRUCTION

Research regarding reading comprehension in all areas of the curriculum strongly suggests that effective strategies instruction includes explicit explanations, modeling, scaffolding, and practice (Duffy, 2002; Pressley, 2006). Teachers of effective strategies instruction explicitly explain to students (1) what the strategy is that can be used to accomplish a specific task, (2) why and how the strategy facilitates learning, and (3) how and when to use the strategy (Gaskins, 2005). In addition, as recommended by Dimino (2007) and others, teachers use think-alouds (Meichenbaum & Biemiller, 1998) or mental modeling (Duffy, Roehler, & Herrmann, 1988) to share their thinking as they demonstrate using the strategy in authentic situations.

Thinking aloud, as described by Meichenbaum and Biemiller (1998), is verbally guiding oneself while carrying out a task. Teachers’ think-alouds may be in the form of self-questioning or directive self-instructional statements sharing with students what they think before, during, and after completing a task. In contrast, the goal of mental modeling, as discussed by Duffy, Roehler, and Herrmann (1988), is to make reasoning visible. Mental modeling is differentiated from the “modeling of procedures which consist of telling students directions or steps to follow in completing a specific task” (Duffy, et al., p. 765). Instead, in mental modeling, the focus is on the thinking one does to complete the steps, not on the steps themselves. The intent is to convey the flexibility associated with reasoning as opposed to rigid following of steps. Mental modeling is implemented “in tandem with fluid teacher-student dialogues to ensure that students do not misinterpret the modeling and end up with misconceptions” (p. 766).

As part of explicit strategies instruction, teachers also guide, support, and cue students as they gradually release responsibility to students for putting a strategy, or a bundle of strategies, to work. The teacher scaffolds (supports) students in the application of strategies during guided practice, turning as much responsibility over to each student as that student can successfully handle, with the goal being that each student achieves independence in strategy use at his or her own pace.

EFFECTIVE INSTRUCTIONAL SUPPORTS FOR STRATEGIES INSTRUCTION

The success of strategies instruction depends on more than explicit explanations, modeling, scaffolding, and gradual release of responsibility. Other instructional supports need to be incorporated into strategies instruction, if the use of strategies is to become habitual for students. These supports include: emphasizing metacognition; making strategies use meaningful by sharing learning principles and brain-related rationale; teaching strategies school-wide and across the curriculum; and providing opportunities for professional development. Each of these instructional supports is discussed below.

Emphasizing Metacognition. Dimino (2007) postulates that one essential component of an instructional design for effective and explicit instruction of strategies is metacognition, a concept introduced in the 1970s but as of the early 2000s still not commonly discussed in classrooms. Metacognition is composed of two parts: (1) knowledge about thinking and (2) self-regulation of thinking. Knowledge of thinking includes knowledge of high-utility strategies that enhance thinking, as well as how and when to employ them. It is also the knowledge gained from self-evaluation regarding which strategies are personally effective and work well in which situations. As part of developing student awareness, teachers encourage students to share strategies that have led to successful learning and problem solving, and they praise students for their effort in applying appropriate strategies. They also engage students in self-assessing their work and in attributing satisfactory attainment of academic goals to strategy use. The second aspect of metacognition is executive function or volition, taking control of thinking by self-monitoring and putting into action a plan to successfully meet a goal. Awareness alone does not produce success.

As strategies are practiced, teachers gradually transfer control of implementing the strategies to students. Students assume responsibility for knowing where and when to use the strategies and for independently using them. Thus, they become self-regulated (Schunk & Zimmerman, 1997). This ownership is possible because students have gained awareness and control of their thinking. Students who have been engaged in a systematic strategies program have been taught how to monitor progress toward a goal (e.g., solving a math problem, composing a science report, decoding a word, or understanding a text) (Gaskins, 2005). They know how to manage accomplishing their goals by such tactics as adapting strategies to their purposes, engaging in an inner conversation so they can catch themselves when they need to mend understanding, and matching the appropriate strategy to the situation so they can make renewed progress toward their goals.

Making Strategies Use Meaningful. Explicitly teaching strategies and adding all the components outlined above may still not be enough to develop self-regulated students who independently employ strategies. Instructional experts and researchers recommend including a motivational component to strategies instruction that focuses on meaningfulness, including interest and value (Alexander, 2006; Anderman & Wolters, 2006; Gaskins, 2008). Because learning and applying strategies initially takes quite a lot of effort, students want to see some value in putting forth the extra work. They often need to be convinced of how what they are asked to do will benefit them. This calls for personal or situational interest.

Students are more likely to be interested in and take strategies instruction seriously if teachers provide a convincing rationale for each strategy they teach (Paris, Lipson, & Wixson, 1983). For example, teaching students how strategies help the brain work more effectively has proved a convincing rationale (Gaskins, 1991, 2005, 2008). Perhaps this is the case because students enjoy hearing interesting stories and sophisticated information about learning theory and knowledge about how the brain functions that is usually reserved for college courses. Teachers share both why they are teaching a particular strategy and how the strategy helps the brain work more effectively.

For example, in teaching students to survey, the teacher's explanation of why might sound something like this: "We survey to hook our interest and to get a sense of what the text is about. In addition, the information you gain while surveying provides an outline that you can fill in with new information as you read" (Gaskins, 2005, p. 197). The teacher's explanation of how surveying helps the brain might sound like this: "Surveying helps your brain by telling it what background knowledge to get ready to assist you in understanding the new information" (p. 197). Similarly, in teaching students to access background knowledge, the teacher might say: "We access background knowledge to help us become actively involved by relating what we are reading to what we know" (p. 197). An explanation of how might include that accessing background knowledge helps the brain make sense of and remember what is read "because our brains don't remember things that don't make sense. We also want to hook new information to what we already know, because it is easier to get information back out of our brain if it is hooked to what we already know" (p. 197).

In the same vein, teachers explain how learning works by sharing principles of learning with students (Gaskins, 2008). Examples of principles that might be shared with students include: organized knowledge is easier to recall than random information; information that is thoughtfully and deeply processed is likely to be understood and used; and concepts and strategies that are repeatedly practiced and applied are not easily forgotten

(Gaskins, 2008). To make these principles even more convincing, teachers can conduct mini-experiments with students to illustrate the principles (Gaskins, 1991).

Teaching Strategies School-wide and Across the Curriculum. Strategies instruction and application must take place in authentic settings across the entire school (Allington, 2006). Effective teachers make strategies instruction an integral part of all classroom instruction all year long in all areas of the curriculum. Each year they teach a small repertoire of strategies, bundling a newly taught strategy with those that have been previously learned. For example, a teacher might initially teach beginning readers to survey a pre-primer story. After students have practiced surveying until they are comfortable with the strategy, the teacher then bundles surveying with accessing background knowledge by explicitly explaining and modeling how to access background knowledge related to the information gained from surveying. This lesson is ideally followed by teaching students to make predictions based on information gained from surveying and accessing background knowledge. For each strategy taught and bundled with other strategies, teachers explicitly explain, model, scaffold, and guide practice, and they guide students to apply or adapt strategies to all areas of the curriculum.

The goal of strategies instruction is that the application of strategies to comprehend, compose, problem solve, remember, reason, evaluate, and decode is self-regulated by students. This occurs when students receive explicit strategies instruction as described above throughout at least their elementary and middle school years, and they are guided in their application of high-utility strategies to authentic situations until strategies use is each student's chosen way of addressing learning, thinking, and problem-solving tasks in all areas of the curriculum..

Ideally, there is a school-wide or district-wide plan for strategies instruction in order to provide continuity and consistency of strategy instruction across the curriculum and across grades. With such a plan, each teacher knows what his or her responsibility is for introducing and reinforcing specific strategies, and students are much more likely to be strategic in their learning, thinking, and problem solving because strategies introduced during one school year are reinforced, expanded, and bundled with other strategies in each consecutive year of schooling (Pressley, 2006).

Providing Opportunities for Professional Development. Given that what is known about strategies teaching is underused in the late 2000s, it is imperative that there be ongoing professional development so that students have the benefit of instruction from teachers who know what works and how to implement instruction based on evidence from scientific investigations (Pressley, Graham, & Harris,

2006). In addition, because experience and research have indicated that teaching strategies has initially proved difficult for teachers to implement (Hilden & Pressley, 2006), there must be frequent professional-development support, especially for teachers new to strategies instruction. Ideally, this support would include both workshops and in-class coaching by supervisors, principals, or instructional coaches, who support staff in employing approaches for teaching and reinforcing strategies with their students.

IMPLICATIONS FOR EDUCATORS

Despite ample research evidence upon which to base decisions about strategies instruction and despite the many college textbooks published since 1995 that introduce pre-service teachers to strategies instruction, strategies instruction is not commonplace in K-12 classrooms in the United States.. It is particularly absent in content-area classes such as mathematics, social studies, and science. That the need for strategies instruction is being recognized is evidenced by the burgeoning number of commercial programs to teach general and specific strategies. The drawback to these commercial programs is that, although many attempt to address strategies instruction, they do so outside the context of the core curriculum where these strategies need to be applied. For example, only 12 of the 48 programs reviewed by Deshler and colleagues (2007) were identified as core curricula, whereas 36 were designated supplemental or remedial intervention programs. An alternative to these commercial programs is for teachers to provide strategy instruction as an integrated part of all mainstream language arts and content-area instruction with the goal of enabling all levels of learners to participate in courses with more challenging content.

In order for the United States to produce young people who are well prepared to succeed in whatever they undertake, every teacher at every grade level in every domain must become a strategies teacher. Strategies instruction needs to be adopted across the curriculum and throughout schools and school districts. It needs to begin when children enter school and continue through 12th grade. Because the need for strategies is often specific to each discipline and transfer between disciplines is not automatic, students should receive instruction in strategies for reading, writing, and learning that is differentiated for each content area (Deshler, et al., 2007). Ongoing professional development and support for strategies teachers are keys to the success of a school-wide effort to make every teacher a strategies teacher and every student a self-regulated strategy user.

SEE ALSO *Cognitive Strategies; Metacognition; Problem Solving; Reasoning; Self-Regulated Learning; Strategy Development.*

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Irene W. Gaskins

STRATEGY DEVELOPMENT

A strategy is a purposeful action, or sequence of actions, executed in the interest of achieving a goal. The mistaken idea that children do not exhibit strategies prior to school

age arose from studies asking preschool and older children to remember a set of items (for review, see Pressley & Hilden, 2006). Preschoolers did no better in remembering the items than they did when merely asked to look at them. Older children asked to remember the items, in contrast, were likely to employ strategies, such as organization or rehearsal. But this finding did not mean that children do not use strategies until they are 7 or 8 years old. An infant who uses a stick to bring a toy within reach is employing a strategy to reach a goal. The important questions are what strategies is a child able to employ, what is the degree of conscious control under which strategies operate, does the child know to apply the strategy or can the child be taught when and how to do so, and can strategies be employed more effectively to aid performance.

Strategies are not autonomous, multi-purpose tools stored away in a toolkit and brought out and applied when needed. Most often, people are unable to say definitively that a child either has or lacks possession of a particular strategy. Instead, strategies are linked to the contexts in which they are employed and the goals they serve. A child may exhibit a strategy in one context and not in another seemingly equivalent one.

Children's memory may differ, for example, when asked to retrieve a list of items from a mock grocery store and when asked to memorize a list of words. Multiple factors, however, are likely to contribute to such differences (Weissberg & Paris, 1986). The use of deliberate strategies, such as rehearsal, is one factor, but additional possibilities need to be weighed. These include the differing goal (and hence motivational) structures linked to the tasks and the differing familiarity of the task materials and the task activity itself. Moreover, these different contributors themselves interact with one another. A powerful memory strategy, for example, is elaboration, in which an association is formed between separate entities by identifying a theme that links them (e.g., the digit sequence 312 is remembered as a telephone area code or a batting average). In order to make use of this strategy, however, the learner needs to be familiar with such content domains.

In classroom settings, teachers need to be sensitive to these contexts of strategy use. A strategy may appear in one context but not another. A child faced with multiplying three times five, for example, may use a successive-addition strategy of laying out three groups of five objects and adding them. When the child later encounters the problem five times three, however, the child may be unable to apply the same strategy. The most common challenge teachers encounter is that students fail to apply a strategy that has been taught explicitly in one context when they later encounter problems for which it is appropriate. Simply learning how to execute the strategy is not enough.

ASSESSING STRATEGIES IN SITUATED CONTEXTS

Identifying what strategies a student is using can be difficult. Mental strategies most often are not detectable from overt performance. Asking people how they performed a task or solved a problem is one way of gaining information about strategy use, but not always a reliable one. How someone reports having solved a problem may not be identical or even similar to the mental operations that were actually performed to reach a solution. Asking the person to think aloud while engaged in the task is a better method, but it too can be misleading, because the think-aloud talk can disrupt or otherwise alter performance.

Mostly, cognitive psychologists must employ indirect methods in making inferences about strategy use, for example, by examining performance over different kinds of problems and observing response times or patterns of correctness as a way of testing hypotheses about the strategies the performer used. Nonverbal behavior (such as visual fixation patterns and gesture) may also be informative.

Teachers are in effect researchers-in-practice in the classroom, as they seek to diagnose the strategies that individual students apply to their work. They do best to treat their interpretations as hypotheses and then seek multiple kinds of evidence by talking to the child about what he is doing as well as observing his work on different kinds of problems that will either support or disconfirm such hypotheses. Teachers also need to be sensitive to two kinds of variation. One is the wide individual variation across children in how they approach a problem. Children of similar age and ability within a single classroom are likely to exhibit quite different strategies for the same task, including some that even the teacher may not have previously considered. The other kind of variation, discussed below, is variation in strategy usage within a single child.

STRATEGIC DEVELOPMENT

Adding to the assessment challenge, strategies must always be considered in relation to a task, a goal, and a situation. Still another challenge comes from the need to consider any strategy in a context of its alternatives. One of the major discoveries psychologists have made about strategies is that multiple alternative strategies applicable to a task typically exist in a learner's repertory. These strategies are of differing degrees of correctness or effectiveness. They also have different probabilities of application (see Figure 1). The instructional goal, then, is to reduce the strength, that is, probability of occurrence, of less effective strategies and increase the strength of more effective ones. New strategies do, of course, appear, but first emergence rarely indicates the beginning of consistent usage. The majority of change is thus of this

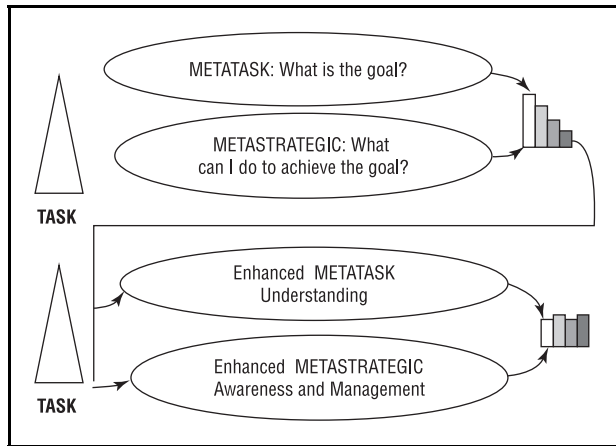


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

shifting-frequency variety. Siegler (2000) proposes an “overlapping waves” model to portray this process. A particular less-than-ideal strategy initially appears infrequently, begins to increase in frequency, enjoys a period of ascendance, and then diminishes in frequency, while another strategy follows this same course but at a later, although overlapping, time. Siegler and his colleagues tracked the course of various strategies children use in performing simple single-digit addition and subtraction problems. When faced with adding nine plus three, a first-grade child may first count one subset, then the other, and then the entire set, to produce the answer, twelve—an unnecessarily burdensome and inefficient strategy. Asked to carry out a series of such calculations, the child may after a time discover a more efficient strategy which Siegler calls the Min strategy which involves simply counting up from the first addend, i.e., “ten, eleven, twelve,” and requires enumerating only the second subset. Students may use these two (and several other) strategies as they tackle a set of problems. Over time, however, use of the less efficient strategy diminishes in frequency and use of the more efficient strategy increases.

What is entailed in this change process? Microgenetic studies (Kuhn, 1995; Siegler, 2006), in which an individual is observed engaged in the same or a similar set of problems over an extended period of weeks or months, show that the exercise afforded by this rich problem environment is sufficient to induce strategy change in a majority of cases, enabling researchers to examine its characteristics. One point that has become clear is that two distinct components are involved. The more familiar is the desired increasing strength of the more advanced strategy or strategies. But equally important is inhibition of less advanced strategies. In postulating mechanisms,

Siegler (2000, 2006; Siegler & Jenkins, 1989) emphasized the need for associations with the more frequent, less effective strategies to be weakened, as well as associations with more effective strategies strengthened.

Consistent with such a model is the finding that strategies when they first appear may not be used effectively enough to enhance performance. Researchers studying the development of memory strategies have in fact found this to be the case, giving rise to what has been called a *utilization deficiency*. A strategy such as categorization (of the to-be-remembered items), for example, even (or especially) if it has been explicitly taught, may not be used when a child later is free to approach a memory task as the child chooses, or, if it is used, may fail to improve or even diminish performance. The educational implication is that new strategies must be included in the repertory with sufficient frequency so as to allow them to be practiced, consolidated, and perfected until the user is able to experience their utility.

METASTRATEGIC DEVELOPMENT

While similarly emphasizing the relinquishment of less effective strategies as a more formidable obstacle than strengthening new ones, Kuhn and colleagues (Kuhn, 2001; Kuhn & Dean, 2004) proposed that knowledge at a meta-level is as important as that at the performance level and plays a major role in what happens there. The meta-level entails understanding of strategies—recognizing what they do or do not buy one in relation to task goals. Portrayed in the right side of Figure 1 (Kuhn, 2001) are the strategies that co-exist and are available for use (analogous to Siegler’s “overlapping waves” model). In the progress depicted from the upper to the lower half of the diagram in Figure 1, the less effective strategies to the left become less frequent and the more effective strategies to the right more frequent (in this case, yielding a temporary, transitional result of all strategies of roughly equal strategy). Implicated in this change are the meta-level operators that appear in the center of the diagram, representing the individual’s understanding of the task goal, understanding of the strategies the individual has available to apply, and awareness of the need to coordinate the two in selecting a strategy. Feedback from the performance level should enhance meta-level understanding, further enhancing performance, in a continuous process.

Kuhn and colleagues have made use of this model in research on the scientific thinking of children and adults, in particular how they coordinate their own preexisting beliefs with new evidence and draw conclusions about the causal roles of various factors in producing an outcome. Even many adults have difficulty *bracketing*, that is, holding in suspension, their own beliefs in interpreting new evidence. Community college students, for example, were

presented data regarding an experiment conducted by a school district on ways to improve reading instruction (Kuhn, Katz, & Dean, 2004). Three factors were investigated: a new reading curriculum, teacher aides, and reduced class size. Among six outcomes students were asked to examine were these two:

Classrooms with the new reading curriculum and teacher aides reported an outcome of greatly improved.

Classrooms with the new reading curriculum, teacher aides, and reduced class size reported an outcome of greatly improved.

Application of a control of variables strategy (in which all variables but the one being investigated are held constant) would dictate the conclusion that reduced class size played no role in the outcome.

Although some students did apply this strategy and come to the appropriate conclusion, a good number did not. One common response reflected the inference strategy that anything present in the context played a role in the outcome. For example, in one student's words: "Yes (class size makes a difference) because this class had it and they improved."

Other students, despite explicit instructions to interpret the presented data, ignored it and relied on their own preexisting knowledge, leading them to offer responses like this one: "Yes (class size makes a difference) because the numbers of children are small so they can learn faster and better."

To apply the more advanced, scientifically correct strategy individuals need to have good metastrategic control over their own thinking. In a problem like this one, this control makes it possible to monitor and manage the dual representations of the evidence and one's own knowledge state, as well as the cognitive strategies that are involved in coordinating them.

MANAGING ONE'S OWN LEARNING

How can teachers promote strategy development? The evidence suggests that a rich problem environment, in which students are given frequent and dense opportunities to engage problems requiring more advanced strategies will in a majority of cases lead to improvement in strategy use (Kuhn et al., 1995; Dean & Kuhn, 2007). Teachers can assist by supporting students' inclinations to take charge of their own learning. This points leads back to the contextual message with which this discussion began. If students develop their own firm understandings of what they are undertaking to learn in a particular situation and why, they are more likely to take charge of finding the most effective ways to enable them to

accomplish the job (Kuhn, 2005). This meta-level awareness and management in turn enhances the likelihood of transfer of strategies to new contexts.

The directions in which individual development progresses are consistent with the growing metastrategic capabilities that older children begin to display (Kuhn & Franklin, 2006). Older children and adolescents are less pliable than young children. They are more likely to question, and they want to try things their way. Expressed differently, they want to assume control of what they do. Growing cognitive and social skills make them more able to do so, and the indications are that in academic settings teachers should give them the space to try their own approaches to problems, to collaborate with others and to revise their strategies as warranted, and to gain from the experience that doing so affords.

SEE ALSO *Microgenetic Research; Strategies Instruction.*

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Deanna Kuhn

STUDENT EMOTIONS

The classroom is an emotional place. The fact that learning and achievement are critical for students' educational careers implies that academic activities and attainments

often arouse intense emotions. Relevant achievement emotions include positive emotions such as enjoyment of learning, hope, and pride, as well as negative emotions such as anger, anxiety, shame, or boredom in class. Due to the interactive nature of classroom settings, social emotions such as admiration, contempt, or envy can also play a major role in these settings. Furthermore, emotions are functionally important by influencing students' academic motivation, behavior, performance, health, and personality development. Nevertheless, as of 2008, there still was a lack of empirical research on student emotions. Research has thoroughly examined students' test anxiety since the 1950s (Zeidner, 1998, 2007) and has produced cumulative knowledge that can inform educational practice. There is little research on student emotions other than anxiety, however, implying that it is difficult to draw firm conclusions for most emotions experienced by students (Schutz & Pekrun, 2007).

DEFINITION AND ASSESSMENT OF EMOTION

Emotions are reactions to significant events and objects. Serving the preparation and adaptive organization of subsequent perception, cognition, and action, emotions are defined as involving multiple coordinated processes (Lewis & Haviland-Jones, 2000). Important components include the following. (1) Affective components comprise emotional feelings that are physiologically bound to the activation of subcortical systems such as the amygdala (e.g., uneasy, nervous feelings in anxiety experienced before an exam). (2) Cognitive components involve emotion-specific thoughts (such as worries about the threat of failing an exam). (3) Physiological components serve the preparation of action (e.g., peripheral physiological activation in anxiety, as indicated by symptoms such as increased heart rate, respiration rate, and sweating). (4) Motivational components comprise behavioral impulses and wishes (e.g., avoidance motivation in anxiety). (5) Expressive components include facial, postural, and vocal expression of emotion.

Due to the multi-component nature of emotion, there are various ways to assess student emotions. Self-report instruments assess self-perceptions of emotion. In test anxiety research, questionnaires such as the Test Anxiety Inventory (TAI; Spielberger, 1980) play an important role. An instrument measuring various achievement emotions experienced by students is the Achievement Emotions Questionnaire (AEQ; Pekrun, Goetz, Titz, & Perry, 2002). Recordings of physiological processes such as heart rate, respiration rate, or changes of skin conductance are used to infer emotions from their peripheral physiological components. Brain imaging

techniques such as EEG and fMRI serve to identify central physiological processes underlying emotions. Finally, emotions can be assessed by observation of facial and postural expression. However, emotion observation is not an easy task with students beyond the early elementary years who control emotion expression by adhering to socially defined display rules.

CATEGORIES AND DIMENSIONS OF STUDENT EMOTIONS

Two distinct ways of describing emotions are provided by categorical and dimensional approaches. In categorical approaches, qualitatively different types of discrete emotions are differentiated, such as enjoyment, anger, anxiety, or boredom. This approach allows taking into account the unique patterns of components and functions that are typical for different emotions. Within the dimensional approach, a small number of dimensions are held to be sufficient to describe human emotion. Two important dimensions are valence (positive versus negative, or pleasant versus unpleasant) and activation (activating versus deactivating). Categorical and dimensional approaches can be integrated in hierarchical models that regard discrete emotions as lower-level factors, and affective dimensions as higher-order factors describing common properties of discrete emotions (Feldman, Barrett, & Russell, 1998).

The two dimensions valence and activation can also be used to classify students' achievement emotions (Pekrun, 2006; see Table 1). Achievement emotions are defined as emotions that relate to achievement activities (such as academic learning) and their outcomes (such as academic success and failure). The two dimensions render four broad categories of achievement emotions: (1) activating positive emotions (e.g., joy, hope, pride); (2) deactivating positive emotions (e.g., relief, relaxation); (3) activating negative emotions (e.g., anger, anxiety, shame); and (4) deactivating negative emotions (e.g., hopelessness, boredom).

In addition, achievement emotions differ according to their object focus, relating either to achievement activities such as learning, or to the success and failure outcomes of these activities. Furthermore, some achievement emotions render an affective self-evaluation by linking positively versus negatively valenced activities and outcomes to the self (e.g., pride after success and shame after failure). Self-evaluative emotions are critical for students' development of self-worth (Covington & Berry, 1976).

Taxonomy of achievement emotions				
Object focus	Positive		Negative	
	Activating	Deactivating	Activating	Deactivating
Activity (Learning)	Enjoyment	Relaxation	Anger	Boredom Frustration
Outcome (Success/Failure)	Joy Hope Pride Gratitude	Contentment Relief	Anxiety Shame Anger	Sadness Disappointment Hopelessness

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

IMPORTANCE OF STUDENT EMOTIONS FOR ACADEMIC LEARNING AND PERFORMANCE

Two lines of evidence suggest that students' emotions profoundly affect their learning and performance. The first line of evidence originates in experimental mood research, the second in situated field studies directly analyzing students' emotions. Experimental mood research has shown that mood and emotions facilitate mood-congruent memory processes, such that positive self-related information is more easily stored and retrieved when in a positive mood and negative information when in a negative mood (e.g., Olafson & Ferraro, 2001). By implication, a positive mood can enhance students' motivation to approach learning tasks, whereas a negative mood can trigger mood-congruent avoidance motivation. Furthermore, the findings indicate that positive versus negative mood can promote different styles of information processing. Whereas creative, flexible, and holistic ways of thinking are facilitated by a positive mood, more analytical, rigid, and detailed ways of processing of information can be enhanced by a negative mood (Lewis & Haviland-Jones, 2000).

The ecological validity of these experimental findings, however, may be limited due to differences between the laboratory and real-life classroom situations, including ethical constraints preventing an induction of more intense emotions in the laboratory. Therefore, field studies have directly addressed the effects of students' emotions as experienced in classroom situations. Most of these studies focused on students' test anxiety (summaries in Zeidner, 1998, 2007). Research on test anxiety has shown that anxiety impairs performance on complex or difficult tasks that demand cognitive resources (e.g., difficult mathematical tasks). Performance on easy and less complex tasks is not impaired or enhanced. Interference and attentional deficit models have been proposed to explain negative performance effects of anxiety. These models assume that anxiety involves task-irrelevant thinking which reduces task-related attention thus interferes

with performance on tasks requiring attentional resources: Students who worry about possible failure cannot focus their attention on learning.

In line with findings on task-related effects, test anxiety correlates negatively with students' academic achievement, typically explaining about 10% of the variance in achievement scores (Hembree, 1988). However, these correlations should be interpreted cautiously. First, they may be due to effects of failure on the development of students' anxiety, rather than effects of anxiety on achievement. Second, correlations were not uniformly negative across studies and individuals. Zero and positive relationships were found as well. One reason may be the ambiguous motivational effects which anxiety can exert: Anxiety reduces students' interest and intrinsic motivation, but it can also motivate students to invest extra effort to avoid failure. In individual cases, these motivating effects can be so strong that negative effects on attention and intrinsic motivation are compensated. From an educator's perspective, however, any positive effect of anxiety in an individual student is certainly outweighed by the negative effect on subject-matter interest and academic performance in the majority of students.

The available evidence for effects of student emotions other than anxiety is limited. For positive emotions such as enjoyment of learning, positive correlations with academic achievement have been reported (Pekrun et al., 2002). For anger and shame, findings suggest that overall relationships with students' achievement are negative. As with anxiety, however, the effects need not uniformly be negative. For example, in students who believe in their capabilities, shame about failure on an exam can fuel motivation to invest more effort in the future (Turner & Schallert, 2001). In contrast, findings on boredom and hopelessness suggest that these two emotions are just detrimental by exerting negative effects on cognitive resources, motivation, information processing, and any kind of academic performance (Pekrun et al., 2002).

In sum, the available evidence implies that it would be inappropriate to assume that positive emotions always exert positive effects and negative emotions always negative effects. Rather, the effects depend on the mediating processes and specific task demands under consideration. More specifically, positive activating emotions such as enjoyment of learning likely are beneficial for students' learning and performance under most task conditions. Conversely, negative deactivating emotions such as hopelessness and boredom can be assumed to be devastating to any kind of academic performance. The effects of positive deactivating emotions such as relief and relaxation, however, probably are more ambiguous. Similarly, negative activating emotions such as anxiety, shame, and anger can exert ambiguous effects by reducing attention and interest, but also by being able to strengthen extrinsic motivation as well as more rigid modes of information processing such as simple rehearsal of learning material. Therefore, negative activating emotions can enhance performance in specific cases, although their average affects across students are negative.

INDIVIDUAL ANTECEDENTS AND DEVELOPMENT OF STUDENT EMOTIONS

Students' achievement-related appraisals are important proximal determinants of their emotions. The impact of factors such as achievement goals and gender likely is mediated by students' appraisals. Also, the development of students' emotions largely depends on the development of their achievement-related thinking.

The impact of appraisals on anticipatory anxiety has been addressed by R. S. Lazarus's transactional stress model, and their impact on emotions following success and failure by B. Weiner's attributional theory. The transactional stress model (Lazarus & Folkman, 1984) assumes that individuals first evaluate the threat implied by a stressful situation such as an exam ("primary appraisal") and then judge the possibilities of coping with the situation ("secondary appraisal"). In case of threat and insufficient perceived control over the situation, anxiety is assumed to be instigated. Weiner's 1985 attributional theory proposes that achievement outcomes immediately produce "attribution-independent" emotions such as happiness after success and frustration after failure. These emotions do not need any more cognitive elaboration. In contrast, attribution-dependent emotions are shaped by the causal attribution of the outcome. Pride is assumed to depend on an attribution of success to internal factors (such as ability). Shame and guilt are induced by failure that is attributed to internal factors that are subjectively controllable (such as lack of effort). Gratitude is expected to be aroused by an attribution of

success to external factors that are under control by others (e.g., help), and anger by attributions of failure to such factors. In line with Lazarus's and Weiner's theories, empirical research has corroborated that indicators of subjective lack of controllability, such as low self-concepts of ability and failure expectancies, are related to students' anxiety and their attributions of success and failure to emotions such as pride, shame, guilt, and anger (Heckhausen, 1991; Zeidner, 1998, 2007).

Different appraisal theories of achievement emotions, such as Lazarus's and Weiner's theories, are complementary rather than mutually exclusive. The control-value theory of achievement emotions (Pekrun, 2006) aims at integrating the assumptions of different theories. In addition, whereas previous theories have focused on outcome-related emotions such as anxiety, pride, and shame, the control-value theory also addresses activity-related emotions such as enjoyment and boredom experienced during learning. The theory assumes that students experience emotions when they feel in control of, or out of control of, activities and outcomes that are subjectively important to them, which suggests that control appraisals and value appraisals are the proximal determinants of their emotions. Occurrence and intensity of achievement emotions are seen as a joint product of these two kinds of appraisals. For example, anxiety is seen to be induced when the outcome of an exam is perceived as not being sufficiently controllable, but subjectively important. Conversely, if a student feels in control and does not expect failure or does not care about the exam, there is no need to be anxious. Similarly, enjoyment of learning is seen to be instigated if a student feels competent to master the material and values the material. If the student feels incompetent or is disinterested, negative activity emotions such as boredom are induced rather than enjoyment.

Achievement goals likely influence students' emotions by shaping emotion-inducing appraisals. Mastery goals can focus attention on the controllability and positive value of achievement activities. Performance-approach goals can facilitate positive appraisals of success, while performance-avoidance goals can sustain appraisals of the uncontrollability and negative value of failure. In line with these assumptions, empirical evidence shows that students' mastery goals relate positively to their enjoyment of learning and performance-avoidance goals to their anxiety (Linnenbrink & Pintrich, 2002; Pekrun, Elliot, & Maier, 2006).

Similarly, the impact of factors such as gender, race, and culture is likely mediated by their influence on students' appraisals of achievement. Specifically, while there is too little research on the impact on race and culture to draw firm conclusions, there is consistent evidence showing gender differences in achievement emotions. Anxiety

research has shown that mean scores for achievement-related anxiety are higher for female than for male students. This is especially true for students' anxiety in mathematics. Gender differences in mathematics anxiety, however, are at least partially due to lower self-concepts of ability for female students in this domain (Frenzel, Pekrun, & Goetz, in press), suggesting that these gender differences are mediated by students' appraisals.

Finally, congruency between appraisals and emotions has also been found for the development of achievement emotions across students' educational career. Developmental research has shown that the occurrence of cognitively mediated emotions (such as pride and shame) in the preschool years is linked to the level of cognitive development (Heckhausen, 1991). Beyond the preschool years, all major achievement emotions are experienced by students. Subsequent development over the school years likely depends on the development of individual appraisals of capabilities and the subjective value of academic achievement. For test anxiety, research has shown that average levels of anxiety are low at the beginning of elementary school, increase substantially over the elementary school years, and remain at high levels throughout the middle school, high school, and university years (Hembree, 1988). This finding is congruent to the high levels of students' self-concepts of ability that are prevalent at the beginning of schooling and are adjusted downward during elementary school.

REGULATION AND THERAPY OF EMOTIONS

Emotion regulation involves up-regulating adaptive emotions such as enjoyment of learning and down-regulating maladaptive emotions such as anxiety. Cognitive competencies for doing so have been labeled emotional intelligence (Matthews, Zeidner, & Roberts, 2002). Concerning student emotions, research has focused on students' regulation of test anxiety (i.e., coping). Three broad categories of coping strategies have been identified (Zeidner, 1998, 2007). Emotion-oriented coping aims to reduce anxiety without changing the situation (e.g., by using relaxation techniques, taking drugs, or changing appraisals). Problem-oriented coping reduces anxiety by attempting to solve the problem (e.g., by investing effort in preparing an exam). Avoidance-oriented coping implies escaping the situation behaviorally or mentally (as implied by procrastination, absenteeism, and dropping out of school). In an academic achievement context, problem-oriented coping often is most adaptive. However, emotion-oriented coping can be adaptive as well (e.g., in situations providing no opportunities for successfully solving the problem).

Similarly, therapy of maladaptive student emotions can aim at directly changing the emotion or at changing underlying causal factors. Therapy of test anxiety has been researched most often and is among the most successful kinds of psychotherapy as of the late 1990s (Zeidner, 1998). Emotion-oriented treatment includes anxiety induction (e.g., flooding), biofeedback procedures, relaxation techniques, and systematic desensibilization. Cognitive therapies modify anxiety-inducing control appraisals, value beliefs, and styles of self-related thinking. Examples are cognitive-attentional training and cognitive restructuring therapy. Study-skills training teaches students to use task-oriented strategies of learning enabling them to be academically successful, thus alleviating their anxiety. Finally, multimodal therapies integrate several of these procedures.

Cognitive and multimodal therapy proved to be especially effective, both for reducing test anxiety and for improving academic performance. For students with deficits of learning strategies, study-skills training also turned out to be successful. Therapy focusing exclusively on emotion-oriented procedures is successful in terms of reducing anxiety but less effective as to students' academic improvement (Zeidner, 1998).

THE ROLE OF THE CLASSROOM CONTEXT AND IMPLICATIONS FOR EDUCATORS

Research in the late 1990s and early 2000s has focused on individual functions, antecedents, and therapy of student emotions. The role of classroom instruction remains largely unexplored. Again, research on test anxiety is an exception. Judging from test anxiety studies (Zeidner, 1998, 2007) and assumptions of appraisal theories (Pekrun, 2006), the following factors that are under the control of educators likely are important for the development of students' emotions.

1. Cognitive quality of instruction. Factors reducing students' perceived control, such as lack of structure, lack of clarity, and excessive task demands, are known to enhance students' test anxiety. With exams as well, lack of structure and transparency has been shown to contribute to students' anxiety (e.g., lack of information on demands, materials, and grading practices; Zeidner, 1998). Conversely, well-structured instruction and clear explanations likely contribute to adaptive student emotions by raising students' competencies and feelings of control. By implication, adaptive student emotions likely can be fostered, and maladaptive emotions reduced, by raising the cognitive quality of instruction.

2. Motivational quality of instruction. Teachers deliver direct messages conveying academic values, as well as more indirect messages implied by their behavior. Two ways of inducing values and related emotions may be most important. First, if learning environments meet the needs of students, positive activity-related emotions likely are fostered. For example, learning environments that support cooperative learning should help students to fulfill needs for social relatedness, thus making learning enjoyable. Second, teachers' own enthusiasm can facilitate students' adoption of positive emotions by way of observational learning and emotional contagion (Hatfield, Cacioppo, & Rapson, 1994).
3. Support of autonomy and self-regulated learning. Learning environments supporting students' self-regulated learning can be assumed to increase their sense of control and related positive emotions. In addition, such environments can foster positive emotions by meeting students' need for autonomy. However, these beneficial effects probably depend on the match between students' competence and individual need for academic autonomy, on the one hand, and the affordances of these environments, on the other. In case of a mismatch, loss of control and negative emotions can result. By implication, teachers should attend to matching demands for autonomy to students' competencies and needs.
4. Goal structures and achievement expectations. Academic achievement can be defined by standards of individual mastery, by normative standards based on competitive social comparison, or by standards pertaining to cooperative group performance instead of individual performance. These different standards imply individualistic (mastery), competitive (normative performance), and cooperative goal structures in the classroom (Johnson & Johnson, 1974). Goal structures and grading practices determine students' opportunities for experiencing success and perceiving control, thus influencing their emotions. Specifically, competitive goal structures imply, by definition, that some students experience success, whereas others have to experience failure, thus increasing levels of anxiety and hopelessness. Similarly, the demands implied by excessively high achievement expectancies of teachers and parents can lead to lowered control perceptions and related negative emotions. The available evidence corroborates that competitive classroom climates and excessive achievement expectancies correlate positively with students' test anxiety. Accordingly, as seen from an emotion perspective, educators should adapt expectancies to students' competencies and should refrain from using

goal structures which induce individual competition between students.

5. Feedback and consequences of achievement. Research suggests that cumulative failure feedback is a major factor underlying students' test anxiety (Zeidner, 1998). Success experiences likely strengthen perceived control and related positive emotions, whereas repeated failure can undermine subjective control and, therefore, instigate negative emotions. In addition, the perceived consequences of success and failure are important. Positive future-related student emotions can be increased if academic success is seen to produce beneficial long-term outcomes (such as future occupational chances). Negative outcomes of academic failure, by contrast, can increase students' achievement-related anxiety and hopelessness. By implication, providing success experiences, defining mistakes as opportunities for learning rather than as personal failure, and linking attainment to beneficial outcomes also is important for helping students to develop adaptive emotions.

SEE ALSO *Anxiety; Evaluation (Test) Anxiety.*

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Reinhard Pekrun

SUBJECTIVE TEST ITEMS

Subjective test items are more commonly called constructed response (CR) items. They require examinees to create their own responses, rather than selecting a response from a list of options (American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, 1999). No single wording (or set of actions) can be regarded as the only correct response, and a response may earn full or partial credit. Responses must be scored subjectively by content experts. The term *constructed response item* may refer to an essay item or performance assessment. Measurement experts traditionally distinguish between two variations of these subjective item types: the restricted response item and the extended response item.

Restricted response items. On restricted response items examinees provide brief answers, usually no more than a few words or sentences, to fairly structured questions. An example in seventh grade science could be: Why are day lengths shorter in December than in July in the northern hemisphere?

Extended response items. Extended response items require lengthy responses that count heavily in scoring.

Ideally these items focus on major concepts of the content unit and demand higher level thinking. Typically examinees must organize multiple ideas and provide supporting information for major points in crafting responses. An example of such an item from 12th grade literature might be: The title of Steinbeck's novel, *The Winter of Our Discontent*, is found the opening line of the Shakespeare's play, *Richard III*. Having read both works, explain why you do, or do not, think this title is appropriate. Support your reasoning by comparing main characters, plots, and use of symbolism in these two works.

Performance assessment, as conceived in personnel psychology, requires the examinee to create a product or deliver a performance in a real world situation or simulation that could be evaluated using specified criteria. Raters typically score the performance using checklists or rating scales (Fitzpatrick & Morrison, 1971). When educators transported this procedure to classroom settings, their early performance exercises reflected this definition as shown in the following examples: determine the cost of carpeting a classroom, given a tape measure and carpet cost per square foot; determine the chemical composition of an unknown powdered compound.

Gradually, educators' views of performance assessment evolved to include pencil and paper items couched in real-world contexts. Coffman (1971) successfully argued that an essay item could be a performance assessment in some content areas. In performance assessments in the early 2000s, examinees may respond to questions containing diagrams, data tables, written scenarios, or text passages, but quite often their responses are written essays. In modern usage, the defining characteristic of a performance assessment is that it requires behaviors that are meaningful end-products of instruction derived from content standards (Lane & Stone, 2006). Performance assessments may also include portfolios or assigned out-of-class projects, but the principles for construction and scoring are the same as for essay items.

CONSTRUCTING THE ITEM

Content standards and test specifications operationally define the domain of subject matter knowledge and levels of cognitive complexity that are sampled by the achievement test items. Within these parameters, the test developer must develop the questions (or prompts), create scoring rubrics (or keys), and plan the scoring process. Welch (2006) provides a comprehensive summary of this process.

Developing the prompt. The prompt for a subjective item poses a question, presents a problem, or prescribes a task. It sets forth a scenario or set of circumstances to provide a common context for framing responses. Action verbs direct the examinee to focus on the desired behavior (e.g., solve,

interpret, compare, contrast, discuss, or explain). Appropriate directions indicate expected length and format of the response, allowable resources or equipment, time limits, and features of the response that count in scoring (e.g., originality, organization, grammar, labeling diagrams, or numeric precision; see Gronlund & Linn, 1995).

Creating the scoring rubric. Scoring rubrics are usually analytic or holistic in nature. For an analytic rubric the item writer lists desired features of the response with a number of points awarded for each specific feature. A holistic rubric provides a scale for assigning points to the response based on overall impression. A range of possible points is specified (e.g. 0-8 or 0-3), and verbal descriptors are developed to characterize a response located at each possible point on the scale. Illustrative responses that correspond to each scale point are often developed or selected from actual examinee responses. These exemplars are called anchor papers because the scorer uses them as benchmarks for comparison when deciding where an examinee's response falls on the score scale.

Scoring responses. During subjective scoring at least four types of rater errors may occur as the rater (a) becomes more lenient or severe over time or scores erratically due to fatigue or distractions; (b) has knowledge or belief about an examinee that influences perception of the response; (c) is influenced by the examinee's good or poor performance on items previously scored; or (d) is influenced by the strength or weakness of a preceding examinee's response. To reduce these effects, a scoring process recommended for classroom teachers includes the following:

1. Mask student names to facilitate "blind" scoring;
2. Use the key on a trial basis for a small sample of papers and revise as necessary;
3. Grade all responses to a single item at one sitting if possible;
4. Shuffle papers between scoring different items so that examinees' responses are scored in varying order;
5. Mask the scores after initial scoring and rescore at least a sample of responses.

In large-scale testing programs, many raters participate in the scoring process. Prior to scoring, raters are trained to use common standards in extensive practice sessions using previously scored anchor papers. During scoring, each response is typically scored by at least two raters. Rater performance is monitored throughout the scoring process (Lane & Stone, 2006).

PERSISTENT ISSUES IN CONSTRUCTED RESPONSE TESTING

Using constructed response items presents issues that do not arise with objective item formats. Lane and Stone (2006) identify and discuss a number of these, but a few selected examples are as follows: Should the assessment present a few important tasks that demand complex, lengthy responses or more items, requiring briefer responses that provide broader sampling of the content and more reliable scores? Should examinees have a choice of prompts or should all respond to the same prompts? Does handwriting quality affect scores? Should examinees have a choice between handwriting or composing their responses at a computer keyboard? Do electronic scoring programs yield comparable results to those of human raters?

Such questions spark continuing debate for two reasons. First, research results from published studies on the issue may be conflicting or may not apply to other testing situations or populations. Second, these issues involve often value judgments rooted in differing educational philosophies. The final decision on such issues in a specific situation should rest on a rationale that weighs available research evidence, viewpoints of stakeholders, and possible consequences.

EVALUATING THE ITEMS

Despite the item writer's best efforts, subjective item prompts and rubrics will contain flaws. The most serious flaws are: mismatch to the content standards; ambiguity of wording; incorrect information in rubrics; inappropriate level of difficulty; content or wording that is offensive to some examinees, and potential for creating gender or ethnic bias due to the problem context or particular wording. Classroom teachers may ask colleagues to review a draft of items and critique them for such flaws. In large scale testing programs such reviews are conducted by multiple independent panels of experts (Welch, 2006).

After item administration, the examinees' numeric scores on each item provide a data set that can be analyzed to determine if the item functioned properly. This analysis typically includes computations of (a) mean item score and distribution statistics; (b) rater consistency indices (i.e., percentage of examinees receiving identical and contiguous scores from multiple raters or the correlations between the raters' scores); (c) consistency of examinee performance across different subjective items; and (d) relationship between item score and score on an objective section of the test (Schmeiser & Welch, 2006). In large scale assessments, these analyses are conducted after the items are field tested prior to live use. Flawed items can be revised or eliminated. At the classroom level, when the item analysis reveals a problem, adjustments to

the scoring rubric can be made and responses can be rescored before examinees' scores are reported.

SEE ALSO *Classroom Assessment*.

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Linda Crocker

T

TA (TEST ANXIETY)

SEE *Evaluation (Test) Anxiety*.

TEACHER BELIEFS

In 1975 Dan Lortie coined the term *apprenticeship of observation* to describe the phenomenon that the majority of teachers teach very similarly to their own teachers:

Teaching is unusual in that those who decide to enter it have had exceptional opportunity to observe members of the occupation at work; unlike most occupations today, the activities of teachers are not shielded from youngsters. Teachers tend to underestimate the difficulties involved, but this supports the contention that those planning to teach form definite ideas about the nature of the role (p. 65).

Lortie contends many beliefs teachers hold about teaching originate from personal experiences as students. Some beliefs may derive from other personal experiences such as family traditions and values, social encounters, community participation, popular culture, teacher preparation, observing teachers, professional development, and scholarly literature.

Inasmuch as they originate from personal experience, beliefs are similar to attitudes and knowledge. Much scholarly debate attempts to determine just how beliefs, attitudes, and knowledge differ. In a 1992 article, M. Frank Pajares echoed Lortie's findings and described the difficulty in distinguishing attitudes from beliefs in the

ways researchers have defined and studied them. Likewise, Patricia Alexander has described the challenges in deciphering what knowledge and beliefs have in common and how they are distinct. What is undisputed is beliefs have a motivational component and play a role in driving behavior.

Teachers' beliefs exist on many levels from global to personal and serve as overarching frameworks for understanding and engaging with the world. They can be thought of as guiding principles teachers' hold to be true that serve as lenses through which new experiences can be understood. Teachers' beliefs may be formed without evidence and sometimes in the face of contradictory evidence. They are a part of teachers' identities. Beliefs, and their influence, tend to be unexamined by teachers because many are implicit, unarticulated, or unconscious. The literature suggests failing to examine beliefs can have negative consequences as they guide practice and priorities, determine what is ignored, influence decision making, and shape what types of interactions are valued.

KINDS OF BELIEFS TEACHERS

HOLD

Fundamentally, teachers' beliefs shape their professional practice. However, the study of teachers' beliefs has been tricky because of the multi-dimensionality of beliefs and the traditional boundaries drawn in educational psychology and teacher education about which beliefs constitute a relevant subset. For example, though teachers' beliefs as parents or as members of a religious group matter, much of the literature has focused on the beliefs most directly related to classroom practice. These beliefs can be

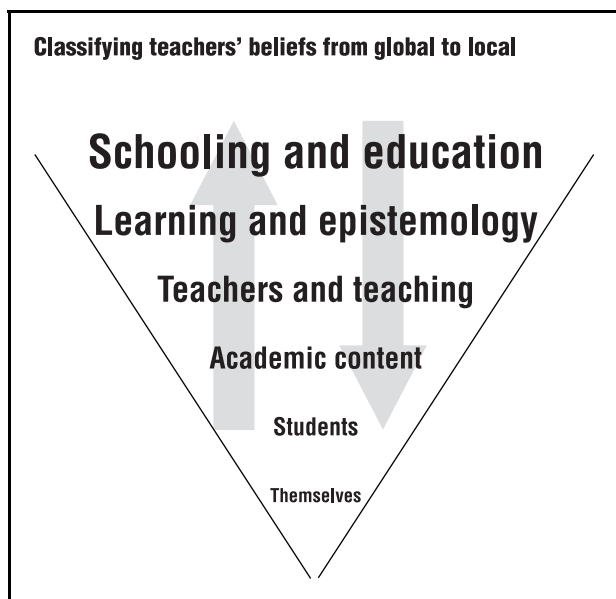


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

organized into categories, each of which operates on a different level ranging from societal to personal. Figure 1 presents these categories as an inverted pyramid with the most global beliefs located at the top and filtering down toward to the most local beliefs teachers have about who they are. Placing teachers' beliefs about themselves as the most local should not, however, suggest they are of lesser importance or that they do not impact other beliefs. In fact, change in teachers' beliefs, at any level, can create a ripple effect throughout the teachers' entire system of beliefs.

Table 1 describes each category of belief along with a working definition synthesizing the related literature and a list of scholars whose work is directly related to that category. The categories are: schooling and education, epistemology, learning, teaching and teachers, academic content, students, and themselves.

BELIEFS ABOUT SCHOOLING, EPISTEMOLOGY, LEARNING, AND TEACHING

At the most global level, teachers hold beliefs about the purpose of schooling. For some teachers, these beliefs are rooted in a holistic perspective wherein the purpose of education is to help all children reach their full potential in every facet of their lives. Other teachers' beliefs, however, are rooted in more essentialist models that position schools as places in which students acquire knowledge critical to becoming productive members of society. Still others believe schooling should envision a new society,

help students become lifelong learners, or enhance the students' individuality.

Beliefs about the role of education can filter down and impact teachers' epistemological beliefs. These include "beliefs about the nature of knowledge and the processes of knowing" (Hofer & Pintrich, 1997, p. 117). They include beliefs about what criteria should be used to determine the validity and value of different types of knowledge. When identifying their epistemological orientation, teachers must ask themselves: Is knowledge singular or multiple? Must all knowledge be consistent or is there room for contradiction? And, who can be the source of knowledge: the teacher, society as a collective, or some singular, external authority?

Just as these epistemological beliefs are shaped by beliefs about the role of schooling, teachers' beliefs about learning are influenced by their epistemological beliefs. Beliefs about learning include those related to how people learn and what it means to have learned (Hofer & Pintrich, 1997). For example, teachers who have essentialist views of education are likely to believe that only certain kinds of knowledge are valid. They, therefore, are likely to focus their efforts on having students learn those kinds knowledge. Similarly, epistemological beliefs impact teachers' understandings of what it means to teach and how teaching is best accomplished. For example, teachers who believe authority figures (e.g., teachers, doctors, scientists) are the only real sources of knowledge may adopt a more behaviorist perspective about learning. They are also likely to enact transmissionist instructional techniques, such as direct instruction, founded on the notions that teachers know and students learn when teachers give them knowledge.

Alternatively, teachers who believe the self can be a valid source of knowing are likely to structure their classrooms in ways that emphasize students' contribution to the learning process. Furthermore, these teachers tend to believe that teachers and students know and learn together and that learning happens best through dialogue and shared interaction. Discussion and discovery learning pedagogies were founded in the belief that individuals and groups can create meaningful understandings.

TEACHERS' BELIEFS ABOUT ACADEMIC CONTENT, STUDENT POPULATIONS, AND THEMSELVES

Global beliefs have local impact on teachers' beliefs about the content they teach, their students, and themselves as teachers. Susan Stodolsky and colleagues argue teachers' beliefs about academic content, particularly with regard to status, stability, sequence, and scope, shape their practice. These beliefs inform the concepts teachers emphasize, the way they order and organize material, the student understandings and misunderstandings they anticipate, and their instructional and assessment decisions.

Teacher beliefs and prominent programs of research		
Type of belief	Working definition	Eminent scholars
Schooling and education	Teachers hold beliefs about the nature and purpose of schooling including the reasons why we send children to school; what it means to educate; and what should be the ultimate goals of an (public or privately funded) education system.	Mortimer Adler, George Counts, John Dewey, Paulo Freire, Barbara Finkelstein, Maxine Greene, Eric Donald Hirsch, Jr., Bell Hooks, Nel Noddings
Epistemology	Teachers hold beliefs about the nature of knowing and knowledge including what types of knowledge are valued and what are the trusted sources of knowledge.	Patricia Alexander, Barbara Hofer, Paul Pintrich, Gregory Schraw, Gale Sinatra
Learning	Teachers hold beliefs about how people learn and the 'best' ways to support conceptual change.	Hilda Borko, James Greeno, Hugh Munby, Tom Russell
Behaviorist	Teachers who endorse behaviorist views of learning believe in the power of external forces, like rewards and consequences, to shape new learning.	Clark Hull, Ivan Pavlov, B. F. Skinner, Edward Tolman, Edward Thorndike, John Watson
Social cognitivist	Teachers who endorse social-cognitive views of learning emphasize the ways in which environmental factors work in combination with students' prior knowledge and their personal motives to create opportunities for performing different behaviors and intellectual tasks.	Albert Bandura, Dan C. Lortie, M. Frank Pajares, Barry Zimmerman
Social constructivist	Teachers who endorse social-constructivist views of learning believe in the power of culture, be it family culture, classroom culture or school culture. They view their role in the classroom as that of a gatekeeper—providing students with intellectual tools that can help them to increase their participation in the school and larger community.	Barbara Rogoff, Lev Vygotsky, Reggio Emilia Approach
Cognitivist	Teachers who endorse a cognitive view of learning emphasize the potentials and limits of students' understanding based on their prior knowledge, their memory capacity, their mental strategies, and their abilities to connect new understandings to what they already know.	Noam Chomsky, Jerome Bruner, Richard Mayer
Constructivist	Teachers who endorse a constructivist view of learning emphasize the individual nature of knowledge construction and emphasize the importance of students' experiential learning.	Paul Cobb, Maria Montessori, Jean Piaget, Virginia Richardson
Teaching and teachers	Teachers hold beliefs about what it means to be a teacher including what roles and responsibilities teachers bear, what it means to serve students, what norms and mores are appropriate for classrooms, and what instruction "should" look like.	Douwe Beijaard, Marilyn Cochran Smith, Linda Darling-Hammond, Lisa Delpit, Fred Korthagen, Lee Shulman, Nancy Zimpher
Classroom management	Embedded in teachers' beliefs about instruction are their understandings of how to best manage a classroom to promote learning. These are, in part, a reflection of their beliefs about the nature and value of student-teacher and peer interactions.	Edmund Emmer, Carolyn Evertson, Nancy K. Martin, H. Richard Milner, Leslie Soodak, Carol Weinstein, Charles H. Wolfgang
Culturally relevant pedagogy	Embedded in teachers' beliefs about instruction are their beliefs about culture in general and classroom culture specifically. These beliefs include beliefs about the role students' home culture should play in the classroom. They focus teachers' efforts on either helping students to assimilate to a predetermined culture or on facilitating students' contributions to a negotiated culture.	David Brown, Geneva Gay, Jacqueline Irvine, Gloria Ladson-Billings
Subject matter/ academic content	Teachers hold beliefs about the nature and structure of the subject matter being taught. These beliefs guide them when planning what the important ideas are in their field, how to sequence their instruction, and what standards should be used in judging student mastery.	Pam Grossman, John Guthrie, Deborah Stipek, Susan Stodolsky
Students	Teachers hold beliefs about the nature of being a student including what it means to be a good student, how students should behave, how students can best spend their time, and the nature of ideal teacher-student relationships.	Jere E. Brophy, Mary McCaslin, Robert Rosenthal, Richard E. Snow, Thomas L. Good
Individual differences in learning	Teachers' beliefs about the impact of learner differences on classroom practice are closely tied with beliefs about the nature of intelligence. They shape teachers' conceptions about the amount of their time and energy different students will require to be successful.	Scott Danforth, Carol Dweck, Howard Gardner, Leslie Soodak, Robert J. Sternberg
Individual differences in interactions	Teachers' beliefs about the nature of students' stable identity characteristics such as their gender, race, religion, or sexual orientation. These beliefs shape can their instruction and interactions with students, privileging some and marginalizing others.	Molly Blackburn, Beverly Cross, Geneva Gay, Etta Hollins, Robert Pianta, Susan Talburt
Themselves	Teachers hold beliefs about themselves in the role of teacher. These include beliefs about their identity, knowledge, capabilities, values, desires, and needs.	Robert Bullough, Jane Danielewicz, Adrienne Dixson, Gail McCutchen, Beverly Tatum, Bruce Toroff
Self-efficacy	Teachers hold beliefs about their own abilities including the extent to which they believe they can be successful in all of their teaching tasks.	Patricia Ashton, Anita Woolfolk Hoy, M. Frank Pajares
Sense of responsibility	Teachers hold beliefs about outcomes they are, and are not, responsible for in their classroom, in their school, with their students.	Thomas Gusky, Julian Rotter

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Even more local than beliefs about content are teachers' beliefs about their students. These beliefs include what it means to be a student, how students should relate to teachers, and the impact of student differences on classroom practice and culture. Scholars such as Richard Ryan, Edward Deci, and Johnmarshall Reeve assert that in order for students to assume responsibility for their own learning they must feel autonomous, competent, and connected to their classmates and teachers. Underlying their theories is the assumption that in order to be self-determined, students must have these fundamental needs met. However, their research suggests teachers' beliefs about their own need to be in control may be in conflict with students' needs.

Likewise, teachers' beliefs about whether their students need relationships with them may be in conflict with what the literature says students actually need. Robert Pianta argues that all students need to experience close relationships with their teachers. However, the literature (see Davis, 2003) suggests that teachers may regard this need as varying with students' development or social group. Similarly, the work of Jere Brophy and Mary McCaslin (McCaslin has also published under the name Mary Rohrkemper) investigates teachers' definitions of and interactions with problem students. When teachers believe the source of behavior problems is a lack of competence as opposed to an attempt to usurp control in the class, they tend to respond with more caring and are more likely to help those students achieve competence. Other researchers have explored the causes of behavior understood by teachers to be disruptive. For example, Molly Blackburn writes about the experience of lesbian, gay, and bisexual students who are perceived as disruptive but who in actuality may be expressing malcontent with an irrelevant curriculum. More generally, Jacqueline Irvine's work highlights that teachers' beliefs about the way students should behave at school may prevent them from recognizing and appropriately responding to student behavior that critiques marginalizing curriculum. Irvine introduced the concept of *cultural synchronization* to describe how teachers' beliefs about certain student groups may be in conflict with the actual motives, values, and needs of those students. Clashes between teachers' and students' beliefs may have negative instructional and interpersonal consequences.

At the most local level, teachers hold beliefs about themselves—who they are in relation to curriculum, colleagues, and students; perceived strengths and weaknesses; values; self-efficacy; and matters about which they feel responsible. These beliefs may be domain specific; teachers may hold beliefs about who they are as instructors that are different from their beliefs about themselves as classroom managers or content experts. These beliefs may be hierarchically organized such that a teacher may believe they are experts in their fields, they are strong instructors, but they struggle with classroom management. Because teachers

may weigh these domains differently (i.e., placing the most value on being a strong instructor), when asked if they are good teachers, they may respond based on a global perception that they are. Finally, beliefs may not necessarily be calibrated with actual behaviors. In her study of pre-service teachers, Carol Weinstein documented how novice teachers are likely to be unrealistically optimistic regarding their ability to manage classroom tasks.

Finally, it is important to note the majority of the literature on teachers' beliefs has been based predominantly on studies of white, middle class, female teachers (Woolfolk Hoy, Davis, & Pape, 2006). In "The Silenced Dialogue," Lisa Delpit reinforces the notion that teachers from underrepresented or marginalized populations may hold different beliefs about teaching minority students and, therefore, view themselves and their tasks very differently. One African American principal in Delpit's study expressed her experience of being ill-represented in the literature and of her majority colleagues using this literature to ignore her perspective. The principal was quoted as saying: "If you try to suggest that's not quite the way it is, they get defensive, then you get defensive, then they'll start reciting research. I try to give them my experiences, to explain . . . they don't really hear me" (Delpit, 1995, p. 22). Delpit argues alternative, and perhaps transformative, perspectives of minority teachers are not represented in the research base and deserve to be voiced.

THE IMPORTANCE OF TEACHERS' BELIEFS

In the 1960s, Robert Rosenthal (b. 1933) began examining expectancy beliefs and self-fulfilling prophecies research that has remained robust into the early 2000s. When teachers expect students to perform (i.e., high or low), they behave in differential ways that bring about the expected performance. In *Pygmalion in the Classroom: Teacher Expectations and Pupil's Intellectual Development* (1968), Rosenthal and Jacobsen documented how teachers' beliefs about student ability can be subtly manipulated such that teachers believe some students to be more able than their peers and how their beliefs about student ability affect students' actual achievement. Rosenthal's research was extended to understand systemic differences in the way teachers approach students from lower economic standing (Alvidrez & Weinstein, 1999), students in urban settings (Causey, Thomas, & Armento, 2000), and special education students (Soodak, Podell, & Lehman, 1998).

Measuring the power of teachers' beliefs about student intelligence became important. In 1973 W. Burleigh Seaver conducted a naturalistic experiment to examine the effects of teachers' expectations of students' performance given the performance of a high or low achieving sibling

in their class in a previous year. Underlying this study was the assumption that teachers expect siblings to perform similarly given their shared family context and/or genetic makeup. Using school records, and controlling for the younger siblings' actual intelligence, older siblings were classified as either high or low performers and younger siblings' performances when they had the same or different teacher were examined. "When the older sibling had performed at a high level, the expectancy group [i.e., having the same teacher] scored better than the control; when the older sibling had performed poorly, the expectancy group scored lower than the control group" (p. 337). The average size of the effects was .30 on a grade equivalency score, approximately the achievement that happens across one-third of an academic year.

Self-fulfilling prophecies, such as those about student ability, operate through two forms of messages teachers send to students: the explicit (i.e., what is consciously said) and implicit (i.e., what is unconsciously said). In 1973 Rosenthal "derived four major types of teacher behaviors that appear to be associated with [teacher] expectancy effects. These are (1) climate is the teacher warm and encouraging to the pupil? (2) feedback does the teacher offer evaluative comments on the pupil's ongoing performance? (3) input how much does the teacher try to teach the child? (4) output how many opportunities does the teacher give the child to respond?" (Hall et al., 2001, p. 163).

Teachers' beliefs are a form of subjective reality: What they believe is real and true. Their beliefs guide their decision-making, behavior, and interactions with students and, in turn, create an objective reality in the classroom, what students experience as real and true. Teachers' beliefs shape their planning and curricular decisions, in effect determining what should be taught and what path instruction should follow. Moreover, their beliefs are not always a reflection of accepted notions in the field. In a 1998 study of teachers' and students' understandings of knowledge (from prior experience and formal instruction in school) and beliefs, Patricia Alexander and colleagues found teachers and students recognize beliefs and knowledge may not overlap:

Our students and teachers in both Singapore and the United States suggest that there are those objective dimensions of one's understanding (i.e., knowledge) that are factual in nature and learned in school but of limited importance or value. In contrast, there are those personal tenets (i.e., beliefs) that may be unproven or even questioned in schools and society, but which are nonetheless true and which serve as the guiding forces in one's life. (p. 114)

These findings suggest teachers may hold beliefs that are in conflict with their physical and social realities; but

that, nonetheless, inform their practice. Moreover, these findings suggest that teachers cannot assume an understanding of another person's (i.e. another teacher or their students) decision-making even when they share a knowledge base. Teachers need to dig deeper to try to uncover the beliefs, the personal tenets that drive their own, their colleagues', and their students' behavior.

HOW TEACHERS' BELIEFS OPERATE

Essentially beliefs function in a way similar to a lens on a magnifying glass. They clarify and guide interpretation of what may be ambiguous or unfocused. Generally, teachers interpret ambiguous situations in ways that are consistent with their beliefs. Beliefs also serve as a foundation for setting goals and standards by framing what is viewed in detail and focusing teachers' attention and energy. Similarly, they delimit what is peripheral, determining what teachers do not see, emphasize, or examine. Because beliefs help teachers to make sense of what they experience in the classroom, they create meaning for teachers. Moreover, they prepare teachers to experience certain emotions by mapping pleasant feelings onto some experiences (i.e., success or failure) and unpleasant feelings onto others.

Debate continues about the extent to which teachers' beliefs and their identity as teachers are the same. The literature on teachers' beliefs suggests teachers may simultaneously hold beliefs that are inconsistent, in conflict, and even contradictory and still see themselves as a teacher. Fred Korthagen posits teachers are likely to be the most effective when their beliefs are aligned with each other and with the field.

That beliefs are intimately tied with teachers' sense of self (be it their personal identities or their teaching identities) is consistent across the literature, and, for this reason, beliefs tend to be resistant to change. In the face of information that challenges their beliefs, such as policy inducement to reform, to modify/include new populations of students, or to innovate with new technologies, teachers tend to feel threatened (Fecho, 2001; Gregoire, 2003). This reaction constitutes a fundamental challenge and, at times the paradox, of practicing and pre-service teacher education. The problem is to figure out how can teachers be encouraged to approach research in education, professional development, and policy reform with open minds.

HOW TEACHERS' BELIEFS CHANGE

There is an inherent tension in the field of teacher beliefs between the call for teachers to habitually confront and revise their beliefs and the need for teachers to identify and preserve beliefs that serve them well. On one hand, at some point teachers inevitably have some maladaptive beliefs because the nature of childhood, the demands of

society, and the curriculum change. On the other hand, there is an assumption in the literature, particularly with regard to beliefs about diverse students and best practice, that teachers' beliefs are bad and need to be changed. The danger of this thinking is that in order to protect their sense of self as good persons and as effective and altruistic teachers, teachers may defensively hold on to beliefs that do not serve their students. What appears to be a dichotomy here need not be. What teachers need to be encouraged to do is honestly face their beliefs in their entirety, evaluating which beliefs serve them, their content, and their students and which do not.

The question is what teachers should do when they confront beliefs that do not work anymore. The malleability, or persistence, of beliefs and ways to bring about belief change are highly debated issues. In general, the more beliefs are tied to a teacher's sense of self, the more they will resist change. Literature in the field of teacher education often suggests that the ideal conditions for belief change include: 1) bringing pre-existing beliefs to consciousness, 2) creating conditions in which pre-existing beliefs break down, 3) helping teachers to judge the conflict as challenging rather than threatening (Gregoire, 2003), and 4) providing teachers with the necessary time to reflect on their beliefs and reconcile them with the field and their current teaching context (Davis, 2006).

Mere awareness of beliefs may not be motivating enough to create change. Nearly all theories of conceptual change would argue that there needs to be some cognitive dissonance by which teachers see their beliefs do not work given serving a specific student population, teaching a specific concept, or enacting desired outcomes. Dissonance challenges teachers by forcing them to face failures, however small. When studying adaptive teaching Lyn Corno and colleagues (Corno & Snow, 1985; Rohrkemper & Corno, 1988) describe how adaptive teachers face dissonance and learn from it. Corno contends adaptive teaching involves monitoring which students are struggling and identifying the sources of the struggle. She argues that failures can have meaning and can transform teaching. In some cases, student failure can point to beliefs teachers have that are holding students back. Can teachers reframe failure to help themselves grow professionally? By thinking of students' struggles as "functional failures" (Rohrkemper & Corno, 1988; p. 303) teachers can modify what they are doing to help their students learn and, in doing so, help themselves to work more effectively with all students and their subject matter. What makes this so hard, according to Michelle Gregoire Gill, is helping teachers learn to interpret failure (or educational reform) as a challenge and an opportunity for growth rather than as a threat.

Perhaps the most challenging parts for administrators and teacher educators are building in the time and

providing teachers with the tools necessary to engage in productive reflection (Davis, 2006). Elizabeth Davis describes the ways reflection on beliefs can go awry and makes three recommendations. First, teachers should be encouraged to move beyond describing what they see and experience and to analyzing what is happening in their classrooms. Second, teachers should be encouraged to think about problems from an alternate perspective, particularly their students'. Third, to put an end to dichotomous thinking, teachers should be encouraged to integrate what may feel like competing tensions and create space for new solutions. Fundamentally, doing so entails a shift from either-or to both-and thinking. In other words, instead of teachers feeling like they have to choose between following their beliefs or participating in reform, when reform is important, teachers should seek ways to align their beliefs with the reform.

IMPLICATIONS FOR CLASSROOM TEACHERS

If there are three clear messages throughout the literature on teachers' beliefs, they are, first and foremost, that teachers' beliefs have profound impact on classroom life; that the beliefs that impact students are layered, multi-dimensional, sometimes implicit, and difficult to change; and that teachers who fail to examine their beliefs may bring about unanticipated consequences in the classroom. Without intending to, teachers may set aside valuable curriculum, overlook or marginalize students who need them, misinterpret students' motives or behavior, and limit their potential as professionals. Conversely, teachers who are willing to explore their beliefs, and how their beliefs relate to practice and the professional knowledge base, can capitalize on the beliefs they hold to promote students' intellectual growth, autonomy and reciprocity, and equity in their classrooms. Moreover, they create spaces for their own growth as they identify and revise beliefs that do not serve them, their students, or their schools.

SEE ALSO *Conceptual Change; Epistemological Beliefs; Identity Development; Knowledge; Metacognition; Teacher Efficacy; Theories of Learning.*

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TEACHER EFFICACY

The concept of self-efficacy was pioneered by Albert Bandura (1925) who characterized self-efficacy as the extent to which individuals believe they can organize and execute actions necessary to bring about a desired outcome. Self-efficacy is fundamentally concerned with the execution of control rather than the outcome action produces.

In 1984, Patricia Ashton (1946) published a groundbreaking study that fundamentally expanded the concept of efficacy to include the extent to which teachers feel confident they are capable of bringing about learning outcomes. Ashton identified two dimensions of teaching efficacy: general, the extent to which a teacher believes her students can learn material; and personal, the extent to which a teacher believes her students can learn under her instruction. Ashton argued that teachers' beliefs

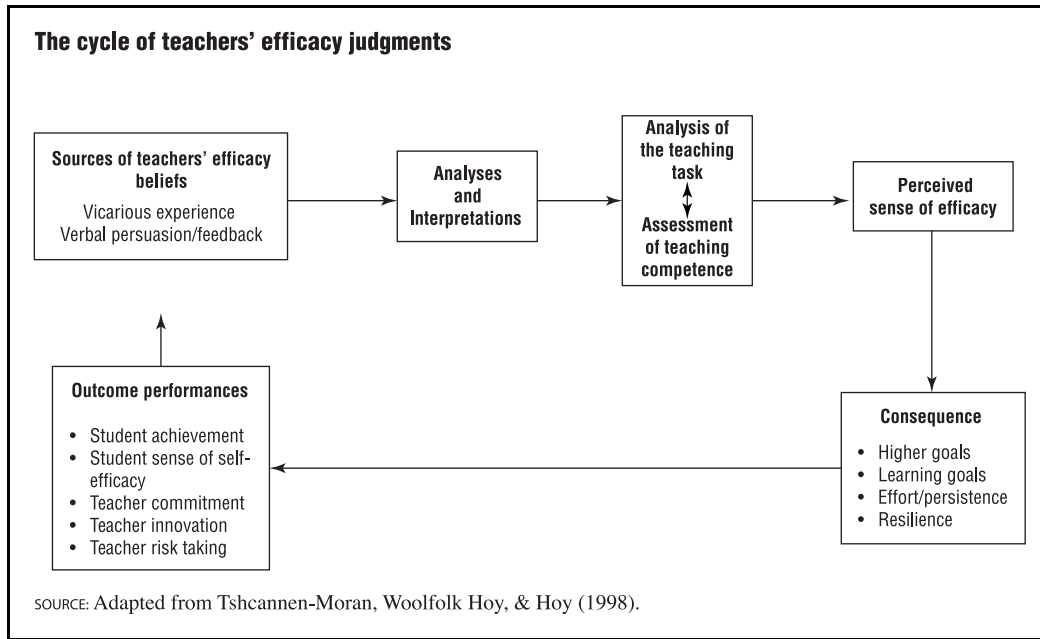


Figure 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

about their ability to bring about outcomes in their classrooms, and their confidence in teaching in general, play a central role in their abilities to effectively serve their students. Since then, studies of teaching efficacy and its inclusion in studies of teacher effectiveness have grown exponentially.

Subsequent understandings of teaching efficacy have refined Ashton's understanding of personal efficacy. In a seminal review of teacher efficacy, Megan Tschannen-Moran (1956) and Anita Woolfolk Hoy (1947) operationalized teachers' sense of control over student outcomes in the Teachers' Sense of Efficacy Scale (TSES) (Tshannen-Moran & Woolfolk Hoy 2001). Rather than thinking about efficacy as a proxy for a global sense of confidence, they defined teacher efficacy as teachers' perceptions of their resources and strategies for bringing about student behavioral and instructional outcomes. Rather than ask, "How much can you help your students think critically?" the TSES asks, "How much can you do to help your students think critically?" This minor change in wording illustrates a critical issue in teacher efficacy research: that teachers' sense of efficacy reflects the judgments they make about their capabilities given the emotional and instrumental resources they can gather in a specific context. Because teachers' judgments of their resources and strategies may vary across teaching contexts, Woolfolk Hoy argues that teachers' efficacy beliefs may not be uniform across all disciplines or even across all student populations. It is therefore important to account for context and discipline in order to accurately assess teacher efficacy.

HOW TEACHERS DEVELOP SELF EFFICACY BELIEFS

Tshcannen-Moran and colleagues (1998) developed a model of teacher efficacy identifying the ways in which efficacy judgments result as a function of the interaction between teachers' analysis of teaching task in context and their teachers' assessment of their personal teaching capabilities as they relate to the task (see Figure 1). In addition, Bandura also identified four specific sources of efficacy beliefs: mastery experiences, vicarious experiences, verbal persuasion, and arousal. Mastery experiences are direct encounters with success through engagement in a behavior that brings about a desired outcome. For example, student-teachers who facilitate laboratory experiments in which students demonstrate conceptual understanding may believe their actions led to student learning. These judgments are likely to increase their efficacy for conducting lab experiments in the future. This may be why some studies have found a connection between teacher education coursework and pre-service teacher efficacy. If student-teachers watch experienced teachers successfully facilitate laboratory experiments, they might also develop a sense of efficacy because they saw how to implement the actions necessary to bring about students' success. This would be an example of a vicarious, or observed experience leading to higher efficacy.

When student-teachers do not have opportunities to observe, their mentor teachers might remind them of the teaching skills they have developed and provide them with specific suggestions. This would be an example of

verbal persuasion, which appeals to the teacher's ability to bring about success. Finally, arousal is a physiological state involving the release of hormones that signal an individual to prepare for action. Arousal can be interpreted as both pleasant and unpleasant. On the one hand, the body's natural release of hormones while teaching can help teachers feel alert or excited to take on the challenges of the lesson. On the other hand, heavy release of hormones (as in the case of extreme nervousness) can be paralyzing rather than helpful.

Calibrating and Re-Calibrating Teacher Efficacy. There is little consistency across the literature regarding the stability of teacher efficacy over time; some studies indicate efficacy may increase over time and others suggest it may decline. What is clear is that teachers' efficacy judgments tend to calibrate when they move into new contexts. For example, Woolfolk Hoy and Burke-Spero (2005) found teacher efficacy declined as they entered the field. One explanation for possible initial declines in efficacy may be that when new teachers enter the teaching force, they encounter a "reality shock" as they confront the complexity of the teaching task. Carol Weinstein (1988) suggests this may indicate a tempering, or calibration of overly optimistic efficacy beliefs, or what she termed "unrealistic optimism." Those who continue to feel incompetent are likely to leave the field, while teachers who remain in the field appear to experience a rebound in their efficacy judgments.

THE CONTEXT AND MEASUREMENT OF TEACHER EFFICACY

Teacher efficacy beliefs are one type of belief within a system of interrelated self-beliefs. Moreover, teacher efficacy beliefs emerge, in part, as a function of teachers' global and specific judgments about themselves within the context of their classroom. In the field of teacher beliefs, there has been a lot of debate about how best to study the relationship between teachers' beliefs about themselves and the impact of these beliefs on classroom learning. In part, this is because scholars from across a variety of research traditions developed frameworks for understanding self-beliefs, with each framework critiquing the level at which we should evaluate teachers' beliefs, the domains that matter, and which judgments inevitably lead to action. In an effort to delineate what teacher efficacy is and how it should be measured Table 1 outlines conceptual distinctions among the prominent programs of research on teachers' other self-beliefs.

Although teacher efficacy is related to self-concept, self-esteem, locus of control, and sense of responsibility, it is theoretically and empirically distinct from these constructs. On a global level, teachers hold beliefs about who

they are in their classroom, their teaching self-concept, and how they feel about themselves in their classrooms, their teaching self-esteem. Teachers' self-concepts and self-esteem are considered global because they are broad, descriptive mental representations teachers hold about the work they do in their classrooms. In contrast, scholars studying teacher efficacy attempt to identify specific, task-related judgments teachers make about their ability to bring about task-specific outcomes.

Carl Rogers (1902-1987) defined self-concept as a personal understanding of the self relative to other people and environments but unaffected by tasks or contexts. Teacher self-concept goes beyond merely identifying characteristics, "I am a teacher," to classifying those characteristics, "I am a good teacher." Whereas self-concept is based upon comparative judgments, self-esteem is based upon affective judgments. Teacher self-esteem may be defined as the evaluation of each characteristic contained in teachers' self-concepts. For example, "I am good at motivating students" may be evaluated in terms of satisfaction, or the extent to which being a good teacher is desirable. Although self-esteem may change over time, it is not variable across tasks or contexts.

Scholars studying teachers' locus of control and their sense of responsibility are primarily focused on teachers' perceptions of their roles in student achievement. Role attributes are beliefs about the part a teacher can play in bringing about outcomes. Thomas Guskey (1950) characterizes teachers' perceptions of control as based primarily in the teacher (internal) or other factors (external) and variable across situations. If control over an outcome is attributed internally, individuals are more likely to engage in a behavior. The critical distinction between locus of control and self-efficacy is the emphasis on product rather than process; locus of control asserts that individuals are motivated to act based upon perception of control over the outcome. If teachers believe control lies within the student (e.g., smart/dull) or other external factors (e.g., family/community), they may be less likely to engage in actions that bring about desired outcomes even if they feel they can successfully execute those actions.

Responsibility models address teachers' underlying beliefs about who should bring about outcomes. Teachers' sense of responsibility is both an internal and external orientation deriving from perceptions of professional/ethical and personal/moral obligation. Perceptions of control and responsibility can impact teachers' efficacy judgments. In an environment where schools are becoming increasingly culturally diverse and where teachers are held strictly accountable for their students' success on standardized tests, teachers' ability to serve minority students and address politically sensitive issues is limited. Yet, many teachers are motivated to serve students who

Differentiating between teachers' sense of efficacy and their self-concept, self-esteem and self-worth

Construct	Definition	Characteristics	Sample items	Related articles
Teachers' sense of efficacy	Teachers' perceptions of their ability to accomplish specific tasks in a given context.	Task and context specific; Future-oriented; Not based on comparisons with other people or with other aspects of the self—rather question is "Can I do it?" Judgment of capability.	"How much can you do to help your students think critically?" (Instructional) "How much can you do to control disruptive behavior in the classroom?" (Classroom Management) "How much can you do to motivate students who show low interest in school work?" (Motivation) "Students would come to me when they have problems in their daily life because they know I can help." (Relationships)	Tschannen-Moran, Woolfolk Hoy, & Hoy (1998) TSES: Tschannen-Moran & Woolfolk Hoy (2001) Ho & Hau, 2004
Teacher self-concept	Global perceptions of my competence as a teacher.	Global; present orientation; includes self-efficacy and other self-judgments; based on comparisons with others (e.g., "I work with parents better than most teachers") or with self ("I'm better at lecturing than guiding group work").	"I am a good teacher." "My students learn many important things from me."	Friedman & Farber (1992) Brown (2004)
Teacher self-esteem	Global affective statements reflecting teachers' self-evaluations of their accomplishments.	Judgment of self-worth; not necessarily related to self-efficacy—can have low efficacy for a task, but not value the task, so self-esteem is unaffected.	"On the whole, I am satisfied with myself." "I wish I could have more respect for myself."	Singh (1984) Juhasz (1990) Christou, Phillipou, & Menon (2001)
Locus of control and teachers' sense of responsibility	Teachers' beliefs about their responsibility for student outcomes.	Teachers' attributions for student outcomes (Guskey). Teachers' acceptance or rejection of responsibility for implementing culturally relevant pedagogy (Kozel).	"If a student does well in your class, would it probably be: a. because that student had the natural ability to do well, or b. because of the encouragement you offered?" "It is my responsibility to ensure that all students are able to participate in every lesson." "It is my responsibility to provide accurate information about sexual orientations." (Specific beliefs about racial, religious, and social minorities)	Guskey (1988) Kozel (2007)

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

need the most help (Winfield, 1986). Teachers may engage in activities designed to serve such students even when they do not feel efficacious or believe the outcome is outside of their control.

HOW TEACHER EFFICACY AFFECTS CLASSROOM LEARNING

In light of so many different ways of defining teachers' beliefs about themselves, why is teacher efficacy such an important construct? Simply put, empirical studies have recognized teacher efficacy as a major predictor of teachers' competence and commitment to teaching—more powerful than self-concept, self-esteem, and perceived control. Four seminal reviews of the impact of teacher efficacy by Ross (1998), Goddard et al. (2000), Labone (2004), and Wheatley (2005) reveal consistent findings: teachers who report a higher sense of efficacy, both individually and as a school collective, tend to be more likely to enter the field, report higher overall satisfaction with their jobs, display greater effort and motivation, take on extra roles in their schools, and are more resilient across the span of their career. Moreover, the extent to which shifts in teacher efficacy take place as teachers transition into new contexts appears to depend upon the level of support in the context; greater support from administrators and colleagues buffers against declines.

Individual Teacher Efficacy. Teachers with higher levels of efficacy are more likely to learn and use innovative strategies for teaching, implement management techniques that provide for student autonomy, set attainable goals, persist in the face of student failure, willingly offer special assistance to low achieving students, and design instruction that develops students' self-perceptions of their academic skills. Moreover, Woolfolk Hoy and Davis (2005) argue that teachers who feel efficacious about their instruction, management, and relationships with students may have more cognitive and emotional resources available to press students towards completing more complex tasks and developing deeper understandings. This is because teachers with a high sense of efficacy may be less afraid of student conflict and more likely to take greater intellectual and interpersonal risks in the classroom.

Teachers' Collective Sense of Efficacy. Collective teacher efficacy is “the perception of teachers in a school that the efforts of the faculty as a whole will have a positive effect on students” (Woolfolk Hoy, et al., in press). Hoy and Miskel (2008) argue that a school's system of shared beliefs binds the teachers together and gives the school a distinctive identity. Like self-efficacy, collective efficacy is associated with the tasks, level of effort, persistence, shared thoughts, stress levels, and achievement of groups. Studies have demonstrated that higher aggregate teacher and collective efficacy is associated with increased rates of parental

involvement, increased school orderliness, teacher innovation, teacher familiarity with colleague's courses, reduced suspensions and dropout rates, and higher achievement across elementary and secondary schools. In a series of studies Roger Goddard (1966) and colleagues found the collective efficacy of a school had a greater positive impact on student achievement than the locale of the school (i.e. urban, suburban, rural) and individual student demographic variables (e.g. race, gender, socio-economic status).

IMPLICATIONS FOR TEACHERS

The literature on teacher efficacy has important implications for the induction of new teachers and the professional development of practicing teachers. Broadly, research on teacher efficacy can help teachers think about the ways in which they approach tasks in their classrooms including how accurate they are in identifying the challenge level of tasks and the extent to which they try to break down complex, challenging tasks into something more manageable. Teachers can think about the ways in which they attempt to structure their teaching tasks (e.g. selecting activities, employing new strategies/methods) in such a way that allows them to both grow professionally and feel competent. Moreover, teachers need to be reflective about the areas where they feel most and least competent. How do discrete experiences of success and failure shape their beliefs about their ability to carry out similar behaviors in the future? Teachers need to be aware that feeling incompetent may lead them to avoid important classroom tasks. Over time, teachers may purposely make decisions to avoid certain schools and students or even avoid examining data as a way to protect their sense of self. When faced with feelings of failure, teachers need to engage in active help seeking aimed at building their efficacy through mastery experiences or observing colleagues.

Preservice and Early Career. The task of teacher education is, fundamentally, to develop competent and confident teachers. Preservice teachers with little or no teaching experience may lack a sense of efficacy, and program developers need to think carefully about how to structure entry into the field in a way that promotes mastery. On the other hand, if all of their early experiences lead to success, preservice teachers may enter the field with a false, or uncalibrated, sense of efficacy because it was developed without the demands of running one's own classroom, dealing with parents and teachers or managing student problems. In a seminal paper by Rohrkemper and Corno (1985), teachers were cautioned not to ignore the value of “functional failure.” They encouraged teachers to create context in which students can learn from mistakes and learn to persist even when unsuccessful. Their work also has important implications for teacher educators, encouraging programs to

rank task difficulty, complexity and frustration of field placements for student-teachers.

Experienced and Veteran Teachers. Throughout their careers, practicing teachers must strive to maintain a “competent teacher” identity while continuing to serve their students. This can be challenging particularly in light of the increasing complexity of the teaching task (Woolfolk Hoy, Davis, & Pape, 2005). Some scholars argue that teachers with higher sense of efficacy may be more prone to experience burnout because they tend to set higher standards and expectations (Fives et al., 2007). Faced with rapid changes in student populations and reform movements, practicing teachers may feel threatened and, in lieu of seeking professional development to build mastery, may engage in behaviors designed to preserve their sense of self. While it may preserve sense of self, resistance to change may come at the cost of serving important populations of students. For this reason, it is important for administrators to consult teachers prior to and during reform movements to identify the types of professional development experiences necessary for building mastery, carefully monitoring and adjusting the level of arousal, and providing the feedback that persuades teachers they can be successful (Gregoire, 2003). Several studies suggest practicing teachers’ efficacy can be enhanced through participation in action research (Henson, 2001), reviewing lessons with colleagues (Puchner & Taylor, 2006), regular feedback on their goal pursuit (Labone, 2004), and self-reflection that helps identify and interpret mastery experiences while developing self-regulatory skills.

SEE ALSO *Attribution Theory; Caring Teachers; Relevance of Self-Evaluations to Classroom Learning; Self-Efficacy Theory; Social Cognitive Theory; Teacher Beliefs; Weiner, Bernard.*

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TEACHER EXPECTATIONS

How are teacher expectations related to student achievement? For much of the last part of the 20th century social psychologists emphasized the power of expectations to

create and distort social reality through self-fulfilling prophecies and expectancy-confirming biases, whereas educational psychologists typically emphasized the accuracy of teacher expectations. This entry conveys why 40 years of research on teacher expectations shows that teacher expectations are indeed mostly accurate and that they lead to typically small but occasionally large self-fulfilling prophecies.

TEACHER EXPECTATIONS AND RELATED CONSTRUCTS DEFINED

In studies on *teacher expectations*, the term has referred to everything from predictions to beliefs about current levels of ability and performance, to beliefs about students' *normative* behavior (essentially, cooperativeness, rule-following, etc.). This application of the term has been justified because such perceptions and beliefs are often the foundations for predictions, and, to the extent that they are inaccurate, may also produce *expectancy effects*, a term that refers to either of two related yet very different phenomena.

Two Types of Expectation Effects. First, erroneous expectations may bias or distort the expectancy-holder's judgments, a phenomenon sometimes referred to as *expectancy-confirming bias*, *perceptual bias*, or *confirmatory bias*. Sometimes perceivers' (including teachers') erroneous expectations lead them to judge, evaluate, interpret, or explain targets' (including students') behavior in ways consistent with those expectations. For example, if a teacher overestimates a student's academic competence, that teacher may evaluate the student's performance (on tests, homework, etc.) more positively than the same teacher evaluates identical work produced by a student whose academic competence the teacher underestimates. These types of expectancy biases influence the teacher's judgments about students' learning or achievement, but they do not necessarily influence students' actual learning or achievement.

The second type of expectancy effect is a self-fulfilling prophecy, which occurs when a perceiver's originally false expectation leads to its own actual (not merely perceived) confirmation. A teacher's erroneous expectation leads to its own fulfillment when it leads the teacher to behave differently towards high and low expectancy students, and when those students' achievement changes to confirm the teacher's (originally false, but now true) expectation. Thus, the high expectancy student achieves at higher levels, and the low expectancy student achieves at lower levels than they otherwise would have had the teacher's expectation been accurate.

Expectancy-confirming biases and self-fulfilling prophecies are similar because both involve expectations causing their own confirmation in some sense (which is why both are termed expectancy effects). They differ, however, in that expectancy-confirming biases occur entirely in the mind of the perceiver (or teacher), whereas the confirmation in self-fulfilling prophecy occurs as a result of an actual change in the behavior (or achievement) of the target (or student).

Accuracy. Teacher accuracy refers to correspondence between teachers' beliefs (expectations, perceptions, judgments, etc.) about one or more students and those students' characteristics or accomplishments, if the teachers' beliefs have not caused those characteristics or accomplishments. Accuracy is important for two reasons. First, accuracy constitutes a very different explanation (than bias or self-fulfilling prophecy) for why students may sometimes confirm teachers' expectations. When *expectancy confirmation* results from accuracy, it reflects teachers' expertise and competence, rather than their flaws and weaknesses. Second, accuracy represents a plausible alternative explanation (to self-fulfilling prophecy or bias) for evidence that students confirm teachers' expectations.

THE PYGMALION STUDY

The scientific study of teacher expectations was launched by the classic and controversial Pygmalion study (Rosenthal & Jacobson, 1968). Rosenthal and Jacobson led teachers to believe that some students in their classes were "late bloomers" destined to show dramatic increases in IQ over the school year. In fact, these students had been selected at random. Results showed that, especially in the earlier grade levels, the "late bloomers" gained more in IQ than other students. Teacher expectations created a self-fulfilling prophecy.

Rosenthal and Jacobson's study (1968) received considerable attention in the social sciences and the popular press because it seemed to provide a powerful explanation for the low achievement of so-called disadvantaged students. However, it was also criticized by educational psychologists on conceptual, methodological, and statistical grounds. A controversy over the existence of the phenomenon continued through the 1970s, which included numerous attempts to replicate it in classrooms and other contexts (work settings, job training programs, laboratories, etc.). Consistently, only about one-third of the studies attempting to demonstrate a self-fulfilling prophecy succeeded (Rosenthal & Rubin, 1978). This pattern was often interpreted by critics as demonstrating that the phenomenon did not exist because support was unreliable. It was interpreted by proponents as demonstrating the existence of self-fulfilling prophecies because, if only chance differences were occurring, replications would only succeed about 5% of the time.

This controversy was resolved in 1978 by Rosenthal and Rubin's meta-analysis of the first 345 studies of interpersonal expectancy effects, which conclusively demonstrated the existence of self-fulfilling prophecies. The overall expectancy effect size was equal to a correlation of about .30 between teacher expectations and student achievement, and the probability of finding the observed expectancy effects, if the phenomenon did not exist, was essentially zero.

REMAINING CONTROVERSY ON TEACHER EXPECTATIONS AND STUDENT INTELLIGENCE

The most stunning claim that emerged from Rosenthal and Jacobson's 1968 study was that teacher expectations have self-fulfilling effects on intelligence. Although IQ test scores often are the best predictors of many important life outcomes, they are also notoriously resistant to change in response to social interventions designed to increase them. In this context, the claim that teacher expectations influence IQ was extremely important, controversial, and difficult (for some) to believe.

Unfortunately, the original Pygmalion study included some results that some researchers found difficult to believe. Although the methodological and statistical issues were numerous, one particular finding was especially problematic. There were five "bloomers" with wild IQ score gains: 17 110, 18 122, 133 202, 111 208, and 113 211. If one simply excluded these five bizarre gains, the difference between the bloomers and the controls evaporated.

Thus, the claim that the Pygmalion study showed that teacher expectations can have self-fulfilling effects on student intelligence was not universally accepted. Unfortunately, the subsequent evidence was also unclear on this issue, with some reviews concluding that the effect of teacher expectations on student intelligence averages near zero, and others concluding that such effects are small, but above zero. The fairest conclusion that can be reached as of 2008, therefore, may be that, if teacher expectations do have an effect on student intelligence, it is typically quite small.

NATURALLY OCCURRING VERSUS EXPERIMENTALLY INDUCED TEACHER EXPECTATIONS

A limitation of the original Pygmalion study and many follow up experiments was that researchers intentionally misled teachers into believing that some students were likely to show dramatic achievement gains. In general, however, teachers do not develop expectations based on falsified information. Thus, some researchers examined whether self-fulfilling prophecies also occurred when teachers developed their expectations naturally, without intervention by experimenters.

Identifying causal effects of teacher expectations is much more difficult in nonexperimental research than in experimental research. In nonexperimental research any particular correlation between teacher expectations and student achievement might occur because teacher expectations caused student achievement (self-fulfilling prophecy), student achievement caused teacher expectations, or some other variable or variables caused them both.

To address this issue, most naturalistic studies took two precautions. First, they used a longitudinal (over time) design, which takes advantage of the fact that the future cannot possibly cause the past. This rules out one possible causal direction. If teacher expectations are measured early in the year, and student achievement late in the year, that student achievement cannot have caused those teacher expectations. Second, naturalistic studies also typically statistically controlled for many of the most plausible predictors of teacher expectations and student future achievement, including student past achievement and demographics, and, sometimes, student self-concept and motivation. If teacher expectations early in the year predict student achievement late in the year, after controlling for all these variables, many third-variable explanations can be eliminated.

The naturalistic research found consistent evidence of self-fulfilling prophecy. In most studies, teacher expectations early in the year predicted student achievement late in the year, even after controlling for student prior achievement, demographics, motivation, and self-concept. The self-fulfilling prophecy effect sizes in such studies was typically about .1 to .2 (in terms of standardized regression coefficients relating teacher expectations to student achievement). Although statistically significant, these effects were consistently lower than found in Rosenthal and Rubin's 1978 meta-analysis of the experiments. Why might this be?

The most likely explanation was that under naturally occurring conditions, teachers' expectations may often be accurate. Indeed, nearly all naturalistic studies of teacher expectations find: 1) student past achievement has large effects on teachers' expectations; and 2) teacher expectations predict (correlate with) student future achievement much more highly than they cause student achievement. These findings are extremely important because they reflect two types of accuracy. The first shows that teacher impression accuracy is high (*impression accuracy* is the extent to which teachers' expectations correspond with students' current characteristics or achievement). The second shows that teacher predictive accuracy is high (*predictive accuracy* is the extent to which teacher expectations predict but do not cause student achievement). Overall, the naturalistic research has shown that about two-thirds to three-fourths of the reason teacher expectations predict student achievement is that those expectations are accurate, and that

one-fourth to one-third of the reason they predict student achievement is that they create self-fulfilling prophecies.

The naturalistic research has also consistently found that teacher expectations predict student grades more strongly than they predict standardized test scores (even after controlling for prior grades, achievement, and demographics). Because teachers assign grades but not standardized test scores, this result most likely reflects expectancy-confirmation bias—teacher expectations biasing their evaluations of students, rather than influencing students' objective achievement. Both bias and self-fulfilling prophecy can and often do occur for grades, so that their effects are cumulative. Thus, expectancy effects (both bias and self-fulfilling prophecy) for grades often account for about half of the reason teacher expectations early in the year predict student grades (the remaining half being accuracy).

BASES OF TEACHER EXPECTATIONS

Teacher expectations are primarily based on student prior achievement and grades, which helps account for their relatively high levels of predictive accuracy. Because of the obvious social implications, both experimental and nonexperimental research has been concerned with whether teacher expectations are also based on social stereotypes. Again, the results partially diverge. In experimental studies, the most common methodology has been to provide teachers with little or ambiguous information about students from different groups (e.g., boys/girls, African Americans/Whites, etc.), and to assess whether teachers hold higher expectations for students from one group. They often do.

Because in real life, however, groups often do differ in average levels of achievement, such results do not necessarily show that stereotypes cause inaccuracy in teacher expectations. This issue, however, has also been addressed in naturalistic research, which has examined the extent to which student demographics predict teacher expectations, even after controlling for students' actual differences in achievement. Such research most often finds little or no effect of student demographic characteristics, meaning that, when teachers do perceive demographic differences there usually are corresponding bona fide demographic differences. The most notable exception seems to involve student gender and teacher perceptions of effort. Teachers routinely assume that girls try harder at school than do boys, even though there is little evidence that they actually do. Because there is good evidence that, in general, girls are more cooperative and obedient than boys, it seems likely that this reflects a halo effect (the presence of one positive trait in a target leads the perceiver to infer other positive attributes).

In contrast to stereotypes, diagnostic labels (ADHD, learning disabled, neurologically impaired, etc.), presumably because they come with greater scientific credibility,

are often powerful sources of teacher expectations. Unfortunately, however, large minorities of students are often mislabeled, and, even when students are appropriately diagnosed, many teachers lack the training to understand how best to maximize such students' learning and achievement. Thus, diagnostic labels are often a culprit in negative self-fulfilling prophecies.

INTERPERSONAL PROCESSES

Much research has addressed how teachers act on their expectations in such a manner as to produce a self-fulfilling prophecy. This research has shown that teachers hold high expectancy students to higher standards of performance and, at the same time, provide a warmer and more supportive environment to them. Differential treatment can lead to self-fulfilling prophecies through either or both of two general routes. High standards means providing high expectancy students with more opportunities to master difficult material. When coupled with the support for doing so, highs may simply learn more material more quickly. In addition, however, differential treatment also may indirectly affect achievement, by enhancing or undermining student motivation. High standards and emotional support are likely to increase students' psychological investment in school, intrinsic motivation, and self-expectations, all of which have well-established beneficial effects on achievement (and, of course, low standards and a cold emotional environment are likely to be demotivating).

MODERATING CONDITIONS

Research has also examined moderators of self-fulfilling prophecies—the conditions under which self-fulfilling prophecies are stronger or weaker. This research has shown that self-fulfilling prophecies are stronger under the following conditions:

When experimental studies manipulate teachers' expectations early rather than late in the year. It is much harder to mislead teachers later in the year, after they have gotten to know their students.

In first, second, and seventh grades, a result that suggests that it is not younger children per se who are more vulnerable, but children who enter new and unfamiliar situations (seventh grade was the first grade of junior high school in many of the studies).

Among teachers high in dogmatism or cognitive rigidity. Even inaccurate expectations will not lead to self-fulfilling prophecies if teachers readily correct their expectations with new information. Teachers high in dogmatism or cognitive rigidity are unlikely to do so.

Among students with some sort of perceived difference from the majority. Some of the largest self-fulfilling prophecy effects ever obtained have been found to occur among some minority students, those from lower social class backgrounds, and those with histories of low achievement.

Many early researchers speculated that negative expectancy effects (those that undermine student achievement) were also more powerful than positive ones (those that enhance student achievement). The evidence regarding this issue, however, is quite mixed, with some studies showing that positive teacher expectations have more powerful self-fulfilling effects, and others showing that negative teacher expectations have more powerful self-fulfilling effects.

IMPLICATIONS FOR TEACHERS

First, teachers should take considerable comfort from the empirical evidence which, in contrast to some of the more extreme claims, shows that, in general, expectancy effects are small, fragile, and fleeting, rather than large, pervasive, and enduring. Second, any recommendation suggesting that teachers should simply adopt high expectations for all students would be oversimplified, unworkable, and probably dysfunctional. High expectations can work at raising student achievement, but only if they are backed up with the resources and institutional supports to do so.

The most constructive lessons to be learned for teachers from the research are the following:

Teachers should hold expectations flexibly. They might be wrong. The student's label might be wrong. Also, students change.

Teachers should remember that holding high standards without providing a warm environment is merely harsh. A warm environment without high standards is simply feel-good mush. But if teachers can create a combination of high standards with a warm and supportive environment, doing so will benefit all students, not just the high achievers.

High expectations will mean different things for different students. Attaining average performance might be high for one student and low for another. If teachers want to purposely harness self-fulfilling prophecy processes to maximize student achievement, they need to integrate accuracy (a clear sense of students' current levels of skill and learning abilities and styles), with warmth and high standards for future performance in order to develop a clear plan for how those students will maximize their learning and achievement.

SEE ALSO *Caring Teachers*.

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Lee Jussim

TEMPERAMENT

Temperament is a general term referring to individual differences in behavior tendencies that are biologically based, present early in life, and relatively stable across situations and time (Bates & Wachs, 1994; Goldsmith et al., 1987). Individual differences in temperament are evidenced in the unique predispositions students bring to the school setting in terms of activity level, attention span, mood, approach to new experiences, and so on. Many have posited that individual differences in temperament during the early years constitute nascent personality (Caspi, 1998).

Evidence supports both genetic and environmental influences on temperament. Behavior-genetic research studies comparing correlations of temperament characteristics between monozygotic and dizygotic twins indicate significant genetic influences on some temperament characteristics from early childhood through adolescence. Monozygotic twins are much more temperamentally similar to each other than dizygotic twins (Caspi, 1998). Given the evidence supporting the role of genetic factors in temperament, researchers look to physiological, neurological, biochemical, and hormonal variables as the biological mechanisms by which temperament is transmitted across generations (Bates & Wachs, 1994). For example, Werner and colleagues (2007) reported that fetal heart rate activity predicted infant temperament assessed via parental report and behavioral observations at 4 months. With respect to environmental factors, children with difficult temperament are at increased risk of subsequent externalizing behavior

problems when family conflict is present (Guerin et al., 2003).

CONCEPTUALIZATION AND MEASUREMENT OF TEMPERAMENT

Although temperament is an ancient concept (Kagan & Snidman, 2004), a large body of empirical research on temperament in children followed the dissemination of the theoretical perspective developed by Alexander Thomas, Stella Chess, and Herbert Birch (1968). They defined temperament as follows:

Temperament may best be viewed as a general term referring to the how of behavior. It differs from ability, which is concerned with the what and how well of behaving, and from motivation, which seeks to account for why a person does what he is doing. When we refer to temperament, we are concerned with the way in which an individual behaves. (p. 4)

Thomas and colleagues identified nine dimensions of temperament, and these are listed in Table 1. Additionally, they observed three constellations or patterns characterizing young children’s temperament. They labeled the largest temperament pattern, comprising about 40% of their sam-

ple, as “Easy” temperament: regular biological functioning, positive approach to new stimuli, quick adaptation to change, positive mood, and mild/moderate intensity in expression. About 10% exhibited the opposite pattern, labeled “Difficult” temperament. Thomas and Chess labeled the third pattern, seen in about 15% of their sample, as “Slow to Warm Up” temperament. These children’s reactions to new stimuli were more often negative than those of children with “Easy” temperament, but they expressed themselves more mildly than children with “Difficult” temperament. Not all children fit into one of the three categories, however, and most research is based on one or more specific dimensions of temperament displayed in Table 1 rather than the constellations.

Subsequent to the Thomas and Chess model of temperament, other approaches to children’s temperament emerged. Arnold Buss and Robert Plomin viewed temperament as early-appearing inherited personality traits and focused on three temperaments: emotionality, activity, and sociability. Hill Goldsmith and Joseph Campos developed a conceptualization of temperament centering on infant primary emotions, such as fear, anger, sadness, pleasure, and interest, for example. Mary Rothbart and Douglas Derryberry proposed a developmental model defining temperament as constitutional differences in reactivity and self-regulation (Goldsmith et al., 1987). Jerome Kagan and colleagues (Kagan & Snidman, 2004) focused on a single temperament characteristic, children’s initial reaction to unfamiliar events. At the extremes of this continuum are children who respond to unfamiliar stimuli with shyness and restraint (inhibited) and those who are sociable, talkative, and minimally fearful (uninhibited).

The most widely used method to measure temperament in infancy and early childhood is through caretaker (usually maternal) reports on standardized temperament inventories; child, youth, and adult self-report inventories are also available. Inventories for teachers to describe their students’ temperament have also been developed (Keogh, 2003). Inventories offer the advantages of efficiency in assessing a range of temperament characteristics and established reliability and validity, with ratings based on individuals who are well-acquainted with the child over a range of situations and across time. In addition to inventories, a variety of behavioral assessment procedures are available (Goldsmith & Rothbart, 1991). Mechanical (e.g., actometers) and behavioral measures of activity have been employed.

CONSISTENCY OF TEMPERAMENT ACROSS TIME

A growing literature documents the stability of children’s temperament. In the United States, the Fullerton Longitudinal Study in California reported stability on eight of the nine

Temperament dimensions identified by Thomas, Chess, et al.	
Dimension	Description
Activity level	Level, tempo, and frequency of motor behavior
Biological rhythmicity	Regularity of biological functions, such as sleeping, feeding, elimination
Approach/withdrawal	Nature of initial response to new stimuli, such as people, food, toys
Adaptability	Ease with which child responds to new stimuli or changes in situation
Intensity of reaction	Energy level of response, ranging from mild to strong, regardless of whether reaction is positive or negative
Quality of mood	Balance of pleasant, joyful, friendly behavior compared to unpleasant, crying, unfriendly behavior
Persistence/attention span	Continuation of an activity in spite of obstacles and length of time a particular activity is pursued
Distractibility	Effectiveness of external stimuli in altering the direction of ongoing behavior
Threshold of responsiveness	Intensity level of stimulation necessary to evoke a response

SOURCE: Based on Thomas, Chess, and Birch (1968)

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

Thomas and Chess temperament dimensions from ages 2 through 12 years. Additionally, six of the nine dimensions were assessed at ages 14 and 16 years, and they also showed stability from middle childhood (Guerin et al., 2003). Mathiesen and Tambs (1999) reported strong stability of the Buss and Plomin temperament traits in a Norwegian sample followed from 18 through 50 months. Komsuoglu and colleagues (2006) observed significant consistency across infancy and middle childhood in a sample of Finnish children for several temperament dimensions based on the Rothbart framework. In the early 2000s, evidence of stability in inhibited/uninhibited temperament was accumulating (Kagan & Snidman, 2004).

RESEARCH FINDINGS ON TEMPERAMENT AND SCHOOL FUNCTIONING

One question to consider is how these stable, individual differences relate to children's functioning in school. The tasks of school demand not only intellectual ability, but also characteristics such as flexibility and sustained effort (Keogh, 2003). Across the entire span of schooling, temperament characteristics relate to children's ability to successfully negotiate the multiple demands of school, whether in terms of academic achievement, socially appropriate behavior, or relationships.

In elementary school, three primary temperament characteristics relating to accomplishment are activity, distractibility, and persistence (Keogh, 2003). Either high or extremely low levels of activity, high levels of distractibility, and low levels of persistence relate to low levels of academic achievement. Similarly in early adolescence, persistence and distractibility relate to school success (Guerin et al., 2003). Children who can focus on their work and sustain an effort in spite of obstacles and length of time to completion achieve more in the academic realm.

During adolescence and early adulthood the characteristic of persistence, identified as task orientation, again stands out as important in terms of academic success. In the Fullerton Longitudinal Study, task orientation related positively to academic achievement as measured by standardized tests, parent reports, and self-reports. Task orientation related positively to high school GPA and college GPA, over and above socioeconomic status and IQ (Oliver, Guerin, & Gottfried, 2007).

In addition to the intellectual domain, children's temperament relates to classroom behavior as assessed by teachers. Guerin and colleagues found that high levels of persistence and adaptability as well as low levels of activity and distractibility were related to behaving appropriately, learning, and being happy in class (Guerin et al., 2003). Characteristics associated with the "Difficult" temperament constellation relate to children acting out in school, but there are also internalizing behavior

problems related to temperament. Extremely inhibited children lack social competence and have high levels of social anxiety (Martin & Fox, 2006).

The quality of the student-teacher relationship has implications for children's competency and achievement in school. Teachers value certain characteristics such as adaptability, persistence, approach, and positive mood (Keogh, 2003). Thus, the behavior of some students with high activity levels, high distractibility, and low levels of persistence, can be misattributed by teachers as non-compliance and problem behavior. As evidence of the way in which temperament characteristics relate to child-teacher relationships, Guerin and colleagues found that children who are high in activity, low in adaptability, high in intensity, negative in mood, less persistent, and more distractible have greater levels of negative interaction and conflict with their teachers.

APPLYING TEMPERAMENT CONCEPTS IN SCHOOL

Given accumulating evidence that temperament characteristics show long-term stability and that individual differences in temperament relate to children's educational outcomes, numerous temperament researchers and clinicians have provided specific recommendations on using temperament research and theory in the classroom. Indeed, Rothbart and Jones (1998) advocate that college and university teacher-training programs include preparation on both children's temperament characteristics as well as their cognitive-processing capacities. A central tenet of the Thomas and Chess conceptualization of temperament is that development will be optimized when the environment and expectations experienced by children are consonant with their capacities and style of behaving ("goodness of fit"). Because individual children experience the same environment in unique ways, information on children's temperamental patterns could be used to modify classroom management techniques to be more in line with the children's style of behavior and reactivity (Rothbart & Jones, 1998). In addition, recognizing individual differences in temperament helps teachers to anticipate times or situations in which problems are most likely to occur (e.g., in transition periods) with the aim of planning techniques to alleviate or manage the stress of these times (Keogh, 2003). Sources providing specific suggestions to improve the goodness of fit between children's temperament and their classroom experience include Keogh (2003), Kristal (2005), and Rothbart and Jones (1998).

SEE ALSO *Caring Teachers*.

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TEST ANXIETY

SEE *Evaluation (Test) Anxiety*.

TEST TAKING SKILLS

In a seminal article, Millman, Bishop, and Ebel (1965) defined test wiseness as “a subject’s capacity to utilize the characteristics and formats of the test and/or the test taking

situation to receive a high score” (p. 707). The construct was first described in 1951 by Robert Thorndike, who considered its effect on test reliability. Test wiseness is generally thought to include an awareness of the process of test taking and knowledge of a number of individual test-taking skills that can be applied to a number of different testing formats to maximize test scores. Specific test-taking skills include using time wisely, answering all items, using effective guessing strategies, eliminating choices known to be incorrect, and making use of specific cues imbedded within individual test items. It has been suggested that there is individual variability in test wiseness, in that test-wise individuals have an advantage over individuals similar in knowledge or ability but lacking in test wiseness.

EFFECTIVE SKILLS

Effective test-takers possess a number of skills that go beyond the simple and direct knowledge of the content being tested. These skills include a complete understanding of the purpose(s) of the test, the specific requirements of the test, and any specific constraints placed upon performance, for example, time limits. Test wise test-takers use this awareness in order to employ strategies designed to meet these purposes, requirements, and constraints.

There has been some debate concerning whether test wiseness is a separate and distinct construct. However, specific tests of test-taking skills have been developed, suggesting that such skills do exist and can be described. Test wiseness tests may include items that are answerable only through the use of a test-taking strategy, imbedded within “real” test items. Following is an example of a test-taking skills item:

The Matharah tree is found most often in the following:

- a. arid areas;
- b. dry regions;
- c. rainy climates;
- d. barren locations.

Because the Matharah tree does not exist, test-taking skills must be employed to answer the question. In this case, items *a*, *b*, and *d*, all provide very similar information, and because they cannot all be chosen, the only logical choice is *c*. This strategy is referred to as *similar options*. It has been found that older test takers score higher than younger test takers on tests such as this. Other measures of test wiseness include passage independence tests (where test takers are asked to answer questions about a reading passage without having read the relevant passage), direct interviews (where test takers are asked to describe their thinking process as they answer test

questions), and tests of the test taker's ability to use different test formats (such as separate answer sheets).

Finally, relative deficits in test-taking skills can be inferred by directly training participants in presumed areas of deficit and evaluating whether training results in increased test performance over participants who have not received such training. If this training includes skills only, and not the information being tested, any difference between the two groups can be considered deficits in test-taking skills. Overall, test-taking skills training has realized tangible, but modest effects. However, effects have been more pronounced for older (e.g., upper elementary) students and longer training periods; and for students with mild disabilities (e.g., learning disabilities) and those from lower socio-economic backgrounds. For some groups of test takers, test-taking skills training can make a significant difference in test scores.

TEACHING TEST WISENESS

A variety of procedures are employed to teach test wisdom. Without doubt, the most important strategy for improving test performance is academic preparation, particularly with respect to the specific purpose and anticipated requirements and format of the upcoming test. For example, a multiple choice test format may require broad, general, and shallower knowledge, while an essay format may require more focused, detailed, and elaborated knowledge. Another general strategy is physical preparation, which includes getting sufficient rest and nourishment prior to taking the test. Positive attitudes toward the test are also important and can be improved by setting realistic goals, taking practice tests, understanding the purpose of the particular test, rewarding effort, and understanding of specific test-taking skills.

While taking tests, people should use their time wisely. It is important to use time efficiently on familiar or easier items, and not to waste time on very difficult items unlikely to be answered correctly. Test-wise individuals monitor their time frequently and pace themselves as they take the test. That is, when the testing period is half over, test-takers generally should have completed about half the test. If the test is completed early, the additional time can be spent returning to the more difficult items. Efficient test-takers recognize that, when guessing is not directly penalized, it is important to answer every question.

In any test-taking situation, it is important for test takers to maximize the knowledge they have, even when it is not complete. Many standardized tests as well as classroom tests employ some type of identification format, such as multiple choice, in which test-takers identify a correct response from an array of choices. In these cases, efficient test-takers are careful to think first of a correct

response, then consider all choices before answering. Test-wise individuals are aware that they may not only select the option most likely to be correct, they may also discard items unlikely to be correct, by using elimination strategies. In addition to the similar options strategy discussed previously, test-takers can also, based upon their prior or partial, eliminate responses known not to be correct. For example, even when the answer is not known, if an efficient test-taker can eliminate two of four possible answer choices, the probability of making a correct choice is increased to 50 percent from 25 percent. Over the course of a number of test items, this difference can increase a test score significantly. In other cases, particularly in the case of teacher-made tests, the syntactic or semantic content of the item stem (the "question") may provide a cue to the correct answer choice. This strategy can be enhanced if the test-taker has some partial knowledge of the item content. Test-wise individuals consider carefully choices that use absolutes such as *always* or *never* because few statements allow for no exceptions when choosing their answers.

DIFFERING TEST FORMATS

Some tests include specific formats unique to that particular test. For example, a multiple choice phonics test may require test takers to match sounds in different printed words, or a math test may require test takers to identify which missing information is required to solve a particular problem. Test-takers should practice applications of their knowledge in a variety of different contexts in order to be able to address such formats.

Test formats that require test takers to produce, rather than identify, correct responses also lend themselves to specific test-taking strategies. For example, for short answer or sentence completion items, it is important for test takers to guess if unsure, use partial knowledge when necessary, look for cues in the test item, and make the completed sentence appear logical and consistent. For essay tests, it is generally important to study the question and consider command words (e.g., *discuss*, *compare*, *justify*), note important points, organize thoughts, and write directly to the purpose of the question.

It has been argued that test-taking skills training should be discouraged because it encourages test-takers to outsmart the test, rather than by correctly applying content knowledge. Certainly, some strategies (e.g., the longest or most qualified answer choice will be correct) lend themselves to this criticism. However, in most cases, test-wise individuals employ appropriate strategies in conjunction with their content knowledge to maximize the impact of their knowledge on their test score. To the extent that a test-taker's score should reflect the test taker's level of content knowledge, and not be limited

by relative awareness of test format requirements, test-taking skills training is an important overall component of educational measurement.

SEE ALSO *Classroom Assessment*.

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THEORIES (AS A FORM OF KNOWLEDGE)

The term *theory* has been historically used to describe forms of disciplinary knowledge. For example, one may speak of Einstein's theory of general relativity or Keynesian economic theory. However, despite or perhaps because of its common usage both in everyday and professional discourse, there is little agreement on just what a theory is. To illustrate, one traditional approach to describing formal disciplinary theories (such as scientific theories) is to think of them as axiomatic systems comprising of natural laws that correspond to empirical regularities in the world (Hempel & Oppenheim, 1948). Within the tradition of scholarship that construes laws as central to theory, there is disagreement about the nature of laws. Some scholars argue that true laws of nature are universal (Armstrong, 1983) while others argue that scientific laws such as Newton's laws are not universal generalizations and should be viewed as causal powers (Cartwright, 1983). More recently, scholars such as Giere have argued that laws serve no useful purpose in the context of scientific theory. Giere (2004) proposes that scientific knowledge is composed of families of models that selectively represent theoretically important features and relationships of things in the world.

THEORIES AS MENTAL REPRESENTATIONS

In the 1980s psychologists and educators who were interested in the nature of mental representation began to draw attention to theory-like properties of mental representations. Although the specific forms of mental representation proposed such as schemas (Rumelhart, 1980) mental models (Gentner & Stevens, 1983; Johnson-Laird, 1983) naïve theories (Carey & Spelke, 1994; Gopnik & Wellman, 1994), and explanatory frameworks (Samarapungavan & Wiers, 1997) vary greatly, they share certain features. These mental representations are molar or larger in scale and scope, and form structures that coordinate a variety of conceptual elements in complex and multifaceted relationships. Such representations serve important explanatory functions, allowing people to organize, predict, and control their experiences of the world. For example, Rumelhart (1980, p. 37) says of schemas, "it is useful to think of a schema as a kind of informal, private, unarticulated theory about the nature of events."

The most explicit analogy between everyday mental representations and theories is drawn in the research on "naïve theories" (Gopnik & Wellman, 1994). "Novice-as-theorist" accounts assume that people are theory generators. Carey and Spelke (1994) have suggested that some conceptual frameworks, such as a naïve physics of object identity and motion, appear in early infancy and may be innate. A key issue for naïve-theoretic accounts of knowledge acquisition has to do with general structural and qualitative properties of naïve belief systems or their degree of "theoreticity." Three important aspects of theories are:

1. *Structure and content*: Theories comprise of a core of interrelated conceptual elements which constitute the explanatory principles for a target domain. The core explanatory principles are not mere empirical generalizations from experience but rather are abstract interpretations of experience. This is reflected in the fact that competing theoretical principles can provide different interpretations for the same body of experiential data. Theories form conceptual topographies. For example, in addition to domain-specific explanatory principles (e.g., natural selection in Darwinian theory), they contain ontological principles (Chi, Slotta, & de Leeuw, 1994) and epistemological principles or beliefs about what the central problems of the domain are, what sorts of data or evidence can be brought to bear in solving these problems, and how the explanatory fit of concepts can be evaluated (Samarapungavan & Wiers, 1997).
2. *Function*: Theories are explanatory devices. The core beliefs of a theory provide causal explanations for the

phenomena it circumscribes. Frameworks also allow for generative predictions;

3. *Corrigibility through epistemic processes*: Theories can be revised as a result of various epistemic processes of knowledge evaluation (Laudan et al., 1986).

The naïve theory approach has borrowed heavily from the work of historian and philosopher of science Thomas Kuhn (1962). Kuhn claimed that major historical changes in scientific theories are accompanied by changes in the explanatory core and boundaries of a discipline, whereby notions of what counts as data and which problems a theory should address change as well. Using similar ideas to explain why students have particular difficulty with the scientific concept of heat, Wiser (1988) suggests that novices have intensive rather than extensive concepts of heat that resemble a historical precursor of the current scientific theory, one in which heat and temperature were not differentiated. Thus, while students correctly predict that on identical burners, a big vessel of water must take longer to boil than a small one, they also make the “wrong” prediction that it would not take more heat to boil water in the big vessel because their concept of heat is intensional. In other words, in the latter situation the students are using the term “heat” in the sense of “temperature” and their predictions are correct with regard to temperature. Wiser concludes that like their historical counterparts, students’ theories of heat are both different from and incommensurate with the expert theory.

Chi and her associates (Chi, Slotta, & de Leeuw, 1994) have proposed an interesting version of the incommensurability argument. They suggest that novices have ontological theories or beliefs about what “kinds” of things exist and what sorts of ontological properties each class or subclass in an ontological hierarchy of “kinds” can possess. Specifically, they propose that peoples’ ontological knowledge is organized into at least three “trees” or taxonomies matter, processes, and mental states. The three trees are defined by mutually exclusive ontological attributes. For example, objects in the category of matter (e.g., water, cars, and dogs) have ontological attributes such as having volume and mass. Similarly, processes have ontological attributes such as “occurring over time.” Chi and colleagues argue that novices have difficulty with the acquisition of scientific concepts because these concepts require a restructuring of their ontologies. For example, while novices typically classify heat as a substance belonging to the ontological tree of matter, scientists see heat as a constraint-based interaction belonging to the ontological tree of processes.

THE DEBATE OVER NOVICE KNOWLEDGE

There is a vast body of research that shows that novice ideas about the natural world differ in conceptual content from those of scientists (Vosniadou & Brewer, 1992, 1994; Wiser, 1988). However, researchers disagree profoundly about the qualitative nature of such lay concepts. For example, based on research about naïve concepts in the domain of motion and force, diSessa and his colleagues (diSessa, 1993; diSessa, Gillespie, & Esterly, 2004) describe novice knowledge as a weakly organized system of beliefs that lacks internal coherence, is unstable over time and problem context, and malleable in the face of anomalous evidence. In a reinterpretation of the work in intuitive physics, diSessa and associates suggest that novices do not have anything like a naïve “theory” of motion or force. According to diSessa (1993), what novices have is a fragmented, unstable, and malleable collection of beliefs which are low-level abstractions of everyday experience. diSessa refers to such beliefs as *p-prims*, short for *phenomenological primitives*. He argues that novice beliefs are unlike scientific theories because they are not constrained by epistemic requirements of coherence or “systematicity.”

Research in several domains suggests that people’s belief systems about some aspects of the natural world are theory-like, at least in some important respects. For example, children and lay adults appear to construct coherent and robust biological constructs based on principles of biological essentialism across a variety of cultures and task contexts (Ahn et al., 2001). Samarapungavan & Wiers, (1997) describe novice beliefs about species and speciation in terms of explanatory frameworks which they describe as a small set of explanatory principles that constrain but do not fully pre-specify the mental models that children construct when presented with novel biological problems about the nature of species and speciation. Part of the evidence for theoreticity comes from the observation that at least some of the core beliefs of novice biological frameworks cannot be induced directly from experience. For example, it is hard to conceive of any direct phenomenal experience that would lead elementary school children to a belief in the spontaneous generation of complex species (Samarapungavan & Wiers, 1997).

Vosniadou and Brewer and colleagues have conducted research on children’s conceptual development in the domain observational astronomy. Their research shows that across a variety of cultures many elementary school children construct scientifically inaccurate but coherent and explanatory mental models of the earth’s shape and the day-night cycle (Samarapungavan, Vosniadou & Brewer, 1996; Vosniadou & Brewer, 1992, Vosniadou,

Skopeliti, & Ikospentaki, 2004). These representations allow people to generate explanations for phenomena such as the seasons, eclipses, and the day/night cycle and to make and evaluate predictions about what will happen in novel scenarios. Additionally, their research shows that initial theory-like representations are corrigible because children revise their mental models over time to integrate new information presented in formal schooling.

Some researchers claim to have obtained empirical results that contradict Vosniadou and Brewer's findings in the domain of astronomy (Nobes et al., 2003). However, Brewer and Vosniadou and colleagues (Brewer, 2008; Vosniadou, Skopeliti, & Ikospentaki, 2004) point out serious methodological flaws in these studies.

THEORIES AS FORMS OF KNOWLEDGE: OPEN QUESTIONS

The debates about the utility of viewing knowledge as being organized in theory-like structures are hard to resolve definitively because of the great variability in the empirical studies on both sides of the issue. For one thing, findings about the degree of coherence and explanatory power in novice knowledge vary by domain. For example, Nakhleh and Samarapungavan (1999) found that elementary school children's ideas about the nature of matter cohered loosely at an ontological level but were not sufficiently coherent in terms of the specific explanations generated for phenomena such as phase transitions to be called explanatory frameworks. It may be that it is easier for people to form coherent knowledge structures in some domains than in others.

A second difficulty in resolving the debates about novice knowledge is the methodological variation in the studies. The studies draw from different populations; vary dramatically in sample size, in the nature and variety of tasks used to elicit data, and the methods for analyzing and aggregating data. One sub-domain in which two studies employed fairly similar methodologies but resulted in radically different conclusions about novice knowledge is that of force and motion. Ioannides and Vosniadou (2002) conducted a cross-sectional study with 105 Greek children (preschoolers through ninth graders) to investigate the development of concepts of force and motion and concluded that children used a small set of coherent constructs to explain phenomena in this domain. diSessa, Gillespie, and Esterly (2004) conducted a quasi-replication of the Ioannides and Vosniadou study with 30 American children across a similar age range. diSessa and colleagues found that the American children invoked a greater number of constructs to explain the phenomena of force and motion, and their use of these constructs varied contextually, showing a lack of coherence.

Although the two studies were relatively similar in the methods used to elicit data, there were nonetheless important differences. One difference was linguistic; the Greek children were tested in the Greek language while the American children were tested in English. Therefore, it is possible that at least some of the questions were not equivalent in translation between the two studies. A second, more important difference was that the American sample was much smaller, less than a quarter of the size of the Greek sample. Given the wide range of ages involved, the subsamples at each age point may have been too small to be truly representative of the population at large. Thirdly and most importantly, although the procedures for data collection were similar in the two studies, the procedures for data analysis were not. Ioannides and Vosniadou (2002) scored children's explanations of their initial answers to each question while diSessa, Gillespie, and Esterly (2004) noted that they were unable to score children's explanations. Thus, despite the similarities in data collection procedures, the actual data set that was analyzed across the two studies was likely to be quite different.

Differences of the kind described above make it hard to render definitive judgments about the utility of regarding lay or everyday representations of the world as theory-like. In general, even if people represent some aspects of the natural world in theory-like ways, it would be implausible to suggest that all knowledge is organized in theories. Even highly regarded scientists such as Charles Darwin, Albert Einstein, or Michael Faraday, probably did not have good theories for every realm of experience. The extent to which knowledge representations are theory-like probably depends on a number of factors including the nature of domain phenomena, the individual's sustained interest and curiosity in the domain, as well as educational and cultural factors. For example, for American children, the dominant cultural model for observational astronomy corresponds to the scientific model. In other domains such as biology, there are often salient competing cultural models to the scientific theory of evolution for important phenomena such as speciation. The availability and salience of such competing cultural models, and the epistemic authority that students accord to various sources of information, are likely to affect both the content and the quality of students' representations.

Given the diversity of theoretical perspectives and empirical findings described above, it appears that while both children and adults may spontaneously construct theory-like representations of the world in some domains of knowledge, they are unlikely to do so uniformly across domains. Additionally, scientific theories are the products of the public institutions of science and their coherence stems in part from their development and modification under processes of rigorous evaluation and critique by the community of scientific practice. In contrast, individual

knowledge representations used in everyday life are rarely subjected to such scrutiny and evaluation. Consequently, when compared with their scientific counterparts, naïve theories are invariably likely to be far less cohesive and consistent.

SEE ALSO *Concept Development; Knowledge Representation; Theory of Mind.*

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Ala Samarapungavan

THEORIES OF INTELLIGENCE

Students' theories of intelligence are their beliefs about the nature and workings of their intellect. Some students believe that their intelligence is a fixed trait—that they have been given a certain amount of intelligence and that is that. This is called an *entity* theory of intelligence, and students with this view become very concerned with how much intelligence they have. Other students believe that their intelligence is a quality they can develop through their effort and education. This is called an *incremental* theory of intelligence, and students with this view are more focused on learning and becoming smarter. Each theory affects not only students' motivation to learn but also their success in learning and their achievement in school.

HISTORY OF THE CONCEPT

Research on theories of intelligence grew out of the study of students' achievement goals (Dweck, 2000). Research had found that some students were strongly oriented toward validating their ability (they pursued *performance goals*), whereas other students were oriented toward learning in the same situation (they pursued *learning* or *mastery* goals). This raised the question: What determined which goals students would favor? Research by Carol Dweck with Mary Bandura and later with Ellen Leggett, Ying-Yi Hong, and C.Y. Chiu (see Dweck, 2006) showed that students' theories of intelligence predicted which goals they would tend to pursue. Students who held a fixed (entity) view of intelligence tended to pursue performance goals in an attempt to document their ability (or in an attempt to avoid a negative judgment of their

ability), whereas students who held a malleable (or incremental) view of their intelligence tended to pursue learning goals in an attempt to develop their ability (e.g., Dweck & Leggett, 1988).

As this work developed, it was shown that this concept applies to a wide range of abilities, including athletic ability and social skills. Individuals can have theories about the fixedness or malleability of many different abilities, and their theories will predict their goals and motivation in these different domains.

More and more research from cognitive psychology and neuroscience is supporting the idea that important parts of intelligence can be developed through educational programs and that the brain has far more plasticity throughout life than was previously believed. It is interesting to note that Alfred Binet (1857–1911), the inventor of the IQ test, had a very strong incremental theory. He developed the IQ test, not to measure fixed intelligence but to identify students who were not on course in the public schools in the hopes of developing better curricula for them.

PREVALENCE, STABILITY, GROUP DIFFERENCES, AND DEVELOPMENTAL CHANGES

It is found that about 40% of students endorse an entity theory, about 40% endorse an incremental theory, and about 20% do not indicate a preference for either theory. Students' theories tend to be relatively stable over time (Robins & Pals, 2002), but they can be changed by a workshop or an intervention. It is not consistently found that the endorsement of a particular theory of intelligence differs by a student's past achievement level, gender, race, or ethnicity. However, it is increasingly found that the theories of intelligence may matter more for females or for students in ethnic or racial groups that are subject to negative stereotypes about ability. In these cases, it is found that holding an entity theory makes students more susceptible to the harmful effects of these stereotypes, whereas holding an incremental theory makes students less vulnerable to them (e.g., Good, Aronson, & Inzlicht, 2003). Overall, it is found that holding an incremental theory of intelligence favors the growth of ability over time (see, e.g., Blackwell, Trzesniewski, & Dweck, 2007).

Researchers have detected the impact of children's theories in children as young as 5 years of age (Heyman, Dweck, & Cain, 1992). However, these are not theories of *intelligence* but rather theories about goodness and badness, which are the issues that young children are dealing with. Vulnerable young children tend to believe they are bad when they fail or are criticized, and they believe that badness is a stable trait. In contrast, resilient young children

tend to believe they are still good children when they fail or are criticized, and that badness can be changed.

METHODS AND ASSESSMENT

TOOLS

Students' theories of intelligence are studied in several ways. First, their theories of intelligence can be measured. This is typically done by asking them to disagree or agree (on a six-point scale) with statements such as "You have a certain amount of intelligence, and you really can't do much to change it" (entity theory) or "No matter who you are, you can change your intelligence a lot" (incremental theory) (see Dweck, 2000 for measures). Students' theories of intelligence are then used to predict their motivation or achievement. Measuring students' theories of intelligence works best with children 10 years of age and older.

Students' theories of intelligence can also be induced (temporarily) by exposing them to stories or articles that espouse an entity or incremental theory of intelligence or by telling them that a task measured a fixed ability or an ability that can be developed. It is then found that these induced theories will predict students' motivation and performance.

Finally, students' theories of intelligence can be changed through workshops or interventions. In these cases, students are taught an incremental theory by means of lessons that convey that the brain is like a muscle that gets stronger with use and that every time students work hard and learn new things, the neurons in their brains form new connections. Researchers then follow the students and look for changes in motivation and achievement.

MAJOR FINDINGS

The research shows that each theory of intelligence creates an entire psychological and motivational framework that has widespread effects (Blackwell et al., 2007). First, the theories, as noted earlier, affect students' goals, orienting them toward documenting their intelligence or toward learning. It has been shown that students with an entity theory will pass up important opportunities to learn if there is a danger that they will do poorly or expose a deficiency (e.g., Hong, Chiu, Dweck, Lin, & Wan, 1999). This is true even if it means that they are putting future achievement in jeopardy by passing up such opportunities. Students with an entity theory may also act defensively and conceal or lie about their deficiencies rather than confront and rectify them. For example, they are more likely to engage in self-handicapping (Rhodewalt, 1994). These are strategies that put students' performance at risk (e.g., watching television instead of studying the night before a test), but allow them to preserve their sense of their ability if they fail.

Next, students' theories of intelligence create different attitudes toward effort. Those with an entity theory believe that effort is a sign of low intelligence (Blackwell et al., 2007). They believe that if you have ability you would not need effort. In contrast, students with an incremental theory believe that effort is a good thing, something that helps build abilities. These different beliefs play an important role in dampening the achievement of entity students and enhancing the achievement of incremental students.

The theories of intelligence also influence students' reactions to setbacks. Students with an entity theory believe that failures, even at the beginning of a new course, signify a lack of ability (Blackwell et al., 2007). In line with this, they display a lack of persistence. For example, compared to students with an incremental theory, they report that they would study less after a poor grade in a new subject, that they would try never to take a course in that subject again, and that they would seriously consider cheating on the next test. Thus, when students believe they lack a fixed ability, they do not see good options for bringing about success in the future. Students with an incremental theory believe that school failures reflect more readily on their effort and their study or learning strategies. As a result, they react to challenges and setbacks with persistence. They step up their effort and they seek new learning and strategies.

When students have been tracked over challenging school transitions, researchers have found that those with the incremental theory out-achieve those with the entity theory (Blackwell et al., 2007). Those with an incremental theory also show increasing self-esteem over challenging times, in comparison to those with an entity theory, who show eroding self-esteem (Robins & Pals, 2002).

Finally, as noted above, several studies have sought to change students' theories of intelligence by creating workshops that teach students an incremental theory. After these workshops, students have shown significant increases in their motivation to learn, their grades, and their achievement test scores (Aronson, Fried, & Good, 2002; Blackwell et al., 2007; Good, Aronson, & Inzlicht, 2003).

TEACHERS' THEORIES OF INTELLIGENCE

There is less research available on teachers' theories of intelligence and how they affect students' achievement. However, work by Falko Rheinberg in Germany has shown that when teachers believe they have an impact on their students' intelligence, many students who were previously low achievers blossom in their classes. However, when teachers believe they have no impact on their students' intelligence, students who entered their classes as low achievers tend to remain low achievers.

It is interesting to note that in the famous Rosenthal and Jacobson research on the teacher expectancy effect, teachers were in a sense given an incremental theory of intelligence. They were told that certain students in their class would blossom intellectually that year (not, as commonly believed, that certain students were simply smart). Their results speak to the efficacy of teachers' holding an incremental theory of a student's ability.

Butler (2000) has examined the impact of teachers' theories of intelligence on their judgments of students' intelligence. She gave teachers information about two students, one whose performance increased over 10 tests and one whose performance decreased over 10 tests. Teachers with an incremental theory judged the student with the increasing performance to have higher ability than the one with decreasing performance, but teachers with an entity theory believed the opposite. Incremental teachers were focusing on progress over time as an index of ability, whereas entity teachers judged students by initial performance even if that performance was not maintained over time.

There has also been research on practices that foster an entity and incremental theory of intelligence in children (e.g., Mueller & Dweck, 1998). In experimental studies it has been shown that when adults praise children for their intelligence (*person praise*), as opposed to their effort (*process praise*), it fosters an entity theory of intelligence. Praising children for their intelligence also led them to care more about looking smart than about learning, made them lose confidence in their abilities when a task became difficult, led them to show impaired motivation and performance after difficulty, and led them to lie about their performance afterward. In contrast, praising children for their effort led them to embrace challenges, maintain confidence in the face of difficulty, maintain their motivation, and show enhanced performance after difficulty. Interestingly, the self-esteem movement has advocated praising children's intelligence and talents as a way to build their confidence and motivation. However, this research shows that, instead, praise for intelligence backfires by fostering an entity theory of intelligence with all of its vulnerabilities.

IMPLICATIONS FOR TEACHERS

The research reviewed shows that an incremental theory of intelligence promotes in students a greater desire to learn and enhanced resilience in the face of difficulty. It also predicts better performance on difficult tasks and across challenging school transitions, and it appears to be particularly important for the achievement of students who labor under negative stereotypes. It has been shown that an incremental theory of intelligence can be directly taught to students by teaching about the brain, for

example, by telling them that the brain is a muscle that gets stronger with effort and learning and that every time they apply themselves and learn new things, their brain forms new connections. As discussed above, an incremental theory can also be encouraged by process praise. This would include praising children's effort, challenge-seeking, strategies, or improvement rather than their product, outcome, or ability. These are messages that can be readily incorporated into everyday classroom practices without altering the curriculum and without a great deal of additional time and effort on the part of teachers.

SEE ALSO *Goal Orientation Theory; Relevance of Self-Evaluations to Classroom Learning; Social Comparisons.*

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Carol S. Dweck

THEORIES OF LEARNING

Learning is one of the most important activities in which humans engage. It is at the very core of the educational process, although most of what people learn occurs outside of school. For thousands of years, philosophers and psychologists have sought to understand the nature of learning, how it occurs, and how one person can influence the learning of another person through teaching and similar endeavors. Various theories of learning have been suggested, and these theories differ for a variety of reasons. A theory, most simply, is a combination of different factors or variables woven together in an effort to explain whatever the theory is about. In general, theories based on scientific evidence are considered more valid than theories based on opinion or personal experience. In any case, it is wise to be cautious when comparing the appropriateness of different theories.

In addition to formal theories, people hold personal theories, including theories of learning and teaching. Some typical questions such theories might involve are: How does one determine if learning has occurred? What factors determine whether or not learning occurs? Are these factors located in the environment or within the individual?

This entry focuses first on different conceptions and definitions of learning. Next, the evolution of theories and conceptions of learning over the past 100 years is discussed, highlighting some of the advantages and limitations of different theoretical perspectives. Following a discussion of the relationship between theory and practice, examples of different types of learning are presented, and the appropriateness of different theories for different learning situations is pointed out.

CONCEPTIONS OF "LEARNING"

Understanding any theory requires a clear idea of what the theory is trying to explain. When a particular word is used, people usually assume everyone has a common understanding of what the word means. Unfortunately, such is not always the case. In trying to understand the various theories of learning and their implications for education, it is helpful to realize that the term "learning" means different things to different people and is used somewhat differently in different theories. As theories of

learning evolved over the past half-century, definitions of learning shifted from changes that occur in the mind or behavior of an individual to changes in participation in ongoing activities with other individuals to changes in a person's identity within a group (e.g., a change from being a follower to being a leader). Although, most definitions of learning involve a *change* in an individual's knowledge, ability to perform a skill, or participate in an activity with other individuals, there is considerable variation among the theories about the nature of this change.

Further difficulty in understanding similarities and differences among various theories results from the frequently overlooked fact that there are different types of learning. In many cases, the various theories are relevant to different types of learning and are not necessarily incompatible with one another. Rather, they provide different perspectives on the complex phenomena of learning and complement one another in their ability to explain different types of learning situations. Thus, radically different theories are relevant to the classroom by addressing different aspects of classroom learning, and it is wise to avoid comparing apples with oranges. Examples of different types of learning are presented later in this entry.

EVOLVING THEORIES OF LEARNING

The modern psychological study of learning can be dated from the work of Hermann Ebbinghaus (1850–1909), whose well-known study of memory was published in 1885. Other early studies of learning were by Edward L. Thorndike (1874–1949), whose dissertation on problem solving was published in 1898, and Ivan Pavlov (1849–1936), whose research on classical conditioning was begun in 1899 but first published in English in 1927. These theories focused on explaining the behavior of individuals and became known as behavioral theories. These theories use a stimulus-response framework to explain learning and dominated psychology and education for over half a century. Because behavioral theories focus on environmental factors such as reinforcement, feedback, and practice, they conceptualize learning as something that occurs from the outside in.

Behavioral theories provide very good explanations for certain kinds of learning but poor explanations for other types of learning. Operant conditioning, for example, is better than other theories at explaining the rote acquisition of information, the learning of physical and mental skills, and the development of behaviors conducive to a productive classroom (i.e., classroom management). In these situations, the focus is on performing behavioral tasks rather than developing a learner's cognitive structure or understanding. Although classical con-

ditioning frequently is dismissed as irrelevant to human learning (Pavlov's initial research paradigm involved dogs salivating), this type of learning provides by far the best explanation of how and why people, including students, respond emotionally to a wide variety of stimuli and situations. The many types of emotional reactions acquired through classical conditioning include: anger toward or hatred for a particular person or group, phobias to a particular subject area or to school itself, and infatuation with another person. However, they are very poor at explaining how individuals come to understand complex ideas and phenomena.

But environmental factors are not the only ones that influence learning. Serious consideration of other perspectives began to enter mainstream psychological thinking about learning during the 1960s. For example, people clearly learn by observing others, and a learner's belief about his or her ability to perform a task (i.e., self-efficacy) plays an important role in their learning. In 1963 Albert Bandura and R. H. Walters published the first formal statement of social-learning theory in their book, *Social Learning and Personality Development*. Social-learning theory has clear roots in behavioral theory but differs from these theories in significant ways. During the 1980s the theory became known as social-cognitive theory. Although essentially the same theory, the new name more accurately reflects the cognitive features of the theory and aids in differentiating it from behavioral theories of learning.

During the 1970s and 1980s conceptions and definitions of learning began to change dramatically. Behavioral theories gave way to cognitive theories that focused on mental activities and the understanding of complex material. An information-processing metaphor replaced the stimulus-response framework of behavioral theories. These theories emphasized that learning occurred from the inside out rather than from the outside in. During the late 1970s John Flavell and Ann Brown each began to study metacognition—the learners' awareness of their own learning, an ability to reflect on their own thinking, and the capacity to monitor and manage their learning. During the mid 1980s the study of self-regulated learning began to emerge (see Zimmerman & Schunk, 2001).

Then, especially during the later 1980s and the 1990s, these cognitive theories were challenged by theories that emphasized the importance of social interactions and the sociocultural context of learning. The work of the Russian psychologist Lev Vygotsky (1896–1934) first became available in North America and along with the work of anthropologists such as Jean Lave began to have a major influence on theories of learning. Individuals were seen as initially participating in peripheral activities of a group (known as legitimate peripheral participation)

before becoming fully integrated into group activities. Apprenticeship became a metaphor for the way people learn in natural settings. The notion that people learn by observing others, first articulated in social-cognitive theory, was expanded in a new context.

Traditionally, learning has been viewed as something that occurs within an individual. Individuals may participate and learn in groups, but it is the individual person that learns. With few exceptions, the educational systems in Europe and North America have adopted this perspective, if not entirely with regard to instructional practices, certainly in the evaluation of student performance and the assignment of grades. Many psychologists and educators currently consider learning to be a phenomenon that is distributed among several individuals and/or environmental affordances (such as calculators, computers, and textbooks) or situated (existing or occurring) within a “community of practice” (or community of learners). Both a social and a material dimension are involved in this distribution (Pea, 1993). For example, a student may use a calculator to help learn how to solve a three-digit multiplication problem (the material dimension) and/or work with another student to understand the proper procedures to follow (the social dimension). In either case, the student is not learning totally on his or her own but is taking advantages of resources (affordances) available in the environment. If the student is not able to solve a subsequent problem without the aid of the calculator or another student, then it is possible to see the distributed nature of learning. In such situations, participation or activity rather than acquisition becomes the defining metaphor (Greeno, 2006).

The evolution from behavioral to social to distributed to situated theories of learning was accompanied by new conceptions of knowledge (for a good discussion of these changes, see Schraw, 2006). Traditional theories conceive of knowledge as a commodity capable of being transmitted, more or less intact, from one individual to another. According to these theories, knowledge is something an individual acquires; when a student successfully learns it, he or she can reproduce the knowledge in its original form. In contrast, more recent theories conceive of knowledge as something each learner constructs or creates afresh rather than something that is assimilated in its preexisting form. According to current theories, truly “objective” knowledge does not exist, although something similar exists in the form of collective knowledge within a particular culture or discipline. Knowledge resides in the community of learners (individuals) that creates it and is distributed among members of the community and the various environmental affordances available to the group. Because each person constructs his or her own understandings, the knowledge they acquire is unique. Communities and cultures are composed of

individuals with common understandings, and these groups provide opportunities for new members (e.g., children) to construct similar knowledge of the world through schools and/or a variety of informal activities.

The 1990s were dubbed “The Decade of the Brain,” and huge advances were made in neuroscience and how the brain relates to human behavior and learning. The study of how the brain relates to learning is in its infancy (for an introduction to some of the issue, see Bransford et al., 2006). An understanding of how the neurophysiology of the brain affects learning and cognition will add greatly to our understanding of human learning and have a large influence on future theories of learning. Nevertheless, a psychological component to these theories will remain critical for learning in educational settings. Education as it is presently understood is based on psychological processes and interactions capable of being influenced by instruction, and it seems likely that psychological interventions will continue to be important for the foreseeable future.

THE RELATIONSHIP BETWEEN THEORY AND PRACTICE

The relationship between theories of learning and educational practices is complicated by several factors. One would think that instructional practices should be based on the best theories of learning available, but this relationship is not as straightforward as one might think. Schools and educational practices are far more likely to be based on philosophical beliefs than on empirical studies and theoretical understanding of learning. Schools are established according to different community and cultural beliefs about the world, the nature of humankind and children, locus of authority, and what should be learned. Schools also differ in their beliefs about teaching and learning, but the philosophical beliefs often come first. Every educational system and instructional program contains a theory of learning, although frequently this theory is implicit and goes unrecognized.

These philosophical and theoretical differences are formidable. Many have endured for centuries, and the debate is unlikely to end anytime soon. For example, the “factory model” of schooling dominated education in the United States for many years. This model is based on production and management procedures successful during the industrial revolution. It stands in sharp contrast to the voices of Henry David Thoreau (1817–1862), John Dewey (1859–1952), and others who advocated discovery, social reform, and freedom as the appropriate means of education. Both perspectives are clearly evident in modern-day discussions of education and instructional practices.

The correspondence between these philosophical perspectives and the various theories of learning is quite apparent. Classroom activities in a traditional classroom, for example, revolve around and are controlled by the teacher, who presents the to-be-learned material and dictates the type of learning activities in which students engage. Students are expected to study the information (via classroom activities and homework) until it is mastered. The knowledge being learned is seen as a commodity being passed from one individual (the teacher) to another (the student).

Very different classrooms emerge from different philosophical perspectives. If one believes, for example, that knowledge is something created afresh by each student, that learning occurs from working on authentic tasks in a social environment, and that the mental activities of the student determines what he or she learns, then the resulting classroom is likely to be one in which students work in groups and/or on projects, discussing how best to solve a problem, or negotiating the meaning of a concept. Once again consistency exists between theoretical beliefs and classroom practices. However, it is not always clear which comes first, for there is evidence that individuals seek out and accept information that confirms their existing beliefs while tending to reject information that would disconfirm those beliefs.

This reality leads to another realization regarding the relationship between theory and practice, namely that the relationship is two-way. A common belief is that knowledge flows from scientific theories to the development of effective practices, that sound theories of learning dictate effective educational practices. Science, however, does not always operate in such a linear fashion. In both the physical and social sciences, ideas often come from observing and questioning things that occur in the real world: “Why did that apple fall from the tree?” (a question asked by Isaac Newton [1643–1727] that led to his discovery of the three laws of motion). Scientific breakthroughs also come from trying to solve a practical problem (Stokes, 1997), such as “what is the best way to teach the concept of photosynthesis?” Established educational practices that teachers have found effective can and should be a source of ideas in developing a viable theory of learning.

A third caveat in understanding the relationship between theory and practice is realizing that the student is more important than the teacher in determining what is learned. This does not mean the teacher is not important; only that it is the students’ perceptions, prior knowledge, and beliefs that determine what and if they learn something approximating the instructional goals of the teacher. The bottom line in the teaching-learning process is the learning activities in which the students engage, not the instructional activities in which the teacher engages.

Modern-day conceptions of learning and teaching recognize that students are active, often proactive, participants in the learning process, even if they appear otherwise. This dynamic nature of the learning process is one reason why instructional interventions that appear the same to the teacher can result in very different student outcomes and why rather different instructional methods can result in very similar outcomes (e.g., Nuthall & Alton-Lee, 1990; Olson, 2004).

DIFFERENT TYPES OF LEARNING

The relationship between theories of learning and educational practices is complicated by the reality that there is more than one type of learning. None of the present theories is capable of explaining learning in all situations, and scholars working within a particular theoretical perspective often ignore or deny the importance of other types of learning and the relevance of other theories for different situations. Nearly every educational setting involves several types of learning, each with its unique importance to the functioning of the classroom.

There is little agreement on how many types of learning actually exist. Nevertheless, it should not be too difficult to identify different types of learning in the following examples: (a) learning to tie a shoelace or necktie, (b) being afraid (fearful in a literal sense) to work in a math class after a lengthy public ridicule by a teacher two years earlier for being unable to explain a problem to the class, (c) understanding and explaining causes of the French and American revolutions, (d) learning to cook by watching one’s father or mother, and (e) negotiating an understanding of “learning” with a person holding a different theoretical perspective. Different theories are good for explaining one example but poor for explaining other examples.

When evaluating the validity or usefulness of different theories, especially from the perspective of the student doing the learning, it is helpful to consider what the person is learning and what is taken as evidence that learning has occurred. Students do not always engage in the type of learning sought by the teacher. For example, a teacher conducts a lesson on the Civil War that includes authentic activities, having students question one another about the war, and finally giving the students a quiz. It would not be at all uncommon for the teacher to conclude that a particular student *understood* what happened at Gettysburg when in reality he or she only *memorized certain facts*.

Theories of learning are efforts to explain how people learn. Different theories are based on different assumptions and are appropriate for explaining some learning situations but not others. Theories of learning can inform teaching and the use of different instructional resources

including technology, but ultimately the learning activities in which the student actually engages (mental, physical, and social) determine what a student learns in the classroom. Classroom learning involves social, emotional, and participatory factors in addition to cognitive ones, and theories of learning need to take these factors into account. Most current theories of learning presuppose that the goal of education is to develop the ability of students to understand the content and to think for themselves, presumptions that are consistent with the majority of modern-day schools.

SEE ALSO *Cognitive Load Theory; Constructivism; Distributed Cognition; Dual Coding Theory; Information Processing Theory; Self-Efficacy Theory; Self-Regulated Learning; Situated Cognition; Social Cognitive Theory; Sociocultural Theory.*

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Thomas J. Shuell

THEORY OF MIND

Theory of mind (ToM) is the intuitive understanding of one’s own and other people’s minds or mental states including thoughts, beliefs, perceptions, knowledge, intentions, desires, and emotions and of how those mental states influence behavior. Sometimes called intuitive psychology, folk psychology, or even mind-reading, ToM is an innate human ability. The understanding that others have mental states different from one’s own makes it possible to infer what others are thinking and to predict their behavior. This ability to recognize one’s own state of mind and those of others is central to human consciousness. The study of ToM and identification of the skills comprising ToM is a rapidly changing field of developmental psychology.

THE THEORY OF TOM

The word *theory* in ToM refers to a person’s tacit belief rather than to *theory* in the scientific sense. However, ToM is similar to a scientific theory in that it enables one to interpret and predict another’s actions by evaluating their thoughts, beliefs, desires, or emotions. ToM also qualifies as a theory in the sense that the representations of reality generated by ToM are not directly observable.

The ability to develop a ToM is a cognitive ability that develops by degrees from infancy through childhood and adolescence on into adulthood. It forms a basis for a child’s acquisition of language and the development of appropriate social behavior and skills. ToM includes the ability to understand that the representations generated in one’s mind do not necessarily reflect the real world and that other people may hold different representations. Empathy—the ability to understand another person’s perceptions on a deep level without reference to one’s own perceptions—may be a culminating feature of ToM development.

ToM is involved in all aspects of daily living and social interactions. It underlies learning and teaching and the ability to follow directions and understand socially based information. ToM skills are essential for working cooperatively. They also underlie the ability to manipulate and deceive others. A lack of ToM skills is considered by many to be a core deficit in autism, and studies of autism have promoted research on the development and complex functioning of ToM.

As a basic component of human consciousness ToM has roots in philosophy, particularly in the groundwork for a science of the mind laid down by René Descartes (1596–1650). The Swiss psychologist Jean Piaget (1896–1980) suggested that before the age of 3 or 4 egocentrism prevents children from understanding that other people’s thoughts and viewpoints may differ from their own. In 1978 Nicholas Humphrey proposed that introspective

consciousness has a specific function; it enables social animals to predict each other's behavior. Being aware of the effects of emotions on one's own behavior enables humans to predict the reactions of others to those same emotions.

FALSE BELIEF

In 1978 David Premack and Guy Woodruff coined the term *theory of mind* as it is now used in developmental psychology. They argued that chimpanzees and perhaps other nonhuman primates could understand the intentions of others and therefore possessed ToM. Although that issue remains controversial, Premack and Woodruff's work was an inspiration for psychologists studying normal and abnormal child development.

In 1983 Josef Perner and Heinz Wimmer applied Premack and Woodruff's false-belief test to children using an "unexpected location" task. In one version of this test a puppet named Maxi puts a chocolate in the cupboard and leaves the scene. The experimenter moves the chocolate to a new location and asks the child where Maxi will look for it. In another version called the "Sally-Anne" task, Sally and Anne put a marble in a box. Sally leaves and Anne takes the marble out and puts it in a different box. Up until about the age of 4 most children ascribe their own beliefs to Maxi and Sally and tell the experimenter that Maxi or Sally will look for the chocolate or marble in its new location. However, older children understand that Maxi will look for the chocolate where he last saw it in the cupboard, and Sally will look in the first box. The task requires that children understand that other people's beliefs may differ from their own and then predict how those people will react based on their differing beliefs.

Over the years many permutations of the false-belief test have been developed to ensure that it does not require advanced language skills. In the "unexpected contents" or "Smarties" task a child opens a candy box expecting to find a candy called Smarties and finds pencils instead. Until the age of 3 or 4 children assume that someone else will expect to find pencils in the candy box. Furthermore, children claim that they expected to find pencils when they first opened the box, a phenomenon called hindsight bias. The ability to pass the false-belief test is seen as a major milestone in the development of ToM in young children.

TOM IN INFANTS AND TODDLERS

Although children clearly begin to develop ToM at an earlier age than Piaget thought, researchers disagree as to which behaviors indicate a developing ToM in children younger than 3, and it has been very difficult to assess ToM in preverbal children. Some researchers argue that mimicking by infants is indicative of a developing ToM.

Infants under 1 year expect hands and objects to move in ways that are goal-oriented. Between 6 and 12 months infants develop "joint attention" looking in the direction of someone else's gaze. Between 12 and 18 months babies will look in the direction that someone is pointing, rather than at the person's finger, and will themselves point to draw someone's attention to something. In 2000 Charman and colleagues found that children who showed the highest rates of joint attention at 20 months scored the highest on ToM tests at 44 months.

Some researchers argue that as early as 14 months babies can understand intentional behavior and therefore understand that other people are intentional and mental beings. An 18-month-old who watches an adult try unsuccessfully to hang a loop on a hook will imitate the intended rather than the failed action, even though the baby has only seen the failed action. Toddlers begin to recognize that other people have desires and likes and dislikes that are different from their own. For example, a child can predict that another child who wants a cookie will go to the cookie jar. Two-year-olds understand and use words for their senses and their wants. They engage in pretend play and learn to distinguish between physical and mental events such as a real versus an imaginary playmate.

Three-year-olds begin to understand that other people's minds are distinct from their own but cannot yet clearly distinguish between what they know and what others know. Nevertheless, 3-year-olds have a fairly well-developed ToM. Most 3-year-olds can talk about mental states using words such as *think*, *know*, and *remember*. They can distinguish mental states such as dreams. They also understand that perception can lead to knowledge: Someone who looks inside a box will know what is in it, but someone who cannot see inside the box will not know.

TOM IN PRESCHOOLERS

At about age 4 children recognize that other people have minds and that their minds may hold different information. They also recognize that appearances may be deceptive and can mislead. The appearance-reality (A-R) task is used to assess a child's ability to distinguish between reality and representation. A child is given a sponge that is painted to look like a rock. When asked what the object looks like and what it is really, a 3-year-old will give the same answer to both questions—either a rock or a sponge. In contrast, a 4-year-old will correctly answer that it looks like a rock but is really a sponge. By the age of 5 children can understand that someone who appears happy may actually be sad. However, since the ability to recognize that others may have mistaken beliefs is central to ToM, the false-belief test remains the basic criterion for assessing ToM.

Although it is clear that the abilities to pass false-belief and A-R tasks at about age 4 represent important milestones

in ToM development, the nature of these cognitive shifts is unclear. Simulation theory argues that children learn to understand other's beliefs through imagination by imagining themselves in another person's situation. Other scientists believe that this milestone occurs through a process of conceptual change or through the maturing of structures in the brain that facilitate reasoning about the minds of others. Many psychologists believe that failure on false-belief and other ToM tasks is due to children's immature executive functioning.

Although understanding false belief is universal in normal children over the age of 5, a number of factors appear to affect the exact age at which the skill is acquired. Success on false-belief tests correlates with short-term memory ability. Children with larger vocabularies and those from larger families pass false-belief tests at earlier ages. However, attempts to teach younger children about false-belief have been unsuccessful; the children may show improvement on the specific task that is taught, but not on other false-belief tasks.

ToM development in young children is strongly correlated with language ability. Bilingual preschoolers have increased understanding of both mental and non-mental representations. The acquisition of ToM is delayed in children with some specific language impairments. Both language and ToM skills predict later metamemory knowledge and beliefs about one's own memory and metacognition knowledge and beliefs about one's own cognitive processes.

ToM development appears to be advanced in children with older siblings, in children who participate in early pretend play, and in children whose families talk about mental states. Activities that seem to promote the development of ToM skills include:

- Pretend play and role playing
- Talking about past events
- Reading stories
- Discussing situations such as misunderstandings, teasing, and forgetfulness
- Imagining
- Discussing opinions and perspectives

Deaf children of deaf parents who are exposed to American Sign Language from birth perform similarly to hearing children on ToM tests. However, deaf children with hearing parents are significantly delayed in ToM development. A 2002 study by Schick and colleagues found that certain language skills of deaf children correlated with their ToM skills. For example, a deaf child who could understand the sentence "He thought his cake was in the cupboard" was more likely to pass ToM tests.

It has been suggested that deaf children undergo normal ToM development but lack the language necessary to understand the stories that are generally used in ToM tests.

TOM IN SCHOOL AGE CHILDREN

By age 6 children can pass second-order false-belief tests. In contrast to first-order belief tests (Sally believes the marble is in the first box when it is really in the second), second-order tests require a child to understand that Sally thinks Mary thinks the marble is in the first box, but both Sally and Mary are wrong. By the age of 6 children have acquired another ToM skill—the ability to deceive others. In a 2007 study Talwar and colleagues found that among elementary-school children the ability to maintain consistency between an initial lie and subsequent statements increases with age and correlates with the children's scores on second-order false-belief tests.

ToM skills and knowledge about mental states and attitudes increase dramatically throughout childhood. Compared with younger children, 8-year-olds show more skill in first- and second-order false-belief tests involving physical facts and positive and negative emotions and have a much easier time explaining their responses. However, there are far fewer tests for evaluating ToM in children older than 6 and few ToM studies have focused on children older than about 7.

By elementary school children have gone from a state of self-recognition to a state of self-consciousness. At about age 7 they realize that thinking is an ongoing process or stream-of-consciousness, with each thought triggering a new thought. In contrast, preschoolers believe that mental activity starts and stops with each thought. Whereas very young children are unclear about what it means to know something and how they know it, and older preschoolers often insist that they have always known something that they learned just a few minutes ago, with middle childhood comes the realization that knowledge requires adequate information. Furthermore these children are starting to understand that interpretations of knowledge and situations can be influenced by expectations or biases. They are increasingly able to consider other people's points of view. ToM studies have shown that at about age 7 children come to understand that a person's facial expressions and thoughts do not necessarily coincide and they are increasingly able to link physical symptoms with anxiety. Researchers have found that sarcasm, irony, and bluffing are not well understood until about age 8.

Between the third and fifth grades children's understanding of the role of memory develops significantly. Although it has been both assumed and suggested by research that ToM is closely related to episodic

memory—the ability to re-experience past events—recent research has suggested that ToM may function independently of episodic memory. Perner and colleagues reported in 2007 that episodic memory emerges later than false-belief skills, together with the ability to use imagery to solve visual rotation tasks.

A 1999 study by Simon Baron-Cohen and colleagues examined the ability of 7- to 11-year-olds to recognize a faux pas—saying something that is inappropriate or could be misconstrued—such as mistaking a boy for a girl or a customer in a restaurant for a waiter. The researchers found that the ability to recognize a faux pas developed by age 9 and that girls were better at it than boys.

TOM IN THE CLASSROOM

It is likely that ToM skills underlie a child's ability to understand and make up stories and therefore are important for developing reading skills. Astington and Pelletier (1996) have argued that there is a relationship between the degree of ToM development and the ability to learn by instruction and collaboration, and that ToM skills are linked to the development of scientific and critical thinking.

In a 1998 study Perry Klein found that students' skills in predicting or explaining a doll or cartoon character's behavior correlated with their abilities to plan controlled experiments and explain the causes of events. He suggested that first through fifth graders use science strategies that are dependent on their ToM development. Most 6-year-olds understand the concept of evidence, and 8-year-olds can distinguish between ambiguous and unambiguous evidence. Younger children often hold on to prior beliefs despite evidence to the contrary, whereas older children can revise their beliefs. Likewise, younger children manipulate multiple variables when planning science experiments, failing to hold any factor constant, whereas older children and adults understand the concept of testing only one variable at a time and holding the other factors constant.

In school children need to be able to discuss mutual understandings and misunderstandings and their own beliefs and those of others and to make conceptual changes. These activities all require ToM skills. Helping students to reflect on and talk about their thinking may help improve ToM abilities. Teachers report that children with more advanced ToM skills have better social skills. However, advanced ToM skills can also be utilized for antisocial purposes such as bullying.

The development of ToM may be particularly relevant to classroom learning during middle childhood and adolescence. Although all normal children develop ToM skills in basically the same sequence, the pace of ToM development may be different in different cultures, par-

ticularly among older children. This may be a function of the vocabularies about mental states in different languages or cultural differences in amount of thinking and talking about mental states. There also appear to be gender differences in the development of at least some aspects of ToM. In a 2000 study Bosacki found that 11-year-old girls scored higher than boys on tests of self-understanding and social understanding.

ToM development continues throughout adolescence and into adulthood. However most research with adolescents has focused on metacognition rather than on ToM. Adolescents are well known for a particular type of ToM error—believing that those around them, especially peers, are thinking about them and judging them when there is no evidence that this is the case.

THE NEUROSCIENCE OF TOM

Brain imaging while performing ToM tasks has suggested the involvement of a patch of neurons above the eyes called the anterior paracingulate cortex. Some researchers believe that this region is responsible for the central ToM task of distinguishing between one's own mind and that of another person. The frontal cortex is known to be important for both ToM and cognitive abilities and this region continues to develop during adolescence. Moriguchi and colleagues (2007) studied 9- to 16-year-olds and found that, as in adults, activation of the medial prefrontal cortex, the bilateral superior temporal sulcus (STS), and the temporal pole adjacent to the amygdala were associated with ToM, and that during late childhood and adolescence ToM activation of the medial prefrontal cortex switched from the ventral side to the dorsal. Researchers have found that the left medial prefrontal cortex is strongly activated when normal subjects read a story that requires understanding the mental states of characters, whereas this region is not activated when autistic subjects read the same story. The STS senses biological motion. It is activated by a moving hand but not a moving car and is particularly sensitive to eye and lip movements. The temporal pole is crucial for recalling memories. The amygdala, which is important for emotion, may also be involved in ToM.

Autism researchers have focused on the hypothesis that autistic children do not undergo normal ToM development. Autistic children who do manage to pass ToM tests usually have far more verbal knowledge than other 3- to 5-year-olds. They also laboriously explain their reasoning, whereas normal young children cannot explain their reasoning, suggesting that the autistic children use a different method to succeed on the test. In Baron-Cohen's 1999 study children with Asperger syndrome or high-functioning autism who passed false-belief tests were nonetheless unable to recognize faux pas or recognized them but

continued to make them. Autistic children also have difficulty understanding and carrying out deception. Studies on autistic individuals have helped distinguish between ToM and cognition since autistics can have exceptional cognitive abilities while lacking ToM skills.

SEE ALSO *Cognitive Strategies; Metacognition.*

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Margaret Alic

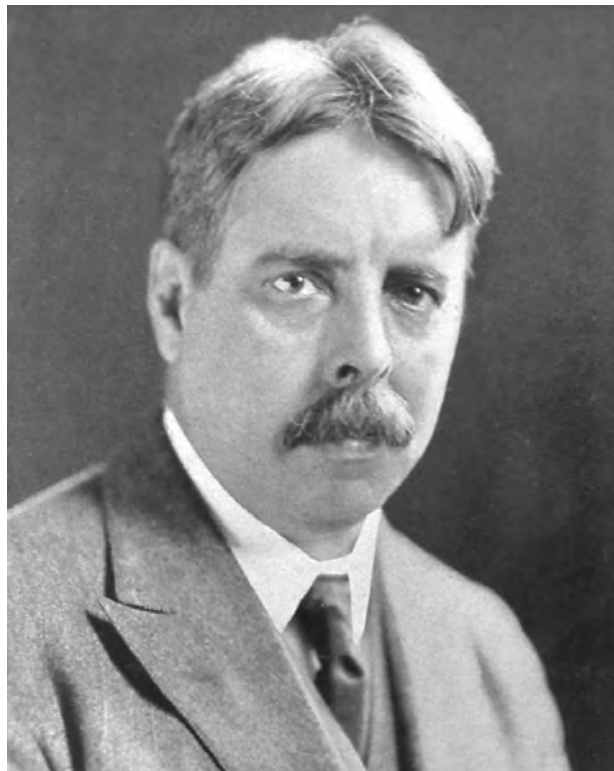
THORNDIKE, E(DWARD) L(EE) 1874–1949

“Whatever exists at all exists in some amount. To know it thoroughly involves knowing its quantity as well as its quality” (Thorndike, 1918, p. 16). This quotation captures the attitude that E. L. Thorndike brought to the study of education. The hallmark of his work was his abiding faith in the quantifiability of all aspects of human experience.

LIFE EVENTS

Edward Lee Thorndike was born in Williamsburg, Massachusetts, on August 31, 1874, to Edward Roberts and Abbie (Ladd) Thorndike. E. R. Thorndike was a Methodist minister who served churches in Maine and Massachusetts. Perhaps in reaction to a strict religious upbringing, throughout his life, E. L. Thorndike favored science over religion.

Upon graduation from Wesleyan University in 1895, Thorndike went to Harvard University to study with William James and begin his psychological studies of learning. He soon moved from Harvard to James McKeen Cattell's lab at Columbia University where he undertook his famous puzzle box studies with cats. After earning his doctorate Thorndike spent a year at Western Reserve University before becoming a member of the founding faculty at Teachers College (TC), Columbia University, in the fall of 1899. He remained at TC until his retirement in 1940, publishing approximately 500



E. L. Thorndike THE LIBRARY OF CONGRESS.

books, monographs and papers. (For a list of publications, see Gates, 1949.)

Thorndike married Elizabeth Moulton on August 29, 1900. They had four children, all of whom earned PhDs. The second son, Robert L., followed in his father's footsteps at Teachers College.

E. L. Thorndike's work was widely recognized within his own lifetime. He was elected president of the American Psychological Association (1912), the American Association for the Advancement of Science (1933), and the Psychometric Society (1936). Cattell ranked him first among American psychologists in a 1921 poll for American Men of Science. Thorndike died of a massive cerebral hemorrhage on August 9, 1949.

THORNDIKE'S RESEARCH AND THEORY

E. L. Thorndike formulated a theory of mental associations called connectionism. He believed that the central nervous system was the basis of all behavior. Learning took place when connections were formed between neurons. The purpose of education was to facilitate the formation of desirable connections.

Thorndike was fascinated with individual differences, trying to measure them, explain them, and use them for prediction. He believed that science could solve human problems, and he applied scientific method to problems of education. Much of his career was spent trying to develop methods to measure individual differences and to use these measurements to make education more efficient and successful.

Thorndike set out to place education on a sound scientific footing. The prevalent educational practice in 1900 was the doctrine of mental discipline. Curriculum was founded on opinion, not evidence. Based on his studies he concluded that education must be conducted in the subject to be learned and tailored to the ability levels of the students. He continued his pursuit of quantification and scientific method in education in one of the first books on psychological and educational measurement (Thorndike, 1904).

In addition to his efforts to make education more efficient and scientifically sound, Thorndike expended considerable effort from 1900 to 1925 in developing measures of intellect. Beginning in 1903, he and his students developed a wide variety of measures of human abilities, culminating in the CAVD, a "test constructed (in 1922 1925) as a sample of what a measuring instrument for a mental ability should be" (Thorndike, 1949, p. v.). The acronym stood for Comprehension, Arithmetic, Vocabulary and Direction following, four of the more important dimensions of intellect in Thorndike's view.

In the 1930s, Thorndike turned his attention to problems of lexicography, and in this work, he revolutionized the way dictionaries were produced. For years he had been keeping records of the frequency of word usage in the English language. He used these counts to determine which words to include in his dictionaries and what the order of definitions should be. He also required that each word be defined only using words that were more frequently used than the word being defined. All modern dictionaries now apply these principles.

E. L. Thorndike's influence on education and psychology is so pervasive that it is hard to detect. He pioneered the scientific study of education and made major contributions to the measurement of human abilities, comparative psychology, and social psychology. The hundreds of students he taught have spread his ideas throughout American education and psychology. Most 21st-century education faculty can trace their intellectual ancestry to him through their mentors. A full biography of E. L. Thorndike is available in Joncich (1968).

SEE ALSO *Rewards*.

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Robert Thorndike

TIME ON-TASK

Arguably, the primary goal of schooling is to provide students with a safe and engaging environment and ample opportunities to learn. A large portion of a student's typical school day is allocated towards providing these opportunities. However, once lunch, recess, and passing periods are accounted for, the amount of time teachers allocate for learning is far more than the amount of time students are actually engaged in learning. Martella, Nelson, and Marchand-Martella (2003) report that students only spend about 42% of their school day engaged in learning. Time on-task, also known as engaged time, is the amount of time actually spent learning (Slavin, 2003). It is important to acknowledge that engaged time is more than a behavioral concept; it also encompasses the emotional commitment to academics (VanDeWeghe, 2006). For example, students should demonstrate behaviors such as writing, participating in tasks, reading aloud, reading silently, and asking questions; they should also be attentive, interested, and invested in their learning (Greenwood, Horton, & Utley, 2002; Marks, 2000).

Some research concludes that engaged time is the most important influence on academic achievement (Greenwood et al., 2002; Marks, 2000; Slavin, 2003). According to Greenwood and colleagues (2002) academic engaged time increases through second grade and levels off through fifth grade. Conversely, off-task behavior is stable through second grade, increases momentarily through fourth grade, and then declines through fifth grade. Examples of off-task

behavior include talking out of turn, walking around the class, disturbing peers, and daydreaming. Students who engage to a high degree in off-task behavior "will be unable to respond to academic opportunities or manage subject matter tasks rapidly and accurately" (Greenwood et al., 2002, p. 328). This pattern "can lead to dysfunctional school behavior [which can] ultimately culminate in some students leaving school entirely" (Marks, 2000, p. 155).

Children from specific populations seem to experience lower levels of on-task behavior than others, particularly those with attention-deficit/hyperactivity disorder (ADHD; Brock, 2005). A literature review by Junod, DuPaul, Jitendra, Volpe, and Cleary (2006) reported that children with ADHD typically struggle academically because of their lower rates of academic engagement. More specifically, they reported that these individuals experience higher rates of retention and lower grade point averages, college enrolment, and socioeconomic status. Children with ADHD are typically 2.5 times more likely to engage in off-task behavior, which was suggested by Junod and colleagues to be the most influential variable associated with academic difficulties.

It is important to acknowledge that too much emphasis on academic engagement can have adverse outcomes on learning. An overemphasis on engagement as a teaching strategy can create an environment of mock participation, within which students pretend to be on-task but are not engaged in learning. While mock participation may achieve one's desire for students to stay on task behaviorally, it can negatively impact academic achievement as it lowers students' rate of emotional engagement (Slavin, 2003).

MEASURING ON TASK BEHAVIOR

Direct observation can be used to assess levels of on- and off-task behavior. The observation might be conducted by a teacher, teacher's aid, behavior specialist, or school psychologist. Two considerations essential to obtaining accurate data are that (a) the observation be discrete and conducted in a way that does not alter the natural environment and (b) the behavior being observed must be concrete and measurable (O'Neil et al., 1997).

Two observation techniques often used to assess engaged time are frequency (the number of times a behavior occurs) and duration (the length of time that the behavior is expressed from beginning to end) strategies. For low frequency academic engagement behaviors event or frequency data is the easiest to collect and can be done as instruction occurs. For example, a teacher can tally the number of occurrences of a behavior throughout any given week, day, hour, or minute, and a behavioral rate calculated by dividing the number of occurrences by the duration of the observation. Examples of off-task

behaviors often assessed via frequency data are calling out during instruction, number of worksheets completed, and getting out of one's seat. Duration recordings measure the length of time a behavior occurs. This type of recording is best for behaviors that occur over a period of time and have a clear beginning and ending. It requires the observer to attend to the behavior throughout its duration, typically with a stop watch. Examples of off-task behaviors often assessed via duration data are moderate temper tantrums and aggressive outbursts (Browning-Wright & Gurman, 2001).

Another common strategy for measuring on-task behaviors that occur relatively frequently is momentary interval time sampling. This technique entails dividing the observational period (usually 20 minutes) into equal time intervals (e.g., one minute intervals) and recording what the student is doing at each time interval. When measuring engaged time behaviors are typically coded using one of the following four categories: on-task (O), passively off-task (P), verbally off-task (V), or actively off-task (A). Once the observation is complete, the examined behavior is divided by the number of observation periods to obtain an estimate of on- and off-task behavior. Examples of off-task behaviors often assessed via momentary interval time sampling include talking to peers, walking around the classroom, or tapping a pencil.

BETWEEN AND WITHIN TASK TRANSITIONS

Transitioning from one activity to the next, although essential and inevitable, can negatively impact a student's engagement in academics (Martella et al., 2003). Effective transitions, either between-tasks or within-tasks, can have a positive effect on engaged learning as they increase allocated time and decrease the opportunity for disruptive behavior (Lee, 2006). Between-task transitions are tasks that include moving from one subject to another (e.g., math to reading, lunch to reading, or music to science; Martella et al., 2003). According to Slavin (2003) maintaining smoothness is important in decreasing the amount of time spent between tasks. Poor smoothness between tasks can cause abrupt breaks, possibly increasing disruptive behavior; instruction should be as seamless and sequential as possible. Within-tasks transitions are discrete activities that happen within a given task (e.g., passing out math worksheets during a math lesson or passing back graded papers during silent reading; Martella et al., 2003). Teachers can keep students on-task during within-task transitions by maintaining the momentum during the task. Momentum "refers to the avoidance of interruptions or slowdowns" once an activity has started (Slavin, 2003, p. 372).

In a literature review by Lee (2006), behavior momentum was examined in relation to facilitating between and

within task transitions. It was found that when students are presented with several high-probability requests (i.e., those that evoke a high probability of compliance) prior to a low-probability request (i.e., those that evoke a low probability of compliance), task initiation increased and became more efficient. For example, when transitioning from silent reading to writing, a teacher could ask the students to take out a piece of paper, take out a pencil, and write their name on the paper immediately before asking the students to write about what they read; the momentum generated by positive responses to the high-probability request carried over to the low-probability request. The same idea can be used to facilitate within-task transitions in that several high-probability requests can be woven within low-probability requests to establish and maintain behavior momentum.

To alleviate the negative effects of transitions, teachers should be knowledgeable of strategies to maintain on-task behavior. Examples of such include the following:

- Establish a consistent routine and illustrate such via a visual daily schedule (Brock, 2005).

- Make lessons engaging and use materials that are interesting and motivating (Brock, 2005).

- Reinforce on-task behavior and work completion (Brock, 2005).

- Ensure that challenging lessons include relatively easy tasks (Lee, 2006).

- Provide students with reminders as transitions approach; reminders can become more frequent as the transition approaches.

- To maintain momentum and smoothness, avoid stopping instruction for longer than a minute to deal with missing papers, pencils, or other mild off-task behaviors (Slavin, 2003).

- To decrease the amount of total class time spent transitioning, ask students to make transitions as a group and not individually (Slavin, 2003).

SEE ALSO *Behavioral Objectives; Feedback in Learning.*

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TOKEN ECONOMIES

SEE *Classroom Management: Token Economies*.

TOM

SEE *Theory of Mind*.

TRANSFER

Can humans benefit from their prior experience when attempting to solve novel problems? Transfer research suggests the complexity within this question. This entry describes the various complexities in studying transfer. First competing definitions of transfer are described, and then the discussion turns to the dimensions along which transfer may occur and the types of evidence that different researchers argue is needed to demonstrate the existence of transfer. Obstacles that prevent some from transferring their experience to new situations are described next, and the interventions that have been undertaken to surmount them. Finally, dominant approaches to studying and conceptualizing transfer are discussed, such as the preparation-for-future-learning view, information processing, and situated cognition approaches.

DEFINING TRANSFER

One definition of transfer is: “the carrying over of an act or way of acting from one performance to another” (Wood-

worth & Schlosberg, 1954, p. 734). Another definition is: “the ability to extend what has been learned in one context to new contexts” (Bransford, Brown, & Cocking, 1999, p. 39). A third definition is: “a situation where information learned at one point in time influences performance on information encountered at a later point in time” (Royer, Mestre, and Dufresne, 2005). The broadest of these conceptions suggests that transfer should be a widespread phenomenon: past learning must affect future performance frequently, and, indeed, formal schooling is predicated on this assumption. However, others disagree. Detterman points out: “Transfer has been one of the most actively studied phenomena in psychology . . . Reviewers are in almost total agreement that little transfer occurs” (1993, p. 8). Detterman goes on to suggest, therefore, that the educational implications of the assumption of transfer are misplaced: “Cognitive psychologists, and other people who should know better, continue to advocate a philosophy of education that is totally lacking in empirical support” (1993, p. 16). One wonders who is correct.

The disparity lies, in part, in what qualifies as successful transfer, both in terms of the extent and nature of the initial learning experience and in terms of the novelty and difficulty of the transfer test. The history of this debate goes back over a century to the debate between two famous early psychologists, Edward L. Thorndike (1874–1949) and Charles Judd (1873–1946), about the implications of their findings. Beginning around 1900, Thorndike and his colleagues reported a series of experiments finding poor or uneven transfer across tasks, despite dependence upon similar operations. For example, after training subjects to estimate the area of certain geometric shapes (e.g., 100 sq. cm rectangles), they did not transfer their learning to solve other problems concerning estimating geometric area, such as estimating the area of other rectangles and triangles (see Thorndike & Woodworth, 1901). By contrast, in Judd’s 1908 experiment, boys throwing darts at a submerged target, adapted better to a change in target depth if they were given an explanation of the principle of optical refraction that made the underwater target appear to be at a different depth.

This disparity in experimental evidence regarding transfer success has continued into the 2000s. For example, Gick and Holyoak (1980) employed an analogical transfer experiment using the classic Dunker tumor radiation problem (how to destroy cancer cells within the body without damaging surrounding flesh by converging on the diseased cells from many directions so as to spread out and dilute the potentially damaging effects of the rays) and an analogous military situation (troops spread over many roads to avoid detonating weight-sensitive mines). They found that if subjects were told to think about the training problem, when tackling the transfer test, transfer was superior. By contrast, Reed, Ernst, and

Banerji (1974) failed to demonstrate transfer on most performance measures, using the missionary-cannibal problem (how to get safely across a river in a limited-capacity boat without having the cannibals in the group ever outnumber the missionaries) and an analogous problem substituting wives and jealous husbands. Judd's underwater target findings suggest that a theoretical understanding of principles may be important for successful transfer, a claim supported by Brown's extensive body of work on transfer which also points to the need to foster theoretical understanding, though not necessarily by explicit instruction (e.g., Brown & Kane, 1988; Brown, 1989). (The above study by Gick and Holyoak also points to the need to foster a connection between the training and transfer materials.)

Given that the world outside of psychology experiments does not generally tell problem solvers which aspects of their experience are likely to be most relevant to current problem-solving situations, it could be argued that spontaneity is a requirement for true transfer and, therefore, that this work shows that such transfer is difficult to obtain. Further, much of the evidence for transfer described above is dismissed by some (e.g., Detterman, 1993) as demonstrating only near transfer, in which the transfer test is so close in some way to the training situation as to be trivial. This viewpoint argues that such near transfer does not count as true transfer because the situations in which society values transfer, such as from school learning to work performance, require far transfer, which is rarely obtained. However, others dispute this gloomy conclusion, claiming that training can enhance general thinking skills, which would constitute far transfer of learning (see, e.g., Perkins & Grotzer, 1997; Halpern, 1998). In sum, as of 2008, "There is little agreement in the scholarly community about the nature of transfer, the extent to which it occurs, and the nature of its underlying mechanisms" (Barnett & Ceci, 2002, p. 612).

DIFFERENT DIMENSIONS ALONG WHICH TRANSFER CAN OCCUR

The conflicting evidence concerning whether transfer occurs can be better understood if the disputed claims are dissected and the findings categorized according to the contextual and content dimensions along which transfer of learning has been assessed. Barnett and Ceci (2002) detailed a taxonomy of 6 context and 3 content dimensions along which transfer might be assessed and along which studies have suggested transfer success may differ, with near transfer (transfer to more similar contexts) generally resulting in easier transfer than far transfer (to more dissimilar contexts). The contextual dimensions include knowledge domain (e.g., physics vs. math), physical context (e.g., school vs. home), temporal context (e.g., in 5 minutes vs.

in a month), functional context (e.g., as an academic exercise vs. a task for earning money), social context (e.g., individual vs. group) and modality (e.g., written vs. verbal).

The content dimensions along which transfer success may vary involve the nature of the skill to be transferred (e.g., rote procedure vs. abstract principle), the performance change measured for this skill (e.g., percentage of correct answers vs. speed of response), and the memory demands of the transfer task used to measure it (e.g., spontaneous recall vs. prompted recognition). For example, as suggested by Gick and Holyoak's 1980 work, discussed earlier, transfer assessed after prompting may be easier to achieve than transfer assessed by spontaneous recall. Transfer may also be more likely when "learning contexts are framed as part of a larger ongoing intellectual conversation in which students are actively involved" (Engle, 2006, p. 451). Engle conducted a detailed case study of fifth graders in a Community of Learners classroom and suggested that future research should take into account not just the content to be transferred but also the framing of the wider learning context. The use of the terms *successful transfer* and *far transfer* without specifying and discriminating between these various dimensions has been the source of much confusion.

OBSTACLES TO SUCCESSFUL TRANSFER

Successful transfer requires encoding and subsequently identifying and retrieving relevant knowledge, followed by application of the knowledge to the transfer problem. Problems can occur at any or all of these stages. For example, knowledge may be adequately encoded but a student may fail to recognize its relevance. Successful near transfer combined with unsuccessful far transfer could be due to either a failure to recognize the relevance of the information, a failure to adapt the knowledge to the new situation, or encoding of such a specific interpretation of the initial learning situation that it is not applicable to the new situation. For example, Schliemann and Nunes (1990) found that school math class learning did not transfer to a fishing problem to which the same mathematical concepts could be applied (e.g., calculating proportions). This failure could be because the math class taught the material in a superficial manner, which did not lead to an understanding of the principles underlying the mathematical routines involved but merely showed the students how to mechanically reproduce a very specific arithmetic procedure. Alternatively, it could be that the relevant knowledge was encoded, but the subjects failed to recognize the relevance of that knowledge to the fishing questions, perhaps because that knowledge was, for them, embedded in their knowledge of the school situation. This kind of situation-specificity was explored by Lave (1988) in her classic work with supermarket shoppers, which found a lack of evidence for

PERSPECTIVES ON TRANSFER

The process of prior knowledge influencing the way students solve a present task is known as *transfer*. The traditional view of transfer is known as *direct application*, where old knowledge is automatically applied to new tasks. So if a student is given the “know how” to perform a mathematical procedure in an algebra class, such skills should transfer to chemistry class if needed. However, transfer fails to happen as often as we expect. Direct application theorists have viewed transfer as a relatively rare phenomenon but believe that transfer is more likely to happen when the new task resembles the original one.

Those who favor *high road transfer* take a different perspective. From this view, transfer occurs when students are made aware that new knowledge or skills are in their “mental toolbox.” In the algebra example, students learning a mathematical procedure might be told by their teacher, “Please keep in mind that this mathematical procedure will be used in your science class today.” Later that day when students are solving a chemistry problem which calls for this procedure, the science teacher might remind them to “think about the skill you learned in math class today.” Proponents of the high road transfer perspective believe that a student’s awareness of how his or her skills can be applied in other situations makes all the difference in whether or not transfer occurs.

These different perspectives have led to different methods for testing the occurrence of transfer, and

subsequently, different conditions under which transfer occurs. Those endorsing high road transfer would say that students must correct their misconceptions through inquiry and discussion with their teacher; giving students a take home message to be generally applied in other domains. Advocates of direct application transfer believe students must practice a skill over and over in similar scenarios, until the behavior becomes second nature. This way, there is little need for deliberation when confronted with a new, yet similar task.

The *situated cognition* offers a both an explanation and a potential solution for past difficulties in demonstrating and explaining transfer. Whereas repetition often may be initially helpful in mastering a given skill, students often maintain a narrow perception concerning when and where the skill should be employed. In other words, a strategy that has worked to solve a problem may only seem applicable in the context in which the student originally learned the strategy. For instance, students in a math class might see a particular algebraic formal as being used only for mathematics, because they never had the opportunity to use it in another context (e.g. science). From a situated cognition perspective, this problem can be aided by advising teachers to present information in various contexts and to switch the activities so that students will grasp the skill while thinking critically, and retaining basic strategies and themes.

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transfer from school math to shopping; despite knowing how to carry out elementary arithmetical operations on a math test, the same procedures were not used to determine unit prices at the market.

Some efforts to resolve these issues have focused on hypothesizing about the precise components of knowledge encoded in the initial training and mapping them onto the components of the transfer problem. Singley and Anderson’s 1989 production rule approach to modeling computer programming learning is of this type. However, applying such approaches to modeling complex and less well structured learning situations, or those

in which similarities are abstract and less apparent, may be difficult.

Transfer processes may also be affected by motivation, which could influence initial learning, initiation of transfer attempts, spontaneity, and persistence in transfer tasks. Studies have shown that having mastery goals consistently predicts cognitive engagement and, in particular, results in activities such as deep processing and metacognitive strategies or insights into the workings of one’s own cognitive systems (Pugh & Bergin, 2006). However, engagement does not always predict achievement, though this may be because of the kinds of achievement measures used, which may not reflect the deep processing associated with transfer

(Pugh & Bergin, 2006). Performance goals may have damaging effects on engagement and transfer because a focus on avoiding a display of incompetence hampers deep processing and a focus on trying to do well shows mixed results. For example, a study by Bereby-Meyer and Kaplan (2005) found that, for a group of grade-school children, the performance-approach goal condition did not differ from the control condition when the goal was induced before encoding and performed worse than the control when the goal was induced after encoding but prior to the transfer test.

INSTRUCTIONAL INTERVENTIONS THAT PROMOTE TRANSFER

Experimental studies have generally found that learning experiences that promote deep, theoretical understanding are most conducive to transfer to different domains (see Barnett & Ceci, 2002, for a review). Deep understanding can be facilitated by encouraging learners to compare and contrast a variety of examples and by requiring them to explain and justify their decisions. A number of researchers have reached similar conclusions and have investigated ways in which training can promote such understanding. Generally, these approaches focus on getting the learners to engage with the training materials at a deep, structural level. Catrambone and Holyoak (1989) used comparison questions with multiple examples, which improved transfer, for example. Similarly, Cummins (1992) found that inter-problem processing (focus on comparison questions) promoted more transfer than intra-problem processing (focus on specific wording or details). Needham and Begg (1991) encouraged their subjects to fruitfully engage with learning materials by using problem-oriented training (e.g., trying to explain) in contrast to memory-oriented training. However, it is not obvious what deep theoretical understanding really means. Wagner (2006) has suggested that it may not necessarily be more abstract but instead may be “increasingly complex sensitivity to the contextual differences . . . encountered” (p. 4).

Halpern, Hansen, and Riefer (1990) suggested that hard work pays off in their study that enhanced subjects' ability to draw inferences from a studied passage by including far analogies in their training materials, presumably encouraging a focus on deep, structural processing. Their subjects did not derive the same benefit from a near analogy, which the authors suggest may be because they did not have to work as hard to make sense of it. Similarly, Reed and Saavedra (1986) showed that a task involving more concrete and effortful processing, termed the *discovery method* (running a computer simulation with feedback), improved performance more than a passive task (observing a computer-generated graph).

The merits of the discovery method of learning have been the subject of much debate. Chen and Klahr (1999)

studied children's learning of the scientific method, specifically the “control of variables strategy” (the idea that one can figure out whether something is causal by changing it while holding all else the same). They compared training using probing questions with or without direct instruction and found that direct instruction was necessary for learning and transfer. Later, Klahr and Nigam (2004) compared the effectiveness of direct instruction and discovery learning on learning and transfer. They concluded that more children learned from direct instruction, challenging the “widely accepted claim in the science- and mathematics-education community . . . that discovery learning, as opposed to direct instruction, is the best way to get deep and lasting understanding” (p. 661). However, Kuhn (2005, 2006) disputes this conclusion, suggesting that “direct instruction appears to be neither a necessary nor sufficient condition for robust acquisition or for maintenance over time” (2006, p. 384) based on her research. Klahr (2005) disagrees with her interpretation of her findings, instead stating that “they show how difficult it is to achieve long-term transfer with anything less than extremely detailed and direct instruction” (p. 871). Further research is needed to resolve this debate.

PREPARATION FOR FUTURE LEARNING

The constructivist view of learning argues that the challenge is for learners to construct new knowledge for themselves and that one factor which determines their ability to do so is their level of prior knowledge (Bransford et al., 2000). For example, Schwartz and Bransford (1998) demonstrated that preparatory work, such as generating distinctions between contrasting cases in psychological experiments, enhanced future learning from a lecture, as measured by transfer one week later. They proposed a distinction between this preparation-for-future-learning view and a sequestered approach which does not provide access to outside sources of information, suggesting that much classical transfer research is from the latter paradigm and advocating for the former. Sequestered problem solving is inadequate as an assessment of learning because it artificially restricts the problem solver's access to other sources of information which are an integral part of problem solving. Their preparation-for-future-learning view advocates exploration of how past learning prepares the learner for future learning in contrast to the sequestered problem-solving approach. However, learning and transfer could theoretically be assessed in an information-poor or an information-rich environment (sequestered or not), independent of the transfer measure used (problem-solving performance or enhanced future learning).

The broader concept of transfer suggested by the preparation-for-future-learning view fits within the tradition of

studying more generalized outcomes such as the development of practical intelligence (see Sternberg & Kalmar, 1998) and metacognitive and critical thinking skills. As stated by the renowned transfer researcher, the late Ann Brown, “Effective learners operate best when they have insight into their own strengths and weaknesses and access to their own repertoires of strategies for learning. For the past 20 years or so, this type of knowledge and control over thinking has been termed *metacognition*” (Brown, 1997, p. 411). Halpern’s 1998 critical thinking program is an attempt to boost such general reasoning skills: “to promote the learning of transcontextual thinking skills and the awareness of and the ability to direct one’s own thinking and learning” (p. 451). Halpern’s program of instruction builds skills such as verbal reasoning, argument analysis, hypothesis testing, probability, and decision-making. Training also aims to promote transfer by focusing on awareness of which skills to use and providing practice with a broad range of examples, supported by feedback and probing questions. One of the goals is to develop the rich, interconnected knowledge structures the deep understanding that Brown (1989) suggested is important for transfer. In line with this view, the National Research Council’s Committee on the Development of the Science of Learning (Bransford, Brown, & Cocking, 1999) concluded that transfer can be facilitated by training students in metacognitive awareness through activities that encourage introspective awareness and self-monitoring.

DIFFERENT THEORETICAL PERSPECTIVES TREATMENT OF TRANSFER

Some cognitive scientists have studied much more tightly specified learning and transfer processes. Holland and colleagues (1986) described the mechanism of analogical transfer, in terms of four steps: “encoding of the target, selection of a source analog, mapping of the source and target, and transfer of knowledge to the target by generation of new rules” (p. 307). Each step can then be broken down further, for example, encoding involves representing the problem in terms of the initial state, goal state, relevant operators, and path constraints. Singley and Anderson (1989; Anderson 1993) took this information processing approach further and proposed that cognitive skills can be understood in terms of production rules which represent knowledge, which can then be instantiated in, for example, computerized tutors for teaching programming skills.

Such decontextualised approaches have been criticized (see, e.g., Lave, 1988) for neglecting the embeddedness of learning and knowledge in context. Lave has advocated a strong view of this “situated cognition” hypothesis and suggests that learning is inextricably entwined with the context in which it was acquired: “Cognition . . . is distributed

. . . not divided among mind, body, activity and culturally organized settings (which include other actors)” (p. 1). More nuanced interpretations suggest that aspects of context may moderate transferability (Barnett & Ceci, 2002).

Lobato (2003) distinguished between what she called the classical transfer approach and actor-oriented transfer and suggested that the apparent failure to transfer in many traditional experiments was, in fact, a failure on the part of the experimenters to adopt the perspective of the learner. On this view, success or failure on the particular outcome measures the researcher had in mind is immaterial; what matters is how the learners make connections between the new and old situations. This approach often uses case studies as an investigative method, either alone (see, e.g., Lobato & Siebert, 2002) or in conjunction with group data (see, e.g., Dufresne et al., 2005). Lobato (2006) contrasts the classical transfer approach, of using highly controlled experiments and statistical analysis to assess whether particular learning opportunities result in predetermined differences on carefully designed transfer assessments, with her actor-oriented approach, using ethnographic methods to search for effects of prior learning on novel situations. This method increases the likelihood of capturing subtle effects on future performance that may not have been the intended lesson to be learned, but that may nevertheless provide insight into the mechanisms underlying the transfer process and generate hypotheses for further investigations. She emphasizes that generalization involves the construction of relationships rather than simply the reproduction of existing relations.

However, the implication that traditional transfer researchers have ignored the wider effects of prior learning and focused exclusively on a narrow, experimenter-imposed measure of transfer is somewhat misleading. Traditional researchers have often devised multiple assessments of learning outcomes and explored the consequences of many experimental manipulations to capture the richness of the learning and transfer processes, as well as used microgenetic methods to understand the step-by-step processes of learning (see, e.g., Brown & Kane, 1988; Chen & Klahr, 1999).

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TRIARCHIC THEORY OF INTELLIGENCE

Webster (1996) defines intelligence as the “capacity for learning, reasoning, understanding, and similar forms of mental activity” (p. 990). This definition implies that intelligence is both multifaceted (i.e., captures many aspects of mental ability) and reflective of differences in capacity, ability, and aptitude among individuals. Yet this definition is not necessarily embraced by all scientists. In fact, there is no consensus on the definition of intelligence among professionals who study it (e.g., psychologists, educators, and computer scientists), and many attempts have been made to define and generate supporting theories about exactly what constitutes intelligence. Among the many theories of

intelligence are those that define intelligence as a cognitive “system.” The overarching assumption of these systemic theories is that intelligence is not a single entity but a multifaceted structure and that traditional definitions of intelligence have been excessively narrow. The quest for theories that reflect the variety of ways in which humans think, learn, and adapt to their environment was initiated in the early 1980s in the United States. Most notable among systemic theories of intelligence is Robert Sternberg’s *Triarchic Theory of Intelligence* (Sternberg, 1996). Other examples are Howard Gardner’s *Theory of Multiple Intelligences* (Gardner, 1993) and the theory of *Emotional Intelligence*, initially presented in the scientific literature by Peter Salovey and Jack Mayer (Salovey & Mayer, 1990) and popularized by Daniel Goleman (Goleman, 1995).

Sternberg’s Triarchic Theory of Intelligence was developed about the same time as Gardner’s Theory of Multiple Intelligences. Rejecting traditionally narrow definitions of intelligence, Sternberg defined intelligence as mental activity central to one’s life in real-world environments; individuals “succeed” in life when they use mental skills to adapt to, select, and shape external environments. Correspondingly, in the late 1990s, Sternberg changed the name of the theory to the *Theory of Successful Intelligence*. As per its original name, the theory comprises three types of intelligence: *analytical* (also referred to as componential); *practical* (also referred to as contextual) and *creative* (also referred to as experiential). *Analytical intelligence* is evoked while analyzing, evaluating, criticizing, reasoning, and judging. *Practical intelligence* is used while implying, implementing, and using. *Creative intelligence* is manifested while discovering, inventing, dealing with novelty, and creating. The theory predicts that “intelligent” people will identify their strengths and weaknesses, make the most of their strengths and compensate for their weaknesses. Individuals are not limited to strength in only one of the three areas; both integrated and uneven profiles of intelligence are possible.

Sternberg’s work on the Theory of Successful Intelligence unfolded in three phases. The first phase was the validation of the fundamental importance of different abilities and the collection of supporting evidence from different cultures and societies. This work took place in a number of countries (e.g., China, India, Jamaica, Kenya, Russia, Taiwan, Tanzania, the United States, and Zambia) and in a variety of settings, both educational and occupational. These studies provided compelling evidence that the focus on traditionally-defined cognitive abilities (i.e., interpreting intelligence through the so-called *general factor* of intelligence, or *g*, as something common to all tests of intelligence) underestimates the importance of practical and creative abilities in human cultures. In one study, for example, Sternberg and his colleagues found that knowledge of herbal medicine among rural Kenyan children was perceived by adults in their communities as equal to or

more indicative of cognitive competence and, thus, as valuable or more highly valued, given the ecological conditions of a relatively isolated African village, than the children’s performance on conventional tests of *g* (such as the Raven Matrices) or their achievement at school. A set of studies has been conducted to investigate implicit theories of intelligence in laypeople around the world. People from different cultures were found to differ widely in their emphasis of what they view as intelligence behavior. For example, even in the United States, people in some cultures, such as Latinos, value and emphasize social functioning facets of intelligence more than other cultures, such as Anglos. Around the globe, people also differ in their taste for when and how intelligence behaviors should be manifested. For example, Taiwanese Chinese appear to value a sensitivity to when one’s intelligence should be shown off and when it should be concealed.

The second phase included studies designed to develop valid and reliable methods to assess analytical, practical, and creative abilities. This domain of research combined multiple efforts to design different instruments that can capture these abilities in both educational and employment settings. As an illustration, Sternberg and his colleagues worked with the U.S. Army to quantify the practical abilities of U.S. officers by capturing, describing, and measuring their “tacit” knowledge of military leadership so that this knowledge could be integrated into the training of military cadets preparing for future leadership roles. Similarly, the theory has been realized in the creation of different assessment instruments. An early version of such an instrument was referred to as The Sternberg Triarchic Abilities Test, or the STAT. The STAT had three subtests, analytical, practical, and creative, and contained items in two formats, multiple choice and essays. The latest generation of this instrument is referred to as the Aurora Battery.

The battery is designed for children in elementary and middle schools and captures their analytical, practical, and creative abilities in the domains of dealing with and manipulating words, numbers, and images (i.e., tapping into verbal, mathematical, and spatial representations). The Aurora Battery contains four components, engaging multiple methods and multiple informants. Specifically, it includes (a) group-administered assessment of abilities, which are captured by multiple-choice, right/wrong responses, and open-ended items; (b) a teacher rating scale; (c) a parent interview; and (d) a portfolio-based observation schedule (i.e., a collection of one-on-one assessments in which children are given a chance to generate specific products in situations modeling real life).

The third phase was designed to apply the Theory of Successful Intelligence to the educational environment. Sternberg and his colleagues completed multiple studies in U.S. schools in a variety of subject matters across

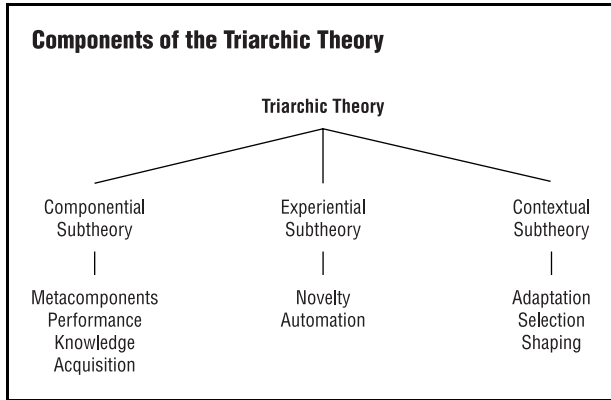


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multiple grade levels. The main thrust of this research was to demonstrate the value of multiple pedagogical approaches that ensure that children are taught in ways that challenge and develop their analytical, practical, and creative abilities. Pedagogical intervention studies based on the theory were carried out across different levels of schooling (elementary, middle, and high) and across a number of academic subjects (e.g., mathematics, science, language arts, social studies). In one of the largest studies, a triarchic theory-based curriculum was administered to a few thousand children enrolled in fourth grade in various locations in the United States. The curriculum was developed for language arts, mathematics, and sciences; it was based on the national standards and, prior to implementation, was adapted to specifics of requirements of the various states and districts where it was delivered. The study included three other comparison groups, all with a large number of children: (a) a group of children to whom a traditional (i.e., “treatment-as-usual”) curriculum was delivered; (b) a group of children to whom a curriculum based on modern theories of memory was administered; and (c) a group of children who were taught with a curriculum based on theories of critical thinking. In each case, the study group was followed for approximately six months.

Although the profile of results is complex and variable for each domain of studies, there is a strong indication of an overall advantage of triarchic-based teaching. In general, this and similar studies have demonstrated the benefit of this approach: students not only developed competencies in thinking analytically, creatively, and practically, but also improved their performance on standardized tests. Capitalizing on empirical evidence obtained in his research studies, Sternberg has brought his work on the Theory of Successful Intelligence to a policy level. As the Director of the PACE (Psychology of Abilities, Competencies, and Expertise) Center at Yale Uni-

versity, Sternberg worked with the College Board on developing a triarchic assessment, referred to as the Rainbow Assessment, augmenting the SAT. As Dean of Arts and Sciences at Tufts University, within the framework of the Kaleidoscope Project, he ensured that, in addition to scores on standardized tests, assessments of creative and practical abilities are considered in student admission decisions.

Sternberg’s theories have two main complements in the literature. The first is Howard Gardner’s Theory of Multiple Intelligences. This theory (also referred to as the *MI* theory) was developed at roughly the same time as Sternberg’s theory and also assumes the presence of a number of distinct forms of intelligence. Individuals possess these types of intelligence in varying degrees, which establishes their unique cognitive profiles. Like Sternberg’s, Gardner’s theory is based on the argument that traditional definitions of intelligence do not capture the wide variety of abilities humans display. To support his argument, Gardner analyzed case studies of individuals with unusual talents, such as child prodigies in music or mathematics; reviewed neuropsychological evidence on specialized areas of the brain that process particular types of information; and integrated evolutionary theory and results of psychometric tests.

According to Gardner, there are eight primary forms of intelligence: *linguistic* (manifested in dealing with spoken or written words); *musical* (demonstrated in dealing with rhythm, music and hearing); *logical-mathematical* (invoked while reasoning inductively or deductively and dealing with abstractions and numbers); *spatial* (engaged in vision and spatial judgment); *bodily-kinesthetic* (required for movement and doing); *interpersonal* (needed for interactions with others); *intrapersonal* (manifested in dealing with self) and *naturalistic* (demonstrated in dealing with nature, nurturing, and classification). The addition of a ninth form of intelligence, *existential* (descriptive of the capacity to raise and consider abstract philosophical questions), is still being considered.

Because of its humanistic approach to acknowledging and promoting the value and contributions of each individual student, the theory has been embraced and supported by the educational community around the world. A number of schools and many teachers claim to use this theory as the fundamental framework for their pedagogy. Yet the theory has been widely criticized as well; it has been argued that the theory is based primarily on Gardner’s intuition and observations rather than evidence, that there are limited empirical data to support the evidence, that the separation between the constructs of multiple intelligences and personality types is blurry, that the assumption that all students are gifted in something might lead to intellectual relativism, and that there has been no systematic evaluation of the value of the theory in the classroom.

The second complementary stream of research, focused on the construct often called emotional intelligence, is associated with both Sternberg's theories (through his concept of practical intelligence) and Gardner's theories (through his concept of intrapersonal and interpersonal intelligences). Emotional intelligence is typically referred to as the ability, capacity, or skill to perceive and register, judge and assess, and manage and act on the emotions of self and others; yet there is currently no consensus definition for this term. The roots of the theory are in the use of the term *social intelligence* by American psychologist Edward Thorndike (Thorndike, 1920), who used this term to refer to the skill of getting along with other people. The term *emotional intelligence* is associated with the doctoral work of Wayne Payne (Payne, 1985); the systematic research on the construct definition and measurement is linked to Peter Salovey and Jack Mayer (Salovey & Mayer, 1990), and the popularization of the concept is associated with Daniel Goleman (Goleman, 1995). The field of emotional intelligence is relatively new, and a number of psychologists and educators are now working on the definition, assessment, and predictive power of this concept.

These three theories, although differing in detail, are aimed at diversifying the views and values of different abilities and competencies as they are exhibited by members of today's complex societies. All three theories stress the importance of expanding teaching approaches so that they encompass and target abilities and competencies that are distinct from those that only memorize and accumulate new knowledge. Although all three theories have been applied in the field of education, the Theory of Successful Intelligence appears to have accumulated the largest body of empirical evidence in its support.

Sternberg's theory has three major implications for educational psychology. First, teaching for all types of intelligence is important because students need to capitalize on their strongest abilities at the same time they work to develop the abilities in which they demonstrate weaknesses. Second, students' strongest abilities are directly connected to their most amenable learning styles. Teachers should know the learning preferences of their students and, when possible, capitalize on them. Third, because these variable abilities exist there should be many diverse assessments of school achievement, not only those that focus on traditional analytical abilities.

Sternberg's theory is widely referenced in the psychological and education literature and can be found in virtually any psychology or education textbook. Yet in the realm of practical applications, the theory has been regarded critically. The major points of criticism focus on the difficulties of reliably measuring "unconventional" (e.g., creative and practical) abilities and differentiating them psychometrically from abilities measured by more

conventional tests of intelligence and achievement. These criticisms, however, are not specific to Sternberg's work and are often extended to the work on MI theory and the theory of Emotional Intelligence. Thus, study in the field continues with the goal of developing psychometrically sound assessment instruments suitable for quantifying these abilities, tracking them developmentally, and demonstrating their importance in educational and occupational contexts.

SEE ALSO *Intelligence: An Overview; Multiple Intelligences.*

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TUTORING

Tutoring refers to an instructional method in which a tutor teaches or guides a tutee about a specific subject matter or for a particular purpose by providing explanations, modeling targeted behaviors, and/or providing prompts and feedback to students' performance. Although one tutor can teach two or three tutees simultaneously, most tutoring involves one tutor teaching one student (thus the term "one-to-one" tutoring). Everyday tutors are often peers and other paraprofessionals with little experience in teaching, although they are knowledgeable about the content domains they teach (Bloom, 1984; Cohen, Kulik & Kulik, 1982). Terms such as *expert* and *novice* tutors are used to differentiate tutors with and without pedagogical expertise. The development of artificial intelligence and information technology has also made it possible for computers to serve as tutors.

EFFECTIVENESS OF TUTORING

One-to-one human tutoring has been shown to be a very effective form of instruction. The average tutored students achieved performance gains about two standard deviations (thus usually referred to as the *2 sigma effect*) above the average students in conventional classrooms with a class size of 30 students (Bloom, 1984). A meta-analysis of school tutoring programs reported superior academic performance of tutored students in 45 of the 52 studies. The average effect size was modest (.4), but it varied from study to study with the largest effect size reaching 2.3 (Cohen et al., 1982).

Tutoring effectiveness varied depending on a number of features of the tutoring program. The effect was larger when mathematics was taught as compared to reading and also when lower level skills were assessed. The effect was also larger in structured tutoring programs and also in programs of shorter durations. However, age difference between the tutor and the tutee did not seem to matter. Providing tutors with pre-training did not increase the effect sizes either (Cohen et al., 1982).

Tutoring produces effects not only on the cognitive level, but also on the affective level. In addition to higher achievement scores, tutored students developed positive attitudes toward the subject matter covered in the instruction. Tutoring also benefits both tutors and tutees. Although the amount of improvement was smaller than that of the tutee's learning, tutors' achievement test scores also improved in 33 out of the 38 studies (Cohen et al., 1982). This effect is often called *learning by teaching* (Bargh & Schul, 1980) or the *tutor learning effect* (Roscoe & Chi, 2007).

WHAT TUTORS DO

The tutoring session is predominantly controlled by tutors. Tutors, not the students, are the ones who set the agenda, introduced the subtopic, and/or proposed problems to solve. Tutors also speak first, take more turns, and make more statements than tutees (Chi, Siler, Jeong, Yamauch, & Hausmann, 2001; Graesser, Person, & Magliano, 1995; McArthur, Stasz, & Zmuidzinas, 1990). Given their dominance of the tutoring session, it is only natural to assume that tutoring is effective because of what tutors do. This leads to the conjecture that tutors would undertake an array of sophisticated pedagogical moves during tutoring. Research on tutoring, however, shows that although certain moves are frequently undertaken by tutors, they rarely undertake other, often more sophisticated pedagogical moves in spite of the conjectures and expectations that they would do so.

Feedback and Explanation. Earlier research on human and computer tutors highlighted the role of tutorial feedback (Anderson, Boyle, & Reiser, 1985; Anderson, Con-

rad, & Corbett, 1989; McArthur et al., 1990; Merrill, Reiser, Merrill, Landes, 1995; Merrill, Reiser, Ranney, & Trafton, 1992). For example, Merrill and colleagues (1995) studied natural human tutoring in computer programming and found that tutors kept the students' problem solving on track by providing ongoing confirmatory feedback and setting new goals. When errors were made, tutors immediately drew students' attention to them if students did not notice their errors first. Later studies of tutoring, however, reported that tutorial feedback was not only infrequent but also unimportant to student learning (Graesser et al., 1995; Chi et al., 2001). Because the majority of the studies emphasizing the role of tutorial feedback came from studies of tutoring procedural skills (e.g., programming language, algebra, and geometry), it is likely that the value of immediate feedback on errors might be most useful in the procedural domain where following the right problem solving steps is important. However, there is considerable variability in how tutors handle errors even in the procedural domain. Some tutors provide explicit feedback, sometimes even telling students how to solve a problem (McArthur et al., 1990), whereas other tutors give very subtle and indirect responses to student errors (Fox, 1990; Lepper, Woolverton, Mumme, & Gurtner, 1993).

Another frequent tutor move during tutoring is giving explanations. Graesser et al. (1995) examined the tutoring of algebra and research methods and reported that one of the noticeable tutor behaviors was providing explanations along with specific examples that connected student understanding to concrete real-world examples. Chi and colleagues (2001) analyzed various tutor statements made by novice biology tutors in a naturalistic tutoring session, such as: (a) giving explanations, (b) giving feedback followed by short corrective explanations when the feedback was negative, (c) reading text sentences aloud, (d) making self-monitoring comments (e.g., "I don't know whether this will help you"), (e) answering questions that students asked, (f) asking content questions, (g) scaffolding with generic and content prompts, and (h) asking comprehension gauging questions (e.g., "is this starting to stick?"). Of the eight types of tutor statements they coded, the most prevalent tutor statement was explanations. Giving explanations is also frequent in the procedural domain (Anderson et al., 1989; McKendree, 1990), but the prevalence of explanation might vary depending on the nature of the content domain. Conceptual domains such as biology are more conducive to tutor explanations than procedural domains such as algebra. In addition, the role of tutorial explanations seems to be limited as they only correlated with shallow measures of students' learning (Chi et al., 2001) or not at all (VanLehn, Siler, Murray, Yamauchi, & Baggett, 2003).

Socratic Technique and Error Diagnosis Rare. Although tutors dominate the tutoring dialogue, this does not necessarily mean that they employ sophisticated tutoring techniques. One such technique that is absent in typical tutoring is Socratic technique. Socratic technique refers to a tutoring method in which the tutors lead students to discover their own misconceptions and construct understanding through a line of questioning instead of giving out information to students directly (Collins & Stevens, 1982). Socratic tutoring appears to produce superior learning outcomes compared with didactic tutoring (Rosé, Moore, VanLehn, & Allbritton, 2001), but it is rare not only in typical tutoring session involving novice tutors (Graesser et al., 1995) but also when tutors have years of experience (VanLehn et al., 2003).

Another tutoring technique that has often been attributed to tutors is the ability to perform a detailed and accurate diagnosis of student understanding especially with respect to errors and misconceptions. An accurate diagnosis and monitoring of students' misunderstanding is essential for tutors to be able to decide how and when to deliver the feedback and explanations and also to tailor their moves to the needs of individual students. Chi, Siler, and Jeong (2004) analyzed how accurately novice biology tutors diagnose and monitor the status of students' misunderstandings. The results indicated that tutors could assess only what students did not know against the normative understanding that the tutors were teaching and were dismal at diagnosing the students' alternative understanding or misconception. Additional evidence indicated that even experienced tutors did not engage in detailed error diagnosis and monitoring (McArthur et al., 1990; Putnam, 1987). It seems that tutors have some sense of what students understand and are aware of the general level of their competence, but are insensitive to the specific errors or misconceptions students have.

REASONS FOR TUTORING EFFECTIVENESS

In spite of the initial belief that tutors would play a critical role in tutoring, a closer examination of tutor behaviors revealed that their contribution is rather limited. This led to a realization that tutoring effectiveness needs to be examined from a broader perspective that considers not only what tutors do but also what students do in the context of interactive tutorial dialogue.

Tutorial Dialogue. To examine the potential mechanisms responsible for the tutoring effect, Graesser et al. (1995) studied the tutoring dialogues of unskilled tutors as they tutored algebra and research methods in psychology and examined the extent to which tutoring dialogues manifest

components that have been emphasized in contemporary pedagogical theories and intelligent tutoring systems. These components were: (a) active student learning, (b) sophisticated pedagogical strategies, (c) anchored learning in specific examples and cases, (d) collaborative problem solving and question answering, (e) deep explanatory reasoning, (f) convergence toward shared meanings, (g) feedback, error diagnosis and remediation, and (h) affect and motivation. Of these, only three components were prominent in a typical tutoring session: collaborative problem solving and question answering, explanatory reasoning, and anchoring in the context of specific examples.

Because most of the sophisticated techniques were underdeveloped or virtually non-existent in typical tutoring, Graesser and colleagues (1995) postulated that the tutoring effect would come from the use of localized strategies embedded within tutorial dialogues. They identified frequent dialogue patterns between tutors and tutees in the following five broad steps (p. 504):

1. Tutor asks a question.
2. Student answers question.
3. Tutor gives short feedback on the quality of the answer.
4. Tutor and student collaboratively improve the quality of the answer.
5. Tutor assesses student's understanding of the answer.

The first three steps of tutoring dialogue roughly correspond to the initiate, response, and evaluation cycle of the classroom dialogue in which the teacher initiates the dialogue typically by asking questions, the students respond, and then the teacher evaluates the responses. There are two extra steps in tutoring dialogue, however. Graesser and colleagues (1995) postulated that these extra steps of tutoring dialogue provided the advantage of tutoring over classroom instruction as tutors and tutees collaboratively construct knowledge during these steps.

Tutor-centered, Student-centered, and Interactive Hypothesis. Chi and colleagues (2001) conceptualized that tutoring effectiveness can be attributed to either what tutors do, what students do, or what tutors and tutees do together, and formulated three corresponding hypotheses: a tutor-centered, student-centered, and interactive hypothesis. The tutor-centered hypothesis states that tutors' pedagogical tactics are responsible for the effectiveness of tutoring and predicts that tutors not only employ sophisticated pedagogical moves during tutoring but also that their moves would make a significant contribution to students' learning. The student-centered hypothesis, derived from the findings that students' generative and constructive activities such as self-explanations aid learning (e.g., Chi, de Leeuw, Chiu, & Lavancher,

1994), states that tutoring is effective because it provides more opportunities for students to be generative and constructive. It predicts that students would be active during tutoring and that their active construction (e.g., question asking, self-explanations) would correlate with their learning outcomes. Lastly, the interactive hypothesis states that the key to tutoring effectiveness is not what the tutors or the students do alone, but the interaction between them. Tutorial interaction is critical because it elicits constructive responses from students. The hypothesis predicts that tutor and student would be interactive and that students' constructive and interactive responses (e.g., responding to tutor questions and scaffolding prompts) would foster learning more so than constructive but non-interactive responses (e.g., self-explanations) or interactive but non-constructive responses (e.g., acknowledgements).

In their analysis of naturalistic tutoring by novice biology tutors, Chi and colleagues (2001) found evidence for all three hypotheses. As for the tutor-centered hypothesis, tutors provided extensive amount of explanations, which was significantly correlated with student learning outcome. However, explanation was the only tutor move significantly correlated with student learning and did so only with shallow measures of learning. As for the student-centered hypothesis, they found that although tutors dominated the tutoring session, students were still more active during tutoring than in the classroom. Students asked far more questions during the tutoring sessions (e.g., about eight questions per hour) than in the classrooms (e.g., less than one question per hour according to Graesser et al., 1995). They also found that some of the students' constructive moves were correlated with learning outcomes, but they were all interactive moves (i.e., responses to scaffolding prompts and comprehension gauging questions), lending support to the interactive hypothesis as well. As for the interactive hypothesis, although tutors were not very interactive (after all, they dominated the tutoring session), students were. They never ignored tutors and always responded to prompts and questions from tutors. Tutorial interaction was also essential to student learning in that interactive construction was correlated with learning outcomes, whereas non-interactive construction was not.

Tutoring is a complex process. On the surface, it appears that tutors play a critical role in making it so effective. However, tutors in general do not use sophisticated tutoring strategies such as the Socratic technique or error diagnosis. In addition, even the tutorial moves frequently used by tutors such as explanations only made a limited contribution to students' learning. A deeper look at the tutoring session suggests that what students do in response to tutorial interaction also plays an important role. Being in a one-to-one situation with a tutor gives

students more chances to engage in active learning and to be constructive, but it is not merely students' construction that mattered. Student constructive responses elicited by tutor moves played a more important role in their learning than self-initiated constructive responses.

MAKING TUTORING MORE EFFECTIVE

Although tutoring is already a quite effective form of instruction, there is still room for further improvement. As Graesser and colleagues (1995) noted, many of the components that have been emphasized in contemporary pedagogical theories are either poorly executed or rare in typical tutoring situations. Thus, one obvious way to improve the effectiveness of tutoring is by training tutors in these missing pedagogical components. Although efforts to teach tutors to use specific strategies can be challenging, it seems that some of the strategies such as scaffolding seem to be relatively easy to implement (Chi et al., 2001).

Alternatively, tutoring can be made more effective by making tutors do less instead of trying to make them do more. Chi and colleagues (2001) also manipulated the kind of tutoring strategies tutors were permitted to use. In order to make tutoring less didactic and promote a more interactive style of dialogue, tutors were asked to refrain from giving explanations and feedback. They were encouraged to prompt the students instead. The results showed that students were just as effective at learning the materials even when tutors were suppressed from giving explanations and feedback. Even in the absence of tutor explanations and feedback, students were able to learn from a greater amount of scaffolding episodes as well as by taking greater control of their own learning by reading more.

COMPUTER BASED INTELLIGENT TUTORS

Computer-based intelligent tutors began to appear in the mid 1980s. These Intelligent Tutoring Systems (ITSs) heavily relied on the cognitive model of competence about how students learn and solve problems (e.g., Anderson et al., 1985; Anderson, Corbett, Koedinger, & Pelletier, 1995). A detailed cognitive model of students allowed computer tutors to trace students' problem-solving behaviors closely and provide directive step-by-step feedback to ensure that students stayed on the right paths. There are now well-tested tutors of algebra, geometry, computer languages, physics, and electronics (e.g., Koedinger, Anderson, Hadley, & Mark, 1997; Lesgold, Lajoie, Bunzo, & Eggan, 1988; VanLehn et al., 2005). According to one estimate, they produce learning gains of approximately 1.0 standard deviation units compared with students learning the same content in a classroom (Corbett, Anderson,

Graesser, Koedinger, & VanLehn, 1999) and are actively implemented and used in schools in the United States (Alevin & Koedinger, 2002; Koedinger et al., 1997).

In spite of their success, existing ITSs are often too rigid, allowing only one strategy for problem solving and providing perhaps too much scaffolding in the form of error correction. They are also limited in promoting deep learning, failing to help students to articulate reasons behind the problem-solving procedures and to apply what they learn to more qualitative problems (Alevin & Koedinger, 2002; Graesser, VanLehn, Rosé, Jordan, & Harter, 2001; Ohlsson, 1986; VanLehn et al., 2000). Several attempts have been made to remedy these shortcomings and make computer tutors as competent as expert human tutors. One approach, based on the research showing the importance of students' own construction activities, is to provide more opportunities for students to self-construct their understanding (Alevin & Koedinger, 2002). Another approach is to endow ITSs with natural language capability so that computers could engage in tutorial dialogue with students using natural language, thereby eliciting collaborative knowledge construction more actively (Graesser et al., 2001; Person, Graesser, Kreuz, & Pomeroy, 2001; VanLehn et al., 2000). The preliminary results from these attempts look promising. Students who explained their steps during problem-solving practice with a computer tutor learned with greater understanding compared to students who did not explain steps (Alevin & Koedinger, 2002). Students tutored by an ITS with natural language enhancement also outperformed students tutored with an earlier version of ITS without the enhancement (Graesser et al., 2001).

INSIGHTS INTO IMPROVING CLASSROOM INSTRUCTION

The tutoring effect demonstrates that most of the students have a potential to reach a high level of learning. In spite of its effectiveness, tutoring has not been used as actively and widely as it should be. The main reason has been the cost. There are ways, however, to circumvent this limitation and introduce the benefits of one-to-one tutoring into classroom instruction. One traditional solution is to use peer tutors. Because the majority of tutors are novices and yet produce significant effects, pairing students with other students of either same-age or cross-age across grades can be an effective alternative to using professional tutors. Peer tutoring can also help those students who serve as tutors since tutors themselves engage in active knowledge construction processes as they tutor (Roscoe & Chi, 2007). Peer-tutoring also brings other benefits such as community building and integra-

tion of students with diverse cultural and linguistic backgrounds (O'Donnell, 2006; Webb & Palincsar, 1996).

Benefits of tutoring can also be obtained by combining collaborative learning with tutoring. For example, Chi, Roy, and Hausmann (in press) examined the effectiveness of collaborative observation of tutoring against several other instructional conditions such as one-on-one tutoring and collaboration without observation. The results showed that students learned to solve physics problems just as effectively from observing tutoring collaboratively as the students who were being tutored individually. It seems that learning conditions such as collaborative observation of tutoring can serve as a promising alternative to one-to-one tutoring while providing all the same benefits.

Research on tutoring has demonstrated and reinforced the idea that students learn best if they construct knowledge for themselves rather than being told the knowledge. Tutoring seems to be a particularly effective form of instruction because it facilitates active knowledge construction within the interactive context of tutorial dialogues. Regardless of whether teachers implement tutoring into the classroom, classroom instruction can benefit greatly by finding ways to elicit more active construction from students in interactive contexts.

SEE ALSO *Reciprocal Teaching.*

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Heisawn Jeong

V

VALIDITY

Validity denotes the meaning of a test score or assessment result. Although historical notions of validity have suggested there are multiple forms of validity, contemporary views of validity consider it to be a unitary construct supported by distinct forms of evidence. Contrary to popular belief, validity is neither obvious nor intuitive. Therefore, the validity of any test or assessment, from teacher-made quizzes, tests, and assignments to published tests and procedures, should be established by collecting relevant forms of evidence so that educators can draw appropriate interpretations of assessment results.

HISTORICAL VERSUS CONTEMPORARY DEFINITIONS OF VALIDITY

Until the twentieth century, the validity of a test or assessment was determined primarily by the content of the assessment process. That is, a test was deemed to reflect mathematical skills if the questions on the test were primarily mathematical in nature; likewise, a test composed of questions about Elizabethan England was viewed as revealing a student's knowledge of history. However, advances in testing and assessment during the early twentieth century challenged these assumptions, in large part because the inferences about what tests were intended to measure changed from direct inferences (e.g., the student knows or does not know trigonometry) to less direct inferences (e.g., the student has strong or weak aptitude for quantitative reasoning). Therefore, the meaning of tests and assessments could not be directly inferred from test content. For example, the answer to the question "Who

wrote *Romeo and Juliet*?" could reflect a student's understanding of a unit on British literature, or it could be a reflection of a student's ability to acquire knowledge incidentally from the environment (especially if the student had not yet had a course in British literature). Content analysis alone is insufficient to determine whether the question was a measure of literary knowledge or student ability.

By the 1980s, assessment experts generally agreed that there were three types of validity: content, construct, and criterion (AERA, APA, NCME, 1985). The meaning of a test result was determined in part by the test's content, but also by evidence that the test result behaved in ways consistent with its theoretical construct (e.g., raw scores on a test of intelligence should increase with age up to the mid- to late teens), and should predict socially valued criteria (e.g., a mechanical aptitude test should predict grades in an industrial arts class). Test users could expect to have all three forms of evidence (content, construct, and criterion) available for published tests, while also recognizing some forms of evidence were more important for some test uses than others.

However, by the end of the twentieth century, professional standards redefined validity so that there was only one "type" of validity i.e., the meaning of a test score or assessment result (AERA, APA, NCME, 1999). However, standards outlined five forms of evidence needed to determine test score meaning: (1) content, (2) response processes, (3) internal structure, (4) relationships to other variables, and (5) test consequences. Test developers (and users) are expected to consider the forms of evidence most relevant to determining the meaning of a test result, and collect and provide relevant evidence to define the meaning of the test score or assessment result. Each of these forms of evidence is

Validity

described to help those who use assessment results (e.g., teachers, psychologists, administrators) to understand, demand, and collect such evidence.

Content. Primary evidence in this domain includes the specification of the intended content and expert judgment of test items regarding adherence to those specifications. For example, tests of state standards (required by the No Child Left Behind Act of 2002) are validated in part by specifying what students are supposed to know and do in a given domain, the degree to which these skills should be represented in a given test, and the cognitive complexity and type of item to be used to assess the skill. A reading test at third grade might therefore have more items devoted to phonological skills (e.g., grapheme/phoneme correspondence), word attack, and vocabulary than an eighth-grade test of reading, which might have fewer items for phonological and word attack skills, but more items reflecting inferential comprehension. For domains with less clearly specified content (e.g., intelligence), judgments regarding content are more dependent on theory than on exact specification of intended domains. In all cases, judges evaluate the test content against the intended interpretation of the test to evaluate the degree to which the test content represents the intended meaning of the test. Additionally, panels of judges with expertise in diversity (e.g., linguistic, ethnic, gender, religious) may also evaluate the content to identify any content that may be problematic for diverse groups.

Response Processes. The psychological processes test takers use when responding to an assessment are known as *response processes*. Evidence that a test elicits the processes it intends to measure, and only those processes, is useful for establishing the meaning of the test score. One cannot assume that a test item will elicit the intended process; for example, the item “Use a barometer to calculate the height of a tall apartment building” could elicit use of air pressure to estimate altitude, but it might elicit social knowledge (e.g., “Offer to give the barometer to the building superintendent in return for telling you the height of the building”). Test takers may get an item right (or wrong) without ever using the process intended to be elicited by the item. Forms of evidence supporting response processes are direct (e.g., ask test-takers how they solved items), and indirect (e.g., analysis of eye gaze, brain activity, or error patterns).

Internal Structure. Simply put, tests should behave the way the developers expect them to behave—meaning items purporting to measure the same thing should be more related to each other than items purporting to measure something different. For example, a mathematics test might intend to measure probability and geometry; if so, the items and subscales measuring probability ought to be more

related to each other than items and subscales measuring geometry. The primary forms of evidence, then, are internal consistency (items that measure the same thing should correlate with each other), and factor analysis (items should aggregate into common scales, and scales into expected patterns).

Relationships to other Variables. Assessment results ought to relate to measures outside of the assessment in ways that are consistent with the intended meaning. Evidence is often framed as *convergent* (i.e., the assessment should relate to things expected to be related), and *divergent* (i.e., the assessment should not relate to things that are expected to be unrelated). Forms of convergent evidence include grades given by teachers or scores on tests of similar constructs; forms of divergent evidence include a proposed independence between creativity and general intelligence (which rarely occurs, calling into question whether creativity is really different from general intelligence).

Test Consequences. Assessments are intended to benefit the test-giver and the test-taker. Therefore, test developers (and users) should collect and provide evidence that tests achieve their intended benefits, and avoid unintended consequences. For example, some argue testing mandates in No Child Left Behind benefit students by holding schools accountable for student achievement; critics argue that tests demoralize students and educators. The evidence needed to determine whether benefits are realized, or whether unintended consequences outweigh benefits, is often lacking from tests in educational settings. For example, in their 2005 study Braden and Niebling note that many popular cognitive ability tests claim to help educators match programs and instruction to student needs, but those promoting the tests do not actually provide supporting evidence.

A fundamental assumption is that no one form of evidence is sufficient to establish validity; rather, multiple forms of evidence must be presented and evaluated to support (or reject) an interpretation of a test score. Therefore, test users should obtain and weigh multiple forms of evidence to determine the validity of a test score or assessment result.

CRITICAL ISSUES IN ASSESSMENT VALIDITY

There are a number of issues that are particularly relevant to educators and educational settings. The following is a brief selection of critical issues.

Distinguishing Validity from Reliability. Validity refers to the meaning of a test score or assessment result, whereas

reliability is the consistency of a score or result. Consistency of assessment results is established over time (i.e., test-retest reliability or “stability”), agreement among test items (internal consistency), and agreement between raters (i.e., inter-rater reliability). A test that is not reliable cannot be valid; therefore, educators should evaluate reliability evidence before they even consider validity evidence. Reliability is most often expressed as a number, which is somewhat analogous to a percentage; reliability indexes of .80 (i.e., 80%) or higher are generally considered to be adequate for use in making educational decisions.

Causes of Test Score Invalidity. In addition to poor reliability, Messick’s 1995 study identified two causes of invalidity: *construct under-representation* and *construct-irrelevant variance*. Construct under-representation means the test inadequately taps what it intends to measure. For example, many multiple choice tests intend to measure skills ranging from lower order (e.g., recognition, recall) and higher order (e.g., analysis, synthesis, application, evaluation) skills. However, it takes time, energy, and expertise to create multiple choice items that tap higher order thinking skills, and so many multiple choice tests over-represent lower-order skills and under-represent higher-order skills. If the test purports to measure a broad range of cognitive skills, but has few items tapping evaluation and application, its scores will be invalid because they under-represent higher-order thinking in the domain.

Construct-irrelevant variance occurs when an assessment demands skills it does not intend to measure. For example, most reading comprehension tests intend to measure the test-taker’s ability to decode and comprehend written text. However, tests demand that the test taker has the visual acuity to discriminate the letters and words in the text. If the test-taker does not have that ability (e.g., the test-taker has an uncorrected visual impairment), then the test score will not reflect reading comprehension; instead, it will reflect the test taker’s skill in an unintended domain (i.e., visual acuity). In cases in which construct-irrelevant variance is high (e.g., limited visual acuity), the test-taker’s score will be invalid if the test taker lacks the construct-irrelevant skill.

Test Accommodations. The principles of construct under-representation and construct-irrelevant variance can help identify ways in which tests can (and cannot) be changed to accommodate test takers. Essentially, changes that reduce construct-irrelevant variance without creating construct under-representation are valid accommodations; those that either fail to reduce construct-irrelevant variance, or that reduce construct representation, are invalid accommodations. Returning to the example of a reading comprehension test, enlarging the text print, or allowing the use of eye-

glasses, reduces construct-irrelevant variance while maintaining construct representation, and is therefore a valid accommodation. However, reading the text to a person with a visual impairment is invalid, because it reduces construct representation (i.e., it under-represents decoding of text). It is important to note that test standards place the burden of proof for accommodation validity on the party recommending the change; the default assumption is that, in the absence of additional evidence, any changes to standardized assessment procedures and materials reduce the validity of the assessment result.

Assessment Bias. Assuming tests are equally reliable across groups (which is typically true), bias occurs when the meaning of the test score is different for one group relative to another (i.e., the validity is not consistent across groups). To determine if an assessment is biased, multiple forms of evidence must be presented showing different meanings for different groups. Simply looking at test content (e.g., claiming that a test is biased because it presumes cultural knowledge more prevalent in one group than in another) is insufficient to demonstrate bias. Most published assessments used in educational settings are not biased for groups whose native language is English; that is, the test scores represent the same thing for all groups of test-takers across ethnic, gender, and socioeconomic groups. Or to put it another way, tests generally reveal, rather than create, differences between groups. However, the validity evidence for test takers whose native language is not English is often limited, and less consistent, leaving open the possibility that assessment results have different meanings for native English versus non-English speakers. Simply noting that one group has lower scores than another is not in itself evidence of bias (i.e., groups can, and often do, differ).

Constructed versus Selected Response Assessments. Many educators and advocacy groups (e.g., Fairtest) are critical of selected-response or multiple choice tests. Critics contend that multiple choice tests emphasize low-level cognitive skills. Advocates of selected-response tests argue such claims are not supported by validity evidence, and they argue selected-response tests are reliable and cost effective. The bulk of evidence across the five validity domains suggests carefully developed assessments can overcome most limitations associated with item formats. For example, development of rubrics and rater training can produce adequate reliability in constructed-response assessments (e.g., performances, portfolios), and carefully constructed selected-response tests elicit higher-order cognitive processes. However, the greater costs in terms of time, scoring, and storing constructed-response assessments are not offset by better validity evidence, so most educational assessment programs primarily use selected-response assessments.

Validity

Teacher-developed Assessments. Most teachers have limited assessment training and even less time to develop and evaluate their own tests. Yet teachers routinely develop, administer, and score tests without considering validity issues. Some practical steps teachers can take to ensure student test scores reflect intended meanings include the following:

1. Develop student assessments before developing instructional units. By deciding in advance what students should know and do, teachers ensure content validity (e.g., breadth and depth of coverage), and can also align their instruction to ensure students learn the intended materials.
2. Specify assessment content and format with an item specification table. For example, a reading test might target 10% phonemic awareness, 20% alphabetic principle/phonics, 30% fluency, 15% vocabulary, and 25% comprehension distributed so that 50% of items are selected-response, 30% are fill-in-the-blank, and 20% are short answer. The resulting two-dimensional table helps teachers ensure content coverage is distributed as they intended, and also helps ensure that methods of assessment are distributed across content domains.
3. Provide multiple opportunities for students to demonstrate knowledge. Large-scale projects or final exams with a single score are less likely to be reliable, and therefore less likely to be valid, than a series of smaller, more frequent assessments.
4. Look for evidence that test scores might not convey intended meanings. Even tests developed by experts have unexpected problems; teacher-made tests are no exception. Teachers should look for evidence of unexpected outcomes (e.g., students who do well on quizzes do poorly on the unit test; items that nobody passes; evidence that groups differ in unusual ways on particular tests or items), and adjust tests if they conclude that the test did not accurately reflect its intended meaning.

Weighing the Evidence. Test makers and users want as much evidence as possible to understand what test scores mean. However, collecting and reporting evidence costs time and money, and so evidence is often incomplete. Test users must therefore weigh evidence to evaluate the degree to which it supports the validity, or intended meanings, of the test. Test users should invoke a four-step process to weigh evidence:

1. Identify the stated claims or purposes of the test.
2. Determine whether test scores have adequate reliability or consistency.

3. Decide which forms of evidence are most important.
4. Evaluate the degree to which the evidence supports intended meanings.

For example, suppose a test purports to measure mathematical knowledge and skills (step 1). Test users should decide what forms of consistency are most important (e.g., inter-rater agreement, stability), and then determine whether the test scores have reliability values greater than or equal to 0.80 (step 2). If the test has reasonable evidence of reliability, users should decide which forms of evidence are most salient. Achievement tests should have substantial evidence of test content (e.g., items should represent domains identified by the National Council of Teachers of Mathematics), internal structure (e.g., items purporting to measure common subdomains actually relate to each other), and relationships to other variables (e.g., the test correlates with other math tests). If the test also claims intended consequences (e.g., it will help plan educational interventions), then evidence showing how test scores enhance intervention selection, implementation, or outcomes should be provided. It should be noted that some domains (e.g., content) are more important than other domains (e.g., response processes). Finally, users should assess the evidence provided to judge the degree to which evidence supports the claims. Test reviews can be helpful, but test standards mandate that test users are personally responsible for ensuring that the tests they use have appropriate supporting evidence.

SEE ALSO *Normal Distribution; Reliability.*

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VISUAL IMPAIRMENTS

Vision is an integral part to standardized learning. Students who lack visual abilities often feel lost in a confusing educational maze. Although the U.S. Department of Education reported that less than 1% of U.S. students had visual impairments in 2004, the actual number of children with visual impairments is higher. The consequences of visual impairment can range from missed opportunities in learning to obstacles to gaining independence.

At one point the term *visual impairment* referred to an eye disorder at the tissue level, but subsequently, visual impairments took on a broader meaning to include the consequence of a functional loss of vision caused by a number of eye disorders.

VISUAL IMPAIRMENT DEFINITION

The definition of visual impairment includes a range of vision loss, including low vision. Specifically, it is defined as “an impairment in vision that, even with correction, adversely affects a child’s educational performance. The term includes both partial sight and blindness” (Pierangelo, 2007, p. 331). In the educational context, three terms describe levels of visual impairment.

The first level, partially sighted, refers to a visual problem that has resulted in the need for special education.

Low vision is used generally to refer to a severe visual impairment. The impairment is not necessarily limited to distance vision, but includes students with sight who are unable to read a newspaper at normal viewing distance, even with the aid of contacts, eyeglasses, or electronic devices. Students with low vision use a combination of vision and other senses to learn; they may require adaptations to lighting, print size, or provision of written materials in Braille.

Legal blindness is defined by vision of 20/200 or less in the better eye after correction, or limited field of vision (measuring 20 degrees at its widest point). Limited field of vision results in some confusion for students. Legal blindness also includes total blindness, or a person with “no vision or only light perception.” These are students who must receive instruction via aural methods, Braille, or other nonvisual media.

Visual impairments are caused by a number of eye disorders, including albinism, cataracts, retinal degeneration, diabetic retinopathy, glaucoma, corneal disorders, congenital disorders, and infection. Although the Department of Education listed fewer than 26,000 students age 6 to 21 as receiving special education services under the visual impairment category in 2004, the actual number is likely higher. Many students with visual impairments have other disabilities as well and are listed in those categories. Visual impairments actually occur at a rate of 12.2 per 1,000 people under age 18. Legal blindness occurs at a rate of .06 per 1,000 people under age 18.

ASSESSING VISUAL IMPAIRMENTS

Early assessment is key to helping a student benefit from appropriate intervention programs. Severe visual impairments are more easily identified in schools than milder vision losses. However, there are warning signs of visual impairment, such as lack of coordination in the eyes or excessive eye movement and blinking. Children who rub their eyes or who have frequent watering and signs of eye infections may need assessment for visual impairment. If children confuse colors, complain of headaches, or have poor posture when reading or writing, they may have vision impairment. More obvious signs include squinting, sitting very close to the chalkboard or screens, messy work, or complaining of difficulty seeing things clearly.

Among the goals set forth in the National Agenda for the Education of Children and Youths with Visual Impairments, Including Those with Multiple Disabilities, is Goal 6. It reads: “Assessment of students will be conducted, in collaboration with parents, by personnel having expertise in the education of students with visual impairments” (American Foundation for the Blind, 2005, p.1). Because the National Agenda emphasizes providing timely, quality educational services for children with visual impairments, initial and ongoing assessments are critical.

Students are assessed by a certified teacher of students with visual impairments (TVI). A functional visual assessment helps to determine how the children currently use any partial or low vision and what visual skills need further development or assistance. The TVI observes each child performing routine tasks and speaks with parents, teachers, and others involved in the child’s care about how the child uses vision. The child’s eye doctor also provides important clinical information on visual acuity, visual field, and diagnosis. A child with visual impairments may be examined by an ophthalmologist, who specializes in diagnosis and treatment of medical and surgical problems of the eye; an optometrist, who specializes in vision problems and treating vision conditions; and other providers such as an optician, who dispenses eyeglasses and other optical aids, or a low vision specialist.

Visual Impairments

The TVI will review the eye doctor's findings of visual acuity and summarize them on the report. The teacher also includes notes from observers and observes the child's visual skills from near and far distances. The teacher also observes how well the child sees objects that are to the sides, above or below the eye level to assess visual field, and notes other visual functions such as ability to localize, fixate, scan, track, and shift gaze. Eye preference and eye-hand coordination, as well as color vision, are additional concerns. The TVI observes the child in different settings and assesses visual abilities in relation to environmental considerations such as lighting, object size, and additional time to complete tasks. A team that consists of the TVI, parent or guardian, a general classroom teacher for the child, and other education professionals such as a school counselor or school psychologist, generally meet to make final recommendations and discuss the child's potential placement. The evaluation should include recommendations for services, adaptations, and instructional skills that will help the student learn.



Alternative media and tools such as books in Braille can aid the visually impaired student. WILL & DENI MCINTYRE/PHOTO RESEARCHERS, INC.

If a child has no vision, he or she still needs a functional visual assessment to confirm medical information and blindness, as well as noting recommendations for instruction modification.

CHARACTERISTICS OF CHILDREN WITH VISUAL IMPAIRMENTS

Many factors determine how visual impairments affect a child's learning experience. Age of onset and severity of vision loss, as well as presence of multiple disabilities, are some of the factors that make each child's situation unique. The U.S. Department of Education reported in 2004 that more boys than girls had visual impairment. As more and more infants are born prematurely, the incidence of visual impairments is expected to rise.

The cause of visual impairment and overall functioning level of a child also determine how the visual impairment affects a child's development. In general, visual impairments have cognitive, academic, social and emotional, and behavioral effects.

Restricted movement within the environment, particularly for children with congenital visual impairment, can affect a child's development. Children with visual impairments often have limited interactions with their environments, less reason to explore interesting objects, and as a result missed opportunities to learn. This lack of exploration may continue until some sort of intervention begins to motivate learning.

Academic performance may suffer for children with visual impairments, particularly in reading and writing. Alternative media and tools may help, such as Braille or an alternative form of print.

Children learn much about social behavior by observing others, so those with visual impairment may not understand nonverbal cues and other nuances of social behavior normally learned through imitation. The functional limitations caused by visual impairments may create obstacles to a child's independence as he or she ages. Studies have shown that some children with visual impairments can display social immaturity, more isolation, and less assertiveness than their peers.

Many myths surround children with low vision. In addition to later discovery of their visual impairment in some cases, those with low vision may not receive the adaptations and services they need as compared with their peers who are declared legally blind. Yet students who have low vision have unique social and emotional needs, such as identity issues, and they may need help with developing communication and self-advocacy skills.

Overall, children with visual impairments require assistance with technology, special print, auditory, or Braille materials. Other specialized needs depend on the

functional visual assessment and ongoing assessments concerning the child's development.

EXAMPLES OF EYE DISORDERS

More than 30 specific diseases and conditions are associated with visual impairments. An ophthalmologist can make the definitive diagnosis as to the cause of the visual impairment based on a physical examination and associated tests. According to a report from the U.S. Preventive Services Task Force, the most common causes of visual impairment in children under age 5 years are amblyopia and its risk factors and refractive error not associated with amblyopia. The common name for amblyopia is lazy eye. It develops in early childhood and involves one eye not working well with the brain, resulting in reduced vision in the affected eye. Amblyopia affects about two to three out of every 100 children.

Amblyopia may be due to effects of other conditions that interfere with normal binocular vision, such as strabismus (ocular misalignment), anisometropia (a large difference in refractive power between the eyes), cataract (lens opacity), and ptosis (eyelid drooping). In anisometropic amblyopia, the two eyes have different refractive powers; one can be nearsighted, while the other is farsighted. The misalignment of the eyes in strabismic amblyopia causes one eye to be used less than the other. The nonpreferred eye does not receive adequate stimulation, and the visual brain cells do not develop normally.

Refractive error not associated with amblyopia primarily includes myopia (nearsightedness) and hyperopia (farsightedness). These problems are correctable regardless of the child's age at detection.

Retinopathy of prematurity can blind a child. It generally develops in premature infants with low birth weights or less than 31 weeks of gestation. It is classified in five stages, from mild to severe. Diabetic retinopathy is a complication of diabetes, brought about by damage to tiny blood vessels in the retina. It is the leading cause of blindness in the United States. Retinoblastoma is a malignant tumor of the eye. Although it can occur at any age, it most often occurs in children younger than age five. The tumors may be present in one or both eyes.

Nystagmus is an involuntary movement of the eye that reduces vision. Typically, the movement is from side to side, but it can be up and down or circular. There are several forms of nystagmus. The condition may be hereditary and can result in severe reduction in vision. Students may need extra time for reading to scan text.

Strabismus is the misalignment of one eye and comes in several forms, such as esotropia, the inward turning of the eye, and exotropia, or outward deviation of the eye. Hypertropia refers to vertical deviation of the eye. Strabismus also can occur intermittently. The cause of strabismus

generally is unknown. Other disorders often are associated with strabismus, including retinopathy of prematurity, retinoblastoma, traumatic brain injury, hemangioma near the eye, Apert syndrome, Noonan syndrome, Prader-Willi syndrome, and others.

EDUCATIONAL PRACTICES

At one time, students with visual impairments were taught only in residential schools for blind children. Early in the 20th century, local school districts began educating students with visual impairments, but primarily in special classrooms. In the early 2000s, itinerant teachers, resource rooms, general education classes, and special schools all may be used in the education of students with visual impairments. By 2004 the U.S. Department of Education reported that about 90 percent of children with visual impairments spent at least some time in regular classrooms with peers.

The Individuals with Disabilities Education Improvement Act (IDEA) was introduced in 1975 and passed in 1990. It was reauthorized in 1997 and 2004 and includes provisions for children with visual impairments as defined above. Students with visual impairments also may be eligible for accommodations for general classroom inclusion under Section 504 of the Vocational Rehabilitation Act, passed in 1973.

The National Agenda for the Education of Children and Youths with Visual Impairments, Including Those with Multiple Disabilities is a grassroots effort that has helped improve education for children with low vision and blindness. In 2003 the National Agenda was updated to include 10 goals. The goals range from ensuring referral to an appropriate education program within 30 days of identification of suspected visual impairment to recommending ongoing professional development for those providing services to students with visual impairments. The National Agenda also encourages implementation of policies that involve parents as equal partners in the education process, that local education programs ensure access to a full array of services, and that access to educational and developmental services include assurance that materials are available to students in the appropriate media and at the same time as their sighted peers. Educational goals should be based on the assessed need of students with visual impairments and goals and strategies should be set throughout the student's life continuum.

The TVI works with local and national professionals as needed to provide access to educational materials for students with visual impairments. Students who are blind may use raised maps and charts and other materials to facilitate tactile learning. Many rely on auditory information from books on tape or CD-ROMs, spoken output from a computer, or tape computers, in addition to large

print or Braille materials. Each state has specific policies and practices for broad programming of curriculum. The National Agenda has an expanded core curriculum that describes the skill areas needed for students with visual impairments to prepare for a successful adult life. This curriculum goes beyond academic skills to include other considerations for the individualized education plan (IEP) team. Examples of expanded core curriculum areas are orientation and mobility, social interaction skills, career education, technology, independent living skills, and visual efficiency skills.

ASSESSMENT AND INSTRUCTIONAL ISSUES

Students with visual impairment should be included in general education when possible through careful assessment, strategies, and use of assistive equipment and materials. A TVI coordinates the instructional program. As children get older, it often is advisable to introduce them to adults with visual impairments so that they can experience normal work situations.

As stated previously, children with visual impairments may have difficulty with reading and writing and some low vision problems simply require more time for students. These issues can be particularly trying during standard testing at schools. The No Child Left Behind (NCLB) Act was signed into law in 2002 by President George W. Bush. The act revised the Elementary and Secondary Education Act, which is the primary federal law in precollegiate education. NCLB requires annual testing of all students in reading and math proficiency.

A student's functional visual assessment may need to include adaptation of achievement and other standardized tests such as those administered to satisfy school and state requirements under NCLB. The test may be conducted in Braille, on a computer, with magnification, or in a number of other ways, depending on the child's visual impairment. Responses may be given orally or through word processors or Braille writers. Scheduling accommodations such as extended time also may be made for students with visual impairments who need them.

There are challenges particular to educating students with visual impairments. Teachers who specialize in educating students with blindness and low vision often are isolated from their colleagues in the field because they may be the only TVI in the school district. They should remain connected with the larger community of professionals serving students with visual impairments. Some of the assistive devices for students can be difficult to find or expensive, so careful assessment, proof of need, and at times assistance from specialized resources may be required. Educators and parents of students with visual impairments should try to provide assistance to students

only when needed, within the guidelines of the assessment plan and IEP, and help students develop a sense of initiative and independence.

SEE ALSO *Individualized Education Program (IEP); Special Education.*

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Teresa Odle

VOLITION

From the late 1980s to the late 2000s, psychologists analyzed personal qualities other than intelligence that predict accomplishments such as success in school. Qualities such as dependability and conscientiousness, which lead to high levels of competence, were recast in information processing terms. What underlies conscientiousness, for example, are wishes and desires that become goals and intentions, which must be implemented and protected from competing goals and other distractions (Kuhl, 1984). Duckworth and colleagues (2007) refer colloquially to a quality they call "grit," which they define as "perseverance and passion for long-

term goals.” Their “Grit Scale” reliably distinguishes students who attest to finishing tasks, persisting under difficulty, and overcoming obstacles from those students who say they tend to vacillate or are easily distracted on tasks. These authors find that “grit” plays a key role in leadership and other long-term achievements.

Cognitive-motivation researchers and positive psychologists alike recognized that there is something in the notion of purposive striving that cannot be captured within the concept of motivation, so they put a new interpretation on the old idea of willpower by returning to serious study of the psychological concept of volition. Volition is that quality of the will that takes a student from implementation to follow-through, reflecting an ability to persist in the face of difficulty. Whereas motivation denotes a process of goal setting leading to commitment, volition denotes a process of implementation leading to goal accomplishment. To the extent that volition helps a student to protect established goals and follow-through on tasks, it is highly important for success in academic settings such as classroom learning.

PROCESSES THAT CONTRIBUTE TO VOLITIONAL CONTROL

The key processes that define volition are the management, protection, and maintenance of attention, motivation, and emotion in tasks: Breaking a task into smaller pieces; beginning without procrastinating; resolving to avoid distraction and concentrate; thinking of the satisfaction completion will bring. Evidence of the ability for selective control of attention and emotion even in very young children has been shown to predict school performance later on (Shoda, Mischel, & Peake, 1990).

Psychologists offer a wide array of models that describe volitional processes. Some of the most cited are models of action control (Kuhl, 1984), effortful control, impulse control, emotion control, learned industriousness (Eisenberger, 1992), implementation intentions (Gollwitzer, 1999), and self-regulated learning or SRL (Corno, 2007). According to Boekaerts and Corno (2005), who reviewed research on self-regulation in education, there are several self-regulation processes that reflect volitional control; these include managing learning tasks, coping with distractions, focusing attention, and productively channeling emotions. In addition to these aspects of volition, SRL models highlight the role of motives and goals in strategy use and academic achievement (Zimmerman & Schunk, 2007).

Although volition theorists emphasize the conscious effort that a student makes to better manage learning, some go on to develop the idea that volitional processes can become automatized with repeated use and associated conditional feedback. Automization frees up mental resources for tasks over time, suggesting that volitional processes can

be transferred to new situations. Transfer across situations, as when there is evidence of automatically applied control on novel tasks, can lead students toward a volitional style of learning (a work style or work ethic) that again is suggestive of traits such as dependability.

STRATEGIES FOR MAINTAINING VOLITIONAL CONTROL

To better understand how volition develops, scholars identified the variety of explicit strategies used by students to manage, protect, and maintain their work efforts. For example, Corno and Kanfer (1993) adapted a list generated by Kuhl (1984) into two categories of covert and overt strategies used by students in educational settings. Both covert and overt (easily observable) strategies are aimed at protecting targeted goals from competing goals or other distractions, and managing negative affect.

The covert strategies studied by these authors included (a) metacognitive controls such as planning and self-monitoring; (b) motivation controls such as self-reinforcement, self-instructing, adapting tasks to make them more meaningful, and prioritizing target goals; and (c) emotion controls such as working out a timeline, controlled breathing in the face of difficulty, imagining rewards and satisfactions, and using available resources for conditional feedback. The overt strategies studied by these authors included controlling the task situation and others in the task setting. To control the task setting, students can create manageable sub-tasks, gather information and materials in advance, and avoid distractions. To control others in the task setting, students can take actions such as seeking assistance from teachers and supportive peers and asking bothersome peers to remove themselves. All of these strategies, whether overt or covert, are proactive, again aimed at managing, protecting, and maintaining focus on tasks.

To exemplify, imagine students who have decided to buckle down, pay attention, and do their schoolwork. Their challenge then is to avoid the idea of doing something else instead (e.g., to spend time with friends), however tempting and potentially more satisfying that alternative act might be. By prioritizing goals to get their work done over and above their competing social goals, and by regulating their emotional reactions to tasks (keeping negative affect at bay), students are using volitional control to manage an inner conflict. They are protecting their targeted goals and maintaining their efforts to achieve those goals. Imagine further that this scenario becomes automatic for more students in more academic task situations, so that the script for “concentrate got to” gets used adaptively by students whenever it is needed. That is the goal for educators who seek to help students move toward better volitional control.

**PERSON AND ENVIRONMENTAL
FACTORS THAT INFLUENCE
VOLITIONAL CONTROL**

Researchers have also studied the individual and contextual factors that support or impede students' abilities to exercise volitional control adaptively. They find that some students are predisposed, by orientation or developmental experience, to be more or less conscientious in their academic endeavors. For example, Snow and Lohman (1984) related volitional strategy use to cognitive ability; using a variety of indicators, they found that college students who score highly on standardized tests of cognitive ability consistently use effective organization and control strategies that maintain concentration while they complete the items. Kuhl (1984) found that a self-reported orientation to take action rather than procrastinate when confronted with decision-making tasks was also predictive of volitional strategy use and task completion in adults. In a different vein, research by Dweck (see Dweck & Master, 2007) linked children's early understandings of the relationship between ability and effort to expressed beliefs about their own capabilities (their "self-theories"); Dweck found that even intellectually able students may have underdeveloped volition if they doubt their own capabilities.

In regards to aspects of the learning context that support and promote self-regulation in students, researchers highlight the importance of teacher modeling (many different explained examples) of self-regulation processes and strategies, with reinforced use in appropriate class assignments. The earlier and more frequent such explanation, the better; like metacognition, volitional control develops experientially (Corno, 2000). This means that parents, too, can serve as role models, particularly in the early grades and when working with children on homework (Xu & Corno, 1994). In general, the evidence supports the idea that acquiring higher-order skills such as self-regulation demands a co-constructive or social learning process that includes evaluative feedback.

In the early 2000s teachers commonly use various forms of collaborative learning activities to create cohesion in the classroom community. Cooperative work and projects are situations in which students with good work habits can model and encourage their peers. These same settings can disadvantage students, however, if poor work habits are being modeled instead, or if there is no conditional feedback. When tasks are carefully structured to maximize opportunities for learning about, carrying out, and receiving reinforcement for self-regulation and co-regulation (as when pairs of students work together in cooperative tasks), there is a positive influence on volitional control. Classrooms in which students share in planning decisions about what material will be covered, when, and in what

venues will also support volitional control because this creates an "implementation intention" (Gollwitzer, 1999).

**EDUCATIONAL OUTCOMES
RELATED TO VOLITIONAL
CONTROL**

Volition influences continued motivation and affect as well as learning and long-term performance. There are potential downsides as well as upsides to volitional control. Gollwitzer's 1999 research on intention suggests, paradoxically, that people tend not to look back once they have firmly established goals that they value. Although this is good for keeping students on task, it also implies that letting go of goals that are impossible to accomplish will be difficult. The person so focused uses volition as a form of denial. Another potential downside of particularly strong volition is the development of an over-controlling or compulsive learning style that can induce a stress response to schoolwork. Stress of course can also trigger related negative affect. Finally, particularly strong volition can mask a sense of inadequacy, just as an easy sense of agency can fuel movement toward goals. There are advantages if students can learn to self-regulate in natural, almost playful, ways, using volitional control automatically under many tasks and circumstances.

The strong upside of adaptive use of volitional control is that it tends to result in the display of good academic work habits. These are the strategies and tactics for effective completion of academic tasks that are honed through experience (Corno, 2007). Work habits studied by psychologists include class participation, using feedback and other available resources, managing a workload, planning, and studying (i.e., habitual use of volitional control strategies). Students with good work habits tend to perform well in school, in part because they are putting in the dedicated learning time. But they also excel because they are recognized and given status as full participants in their academic communities; this recognition fosters a sense of efficacy for academic work that then has its own momentum (Zimmerman & Schunk, 2007). When students are viewed by teachers and parents as responsible and diligent workers, they are likely, ultimately, to benefit in other ways as well. Appreciation and rewards for hard work are given all along the age range (e.g., teacher recommendations, academic awards, nominations for leadership positions). Such acknowledgements are influential in decisions about college admissions and employment because they are predictive of success in these settings (see Willingham, 1985).

**DEVELOPING VOLITIONAL
CONTROL IN STUDENTS**

With respect to the combinations of instructional events that can promote development of volitional control in

students, techniques range from simple manipulations to school-wide programs. An example of the former is illustrated by Oettingen, Honig, and Gollwitzer (2000) who taught students an algorithm for making an action plan: determine when, where, and first steps for doing homework. Results showed significantly more of these students actually completed homework relative to comparable peers in a control group. As already stated, individual teachers can use a variety of techniques for teaching students about self-regulated learning. Perry (1998) provides examples of strategies for teaching young children; Randi and Corno (2000) offer a secondary-level curriculum based on a quest theme in which literary characters are shown to embody self-regulation. Counseling psychologists and special educators have refined cognitive-behavior modification procedures such as self-monitoring to make them useful with children who have impulsivity and behavioral control issues or learning disabilities (Butler & Cartier, 2004). Programs for time management have been adapted from the workplace (Corno & Kanfer, 1994). Even students who are temperamentally or stylistically less self-regulating can learn to use the management aspects and many other strategies of volitional control, particularly if they are motivated by feedback and incentives (Zimmerman & Schunk, 2007).

A more ambitious effort is evident in an after-school program designed to support the self-regulation and academic performance of middle school students (Oyserman, Terry, & Bybee, 2002). In this program, adults helped students plan for their futures and construct paths for achieving their goals; they thought about obstacles and how to work past them and had students learn from interviews with others who followed a similar path. The authors' evaluation of this program with inner city students found increased emotional engagement with school and better attendance and behavior as a result of the experience, particularly among troubled boys. Boekaerts and Minnaert (2003) report on a similarly comprehensive program aimed at vocational secondary schools in the Netherlands. In all of these education efforts, it remains important for teachers to encourage students and provide opportunities for them to practice volitional control in regular class work as well, that is, to afford and reward rather than constrain volitional control.

Educational researchers define volition as a quality of human functioning that takes a student from commitment to follow-through in academic tasks. Volition reflects an ability to avoid procrastination and to persist in the face of difficulty. To the extent that volition helps a student to accomplish school tasks, it is important for success in academic learning and performance.

The key processes that underlie volition are the management, protection, and maintenance of attention, moti-

vation, and emotion, aspects of self-regulation that tend to mark the efforts of exceptional students. Volitional control is evidenced in strategic task management, coping with obstacles and distractions, efforts to focus attention, and productive channeling of emotions. In addition to conscious regulation of thinking as they work, students often have implicit, habitual or automatized processes in place to maintain their effort. Volitional control has been measured reliably in children and adults by observation, interview, and self-report, and the research confirms that it can be manipulated experimentally.

When students use volitional control to manage conflicting goals, they work strategically to protect targeted goals and maintain efforts to achieve those goals. Adaptive use of volitional strategies as needed comes easier for some students than for others. Predisposing orientations that have been identified include high cognitive ability, an action orientation, "grit," and what Dweck (Dweck & Master, 2007) calls an "incremental theory of intelligence" (an understanding that personal efforts will aid improvement after failure). Students with these and similar characteristics or experiences are also likely to develop good academic work habits from the exercise of volition.

Volition affects continued motivation and affects as well as school learning. A moderate level of volitional control used flexibly appears to be the best target for educators, because then students are viewed by teachers and parents as responsible and diligent workers who can benefit emotionally as well. Other motivation processes, such as expectations of success, a goal to get the most from the material, even a hope to earn a better grade, can benefit from protecting goals and follow-through. These motivators, in turn, help to reinforce volition.

To promote the development of volition directly, teachers can encourage students and provide opportunities for them to practice volitional control in regular classroom tasks where they can receive pointed and constructive feedback. Practitioners can enlist competent peers to model self-regulated learning and use collaborative activities that allow students to feel they are active participants in the learning process. Just as in many other endeavors, to reach high levels of competence learners need an understanding of the concept and guided practice using volitional strategies over extended periods of time.

SEE ALSO *Self-Regulated Learning*.

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*Lyn Corno
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VYGOTSKY, LEV SEMENOVICH

1896–1934

Lev Semenovich Vygotsky (1896–1934) is best known for his theories of cognitive development in which he explored the importance of culture, language development, and the use of cognitive apprenticeships in the classroom. Although he was a prominent researcher in the Soviet Union during the cultural revolution, his writings were officially banned when Joseph Stalin (1879–1953) came to power and were overtaken in prominence by the growing influence of Jean Piaget (1896–1980). It was not until his works were translated from the original Russian several decades after his death that many European and American psychologists took note of Vygotsky’s writings and began to incorporate his theories into their research and teaching practices.

Vygotsky graduated from Moscow University in 1917 with a degree in law and a specialization in literature. While attending Moscow University, Vygotsky concurrently attended an unofficial, anti-tsarist institution known as Shinyavskii University where he studied a number of disciplines including history, philosophy, and psychology. These experiences led him to return to his hometown of Gomel, Byelorussia, to teach at a local teachers’ training college, where he also established his first psychology laboratory to study handicapped and mentally retarded children. In 1924 Vygotsky accepted



Lev Semenovich Vygotsky ARCHIVES OF THE HISTORY OF AMERICAN PSYCHOLOGY. THE UNIVERSITY OF AKRON.

an invitation to join the Institute of Psychology at Moscow State University (formerly Moscow University) where he completed his dissertation in 1925. He then founded the Experimental-Defectological Institute at Moscow State University II, where he advanced the field of special education by incorporating Marxist and other psychological influences into his research. At the end of Vygotsky’s career, political and cultural changes in the Soviet Union caused him to lose the directorship of the Institute, though he continued to remain on its faculty until his premature death in 1934 at the age of 37. Vygotsky was associated with a number of prominent Russian and Soviet researchers and theorists during his career, including his friend and colleague Alexander Romanovich Luria, and A. N. Leontiev. He was a contemporary of many notable psychologists, including Jean Piaget.

Though Vygotsky was not well known in Western Europe or North America until the late 1950s, his work in special education and cognitive development has led to important developments in classroom learning. For example, Vygotsky was a firm advocate for integrated classrooms in which disabled students are educated alongside their peers, and he is known as one of the founders of special

education. In addition, his theories on thought and language development are among the most well known of his contributions.

Vygotsky believed that “the most significant moment in the course of intellectual development, which gives birth to the purely human forms of practical and abstract intelligence, occurs when speech and practical activity, two previously completely independent lines of development, converge” (Vygotsky, L. S., 1978, p. 24). That is, when thought and language become one, the individual is able to analyze the world in more complex ways, to parse words and use them to form new meanings, and to organize thoughts. Vygotsky stressed that it is through the tools provided by language that meaning is assigned to what the child perceives, an act that is infused with cultural relevance. The words people use and the ways in which they use them convey certain elements of culture that are passed from one person to the next.

Through his theories of cognitive development, Vygotsky (1978) proposed that children develop most effectively and efficiently when they are engaged in tasks that are within their *zone of proximal development* which he defined as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). In other words, children often learn best when they are given tasks that are slightly beyond their ability to perform alone, but can perform when aided by someone who is more cognitively advanced.

A discussion of Vygotsky’s work is not complete without reference to his proposition that development is situated within a culturally specific social-historical context. Vygotsky believed that development stems from relationships and social activities, whereby culture is imparted to the learner through both organized and unorganized activity. As Vygotsky sought to research various aspects of development, one of his primary concerns was to use appropriate methodologies. He believed that laboratory experiments, for example, were not appli-

cable to the real-world experiences of the participants. Instead, Vygotsky believed that it was important to study development within natural contexts. He also believed that the researcher should determine the most appropriate unit of analysis. In Vygotsky’s research, for example, he often broadened his unit of analysis beyond the individual to include ecological factors.

As a result of Vygotsky’s work, there have been a number of theoretical, methodological, and practical advances in psychology, education, and a wide variety of other disciplines. Barbara Rogoff’s influential concept of guided participation is a contemporary idea inspired by Vygotsky’s work. Also, many researchers have developed ecologically valid research methods. Developmental theorists have expanded Vygotsky’s work to discuss the ways in which culture, history, and context play important roles in human development. Lastly, many pedagogical techniques used worldwide stem from Vygotsky’s advocacy for the education of disabled students along with his theories of thought and language development and the zone of proximal development.

SEE ALSO *Cognitive Development: Vygotsky’s Theory.*

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R. Trent Haines

W

WEINER, BERNARD

1935–

Bernard Weiner was born in 1935 in Chicago, Illinois, the youngest of three sons of Russian immigrants. A product of Chicago's public schools, he received his undergraduate degree in Liberal Arts from the University of Chicago in 1955 and an MBA, majoring in Industrial Relations, from the same university in 1957. Following two years of service in the U.S. Army, Weiner enrolled in a PhD program in personality at the University of Michigan, where he was mentored by John Atkinson, one of the leading personality and motivational psychologists of that era. Weiner completed his PhD from Michigan in 1963, spent two years as an assistant professor at the University of Minnesota before joining the psychology faculty at the University of California at Los Angeles (UCLA) in 1965, where he remained active into the early 2000s.

Drawing on his intellectual roots in the field of motivation, Weiner was a leader in the study of attribution theory, one of the major theories of motivation in contemporary psychology. Attribution theory is concerned with the perceived causes of success and failure—for example, did a student fail an important test because of low aptitude or lack of effort—and the motivational consequences of particular attributions. Fundamental to attribution theory are the properties of causes (including their locus in the person or the world, perceived stability, and controllability), causal linkages to emotions and expectancy of success, and achievement performance.

For example, lack of aptitude is perceived to be an internal, stable, and uncontrollable cause of failure. Being

internal to the person, this attribution for failure reduces self-esteem; since it is stable, expectancy of future success is low; and because it is uncontrollable, feelings of shame are evoked. Low esteem, low expectancy, and shame give rise to poor performance. The factor of aptitude contrasts with lack of effort as the perceived cause of failure, which is unstable (thereby leading to high expectancy) and controllable (evoking guilt, a motivator of achievement rather than shame, an inhibitor). Attributional analyses help explain how individuals interpret their own achievement outcomes, but also the reactions of others. For example, teachers are likely to evaluate the failing student differently if his or her failure is perceived to be caused by low ability versus lack of effort. Thus attribution theory is both an intrapersonal theory of motivation (how one thinks about oneself) and an interpersonal theory of motivation (how others think about one).

Attribution theory provided educational psychology with the theoretical foundation for attribution retraining programs. Such programs are designed to improve motivation and achievement by changing maladaptive attributions for failure. For example, many attribution retraining studies with participants from elementary school through college have documented that students who are taught to attribute their failure to low effort rather than low aptitude are more likely to be optimistic about the future and to persist longer when they encounter academic challenges.

Weiner enjoyed an illustrious career as an attribution theorist. While he is best known to educational psychologists for his attribution research in the achievement domain, he also incorporated other social phenomena such as reactions to the stigmatized, help giving, aggression, excuse giving, punishment, and moral emotions. These phenomena are as



Bernard Weiner PHOTO COURTESY OF BERNARD WEINER.

relevant to educational psychology and classroom learning as the earlier attribution research on achievement strivings. Few other theories of motivation are amenable to such breadth of application.

As of 2008, Weiner had authored 13 books and published more than 200 articles in peer-reviewed journals. He was the recipient of numerous awards, including the Donald Campbell Research Award in Social Psychology from the American Psychological Association and the Palmer O. Johnson Publication Award from the American Educational Research Association. He holds honorary degrees from the Bielefeld University in Germany and Turku University in Finland.

Weiner is a recipient of a Distinguished Teaching Award from UCLA, a testament to his extraordinary ability to mentor students. Among his best known students who have had a significant impact in the field of education psychology are Jacqueline Eccles and Diane Ruble. His most frequent collaborator is a former student, Sandra Graham, also a colleague at UCLA.

SEE ALSO *Attribution Theory*.

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Sandra Graham

WECHSLER INTELLIGENCE TEST

The Wechsler Intelligence Tests include three individually administered intelligence tests, appropriate for preschoolers through adulthood. The Wechsler Preschool and Primary Scale of Intelligence (3rd ed.) (WPPSI-III) is appropriate for children ages 2 years 6 months to 7 years, 3 months (Wechsler, 2002); the Wechsler Intelligence Scale for Children (4th ed.) (WISC-IV) is used for children and adolescents ages 6 through 16 (Wechsler, 2003); and the Wechsler Adult Intelligence Scale (3rd ed.) is used for assessment of those ages 16 and older (Wechsler, 1997). All scales are derived, directly or indirectly, from the Wechsler-Bellevue Intelligence Scale (Wechsler, 1939), and adult intelligence test developed by David Wechsler at Bellevue Hospital. The original WISC was a downward extension of the adult scale, and the WPPSI was a downward extension of the WISC. The three tests thus share a common heritage, structure, and interpretation. Although David Wechsler died in 1982, he continued into the early 2000s to be listed as the author of the Wechsler tests. This entry concentrates primarily on the WISC-IV, the measure most commonly used with school-age children, but many of the comments apply to the other Wechsler scales, as well.

In school settings, the WISC-IV is administered by school psychologists to children referred for a variety of academic and behavioral concerns. The test, administered as part of a battery of intellectual, academic, behavioral, and social-emotional measures, can be useful in differential diagnosis (e.g., mild mental retardation versus low average functioning) and in understanding a child's academic weaknesses (e.g., a problem in reading comprehension may be, in part, the result of low verbal reasoning skills).

Wechsler tests have traditionally included multiple subtests with both verbal and nonverbal content. Brief descriptions of the 15 WISC-IV subtests are shown in Table 1. Ten of the subtests are standard, or core subtests, and are given to all children. Five of the tests are supplemental, meaning that they are not generally used in the calculation of composite scores or IQs; they may

Scales and subtests of the Wechsler Intelligence Scale for Children—Fourth Edition		
Scale	Subtest	Description
Verbal	Similarities	Explain what two words or concepts have in common
	Vocabulary	Defining words
	Comprehension	Answering practical problem-related questions (e.g., why do we put stamps on letters?)
Perceptual reasoning	(Information)	Answering general information questions
	(Word reasoning)	Identifying the common concepts from verbal clues
	Block design	Arranging red and white two-colored blocks to match a pattern
	Picture concepts	Picking pictures that share a common characteristic
Working memory	Matrix reasoning	Completing an unfinished matrix of symbols
	(Picture completion)	Identifying missing parts in drawn pictures
	Digit span	Repeating digits in forward and reversed order
Processing speed	Letter-number sequencing	Series of letters & numbers are presented orally. Examinee recalls numbers in order first, then letters
	(Arithmetic)	Answering oral arithmetic word problems
	Coding	Quickly writing symbols associated with numbers or shapes (younger children)
	Symbol search	Marking the re-occurrence of abstract symbols
	(Cancellation)	Speeded selection of a category (e.g., animals) of pictures

Note: Supplemental subtests are enclosed in parentheses.

Table 1 ILLUSTRATION BY GGS INFORMATION SERVICES. CENGAGE LEARNING, GALE.

be substituted for standard tests, however, if subtests are spoiled or are not given.

For previous versions of the WISC and the other Wechsler Scales, the subtests have traditionally been summed to create verbal and nonverbal (performance) IQs, as well as a full scale IQ designed to estimate general, overall, intelligence. Despite this traditional scoring, factor analyses have long suggested that the various Wechsler Scales were measuring more than just verbal, nonverbal, and general intelligence. The WISC-IV represents a major departure from this tradition; as shown in the Table, the WISC-IV subtests are combined to create verbal, perceptual reasoning, memory, and processing speed indexes (a full scale IQ, representing a composite of all 10 standard subtests, is still calculated). The structure for the WISC-IV was changed in order to make the instrument more consistent with research and with contemporary theory concerning the structure and nature of intelligence (Zhu & Weiss, 2005); presumably the subsequent revisions of the WAIS and WPPSI will also show considerable change.

Research (Keith, Fine, Reynolds, Taub, & Kranzler, 2006) suggests that the verbal scale of the WISC-IV indeed measures verbal reasoning skills, or crystallized intelligence from a three-stratum (Carroll, 1993) or Cattell-Horn-Carroll (CHC) (McGrew, 2005) theoretical orientation. Likewise, it appears that the processing speed index of the WISC-IV provides a measure of processing speed, and the full scale IQ is a valid measure of general

intelligence, or g. The perceptual reasoning tests of the WISC-IV, in contrast, appear to measure a mixture of visual spatial abilities and fluid intelligence (also known as novel reasoning). The working memory index of the WISC-IV, excluding the arithmetic subtest, appears to assess working and short-term memory skills. Arithmetic, however, may measure a mixture of intellectual abilities, chief among them quantitative knowledge or quantitative reasoning, a narrow ability subsumed under the broad ability of fluid intelligence. Interestingly, the arithmetic subtest is among the best single measures of general intelligence on the WISC-IV (Keith, Fine, Reynolds, Taub, & Kranzler, 2006).

The full scale IQ and the four index scores have a national mean of 100 and a standard deviation of 15 for each age level. Thus, because the scores conform to a normal curve, approximately 68% of children and adolescents will have scores between 85 and 115. The subtests use a different standard score metric: they have a mean of 10 and a SD of 3. A report of assessment results using the WISC-IV will generally include a listing of the full scale and index scores, including percentile ranks for those scores and confidence intervals around the scores. Such scores will often be interpreted with statements such as “Johnny’s IQ score was higher than 34% of children his age, and there is a 90% chance that his true FSIQ is within the range of 90–98.”

One perceived historic advantage of the Wechsler scales over the Stanford Binet, the most common individual

intelligence test prior to the advent of the Wechsler scales, was that the multiple IQ (now index) scores and subtest scores allowed the analysis of a profile of scores for an individual. There is often considerable variability in children's performance on the various tasks, and many psychologists believe that a child's pattern of strengths and weaknesses is useful in understanding that child's cognitive functioning and in remediating academic weaknesses.

There is considerable debate about the efficacy of profile analysis, however, with critics contending that profiles rarely produce reliable information and that the most general score (the full scale IQ) is generally the only one that should be interpreted (Watkins, Glutting, & Youngstrom, 2005). It is certainly the case that profile analysis can be overdone, but its cautious use often is helpful in understanding the strengths and weaknesses of children referred for academic and behavioral concerns. Such an approach generally focuses on a top-down approach in which the most general score is interpreted and more specific scores are only interpreted when there is unusual variation in scores. This *intelligent testing* also proceeds in steps from interpretation of the IQ, to the indexes, to combinations of subtests that theory and research suggest measure common psychological constructs. Examiners look to other test results and background and interview information to support or reject hypotheses generated. Such an approach to interpretation of the WISC-IV is explained in Flanagan and Kaufman (2004). To use this approach validly, one obviously needs a strong understanding of the constructs measured by the test being interpreted.

The WISC-IV is well standardized and has a long clinical and research history. The test likely provides reliable and valid estimates of general intelligence and several important broad cognitive abilities. There are also inconsistencies in the scoring structure of the WISC-IV and what the test likely measures, which make interpretation of some of the scores produced difficult. Although more consistent with intelligence theory and research than previous versions of the WISC, the test still has room for improvement.

At one time the Wechsler Scales were among the few choices available for individual intellectual assessment. As of 2008 there are numerous other possibilities. Other possible measures include the Differential Abilities Scales, Second Edition (ages 2 years 6 months through 17) (Elliott, 2007), the Kaufman Assessment Battery for Children, Second Edition (age 3 to 18) (Kaufman & Kaufman, 2004), the Stanford Binet Intelligence Scales, Fifth Edition (ages 2 and older) (Roid, 2003), and the Woodcock Johnson III Tests of Cognitive Ability (ages 2 and older) (Woodcock, McGrew, & Mather, 2001, 2007).

SEE ALSO *Intelligence Testing.*

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Timothy Z. Keith

WITHITNESS

SEE *Classroom Management: Withitness.*

WRITING, LEARNING AND TEACHING

SEE *Learning and Teaching Writing.*

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