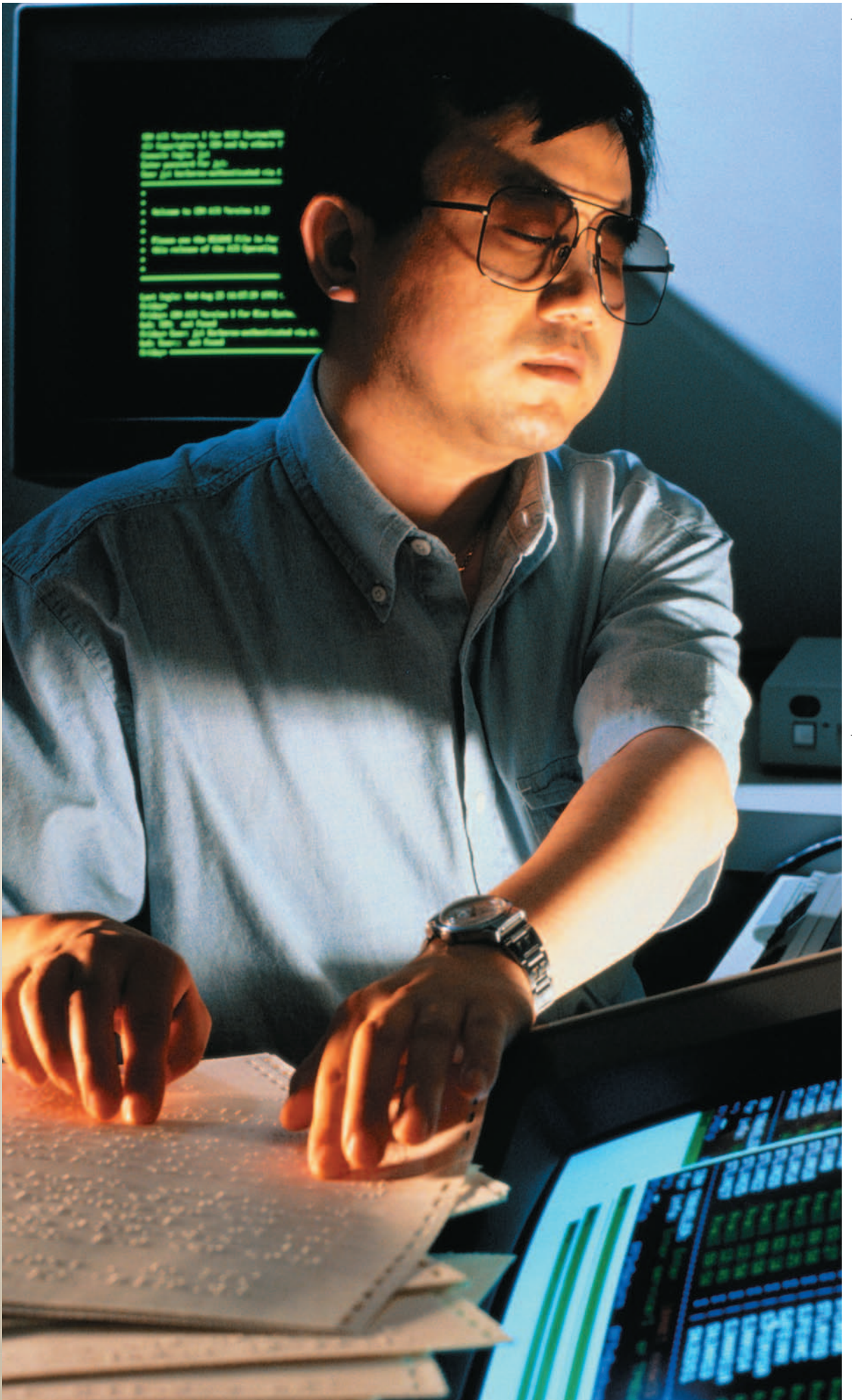


C H A P T E R

8



# Intelligence

## Chapter Outline

## Learning Goals

### THE CONCEPT OF INTELLIGENCE

1

What Is Intelligence?  
Intelligence Tests  
Theories of Multiple Intelligences

Explain the nature of intelligence

### CONTROVERSIES AND GROUP COMPARISONS

2

The Influence of Heredity and Environment  
Group Comparisons and Issues

Outline key controversies about differences in IQ scores

### THE DEVELOPMENT OF INTELLIGENCE

3

Tests of Infant Intelligence  
Stability and Change in Intelligence Through Adolescence  
Intelligence in Adulthood

Discuss the development of intelligence across the human life span

### THE EXTREMES OF INTELLIGENCE AND CREATIVITY

4

Mental Retardation  
Giftedness  
Creativity

Describe the characteristics of mental retardation, giftedness, and creativity

The concept of intelligence has generated many controversies, including whether intelligence is more strongly influenced by heredity or by environment, whether there is cultural bias in intelligence testing, and whether intelligence tests are misused. We will explore these controversies, as well as these topics: the extent to which we have a single intelligence or multiple intelligences, the development of intelligence across the life span, and the extremes of intelligence and creativity.

## 1 THE CONCEPT OF INTELLIGENCE

What Is Intelligence?

Intelligence Tests


Theories of  
Multiple Intelligences

Intelligence is one of our most prized possessions. However, intelligence is a concept that even the most intelligent people have not been able to agree on how to define and how to measure.

### What Is Intelligence?

What does the term *intelligence* mean to psychologists? Some experts describe intelligence as the ability to solve problems. Others describe it as the capacity to adapt and learn from experience. Still others argue that intelligence includes characteristics such as creativity and interpersonal skills.

The problem with intelligence is that, unlike height, weight, and age, intelligence cannot be directly measured. We can't peel back a person's scalp and see how much intelligence he or she has. We can evaluate intelligence only *indirectly* by studying and comparing the intelligent acts that people perform.

The primary components of intelligence are similar to the cognitive processes of thinking and memory that we discussed in chapter 7  P. 231. The differences in how we described these cognitive processes in chapter 7, and how we will discuss intelligence, lie in the concepts of individual differences and assessment. *Individual differences* are the stable, consistent ways in which people are different from one another. Individual differences in intelligence generally have been measured by intelligence tests designed to tell us whether a person can reason better than others who have taken the test.

Intelligence and personality are the two areas of psychology in which individual differences have mainly been emphasized. As you will see shortly, though, the use of intelligence tests to assess intelligence is controversial. However, we'll temporarily set aside the contentions of psychologists who believe that the conventional intelligence tests are inadequate measures of intelligence and use as our definition of **intelligence** the ability to solve problems and to adapt and learn from experiences.

### Intelligence Tests

Robert Sternberg (1997) had considerable childhood anxieties about intelligence tests. Because he got so stressed out about taking the tests, he did very poorly on them. Fortunately, a fourth-grade teacher worked with Robert and helped instill the confidence in him to overcome his anxieties. He not only began performing better on them, but when he was 13, he devised his own intelligence test and began using it to assess classmates—until the school principal found out and scolded him. Sternberg became so fascinated by intelligence that he made its study a lifelong pursuit. Later in this chapter, we will discuss his theory of intelligence.

**Individual Tests** Early psychologists ignored the “higher mental processes,” such as thinking and problem solving, that we equate with intelligence today. Sir Frances

**intelligence** Thinking skills and the ability to adapt to and learn from life's everyday experiences.



Galton, an English psychologist who is considered the father of mental tests, believed that sensory, perceptual, and motor processes were the key dimensions of intelligence. In the late nineteenth century, he set out to demonstrate that there are systematic individual differences in these processes. Although his research provided few conclusive results, Galton raised many important questions about intelligence—how it should be measured, what its components are, and the degree to which it is inherited—that we continue to study today.

**The Binet Tests** In 1904 the French Ministry of Education asked psychologist Alfred Binet to devise a method to determine which students would not profit from typical school instruction. Binet and his student Theophile Simon developed an intelligence test to meet this request. The test consisted of 30 items ranging from the ability to touch one's nose or ear when asked to the ability to draw designs from memory and to define abstract concepts.

The Binet tests represented a major advance over earlier efforts to measure intelligence. Binet stressed that the core of intelligence consists of complex cognitive processes, such as memory, imagery, comprehension, and judgment. In addition, he believed that a developmental approach was crucial for understanding intelligence. He proposed that a child's intellectual ability increases with age. Therefore, he tested potential items and determined that age at which a typical child could answer them correctly. Thus, Binet developed the concept of **mental age (MA)**, which is an individual's level of mental development relative to others. For an average child, MA scores correspond to *chronological age (CA)*, which is age from birth. A bright child has an MA considerably above CA; a dull child has an MA considerably below CA.

The Binet test has been revised many times to incorporate advances in the understanding of intelligence and intelligence testing. Many revisions were carried out by Lewis Terman, who developed extensive norms and provided detailed, clear instructions for each problem on the test. Terman also applied a concept introduced by William Stern. In 1912, Stern coined the term **intelligence quotient (IQ)** to refer to an individual's mental age divided by chronological age multiplied by 100:

$$IQ = \frac{MA}{CA} \times 100$$

If a child's mental age, as measured by the Binet test, was the same as the child's chronological age, then the child's IQ score would be 100. If the measured mental age was above chronological age, then the IQ score was more than 100. If mental age was below chronological age, the IQ score was less than 100. Although this scoring system is no longer used, the term *IQ* is often still used to refer to a score on a standardized intelligence test.

In 1985, the test, now called the Stanford-Binet (Stanford University is where the revisions were done), was revised to analyze an individual's responses in four content areas: verbal reasoning, quantitative reasoning, abstract/visual reasoning, and short-term memory. A general composite score also is obtained. Today the test is scored by comparing how the test-taker performs compared with other people of the same age. The average score is set at 100.

The current Stanford-Binet is given to individuals from the age of 2 through adulthood. It includes a wide variety of items, some requiring verbal responses, others nonverbal responses. For example, a 6-year-old is expected to complete the verbal task of defining at least six words, such as *orange* and *envelope*, and the nonverbal task of tracing a path through a maze. An adult with average intelligence is expected to define such words as *disproportionate* and *regard*, explain a proverb, and compare the concepts of idleness and laziness.

Over the years, the Stanford-Binet test has been given to thousands of children and adults of different ages. By administering the test to large numbers of individuals selected at random from different parts of the United States, it has been found



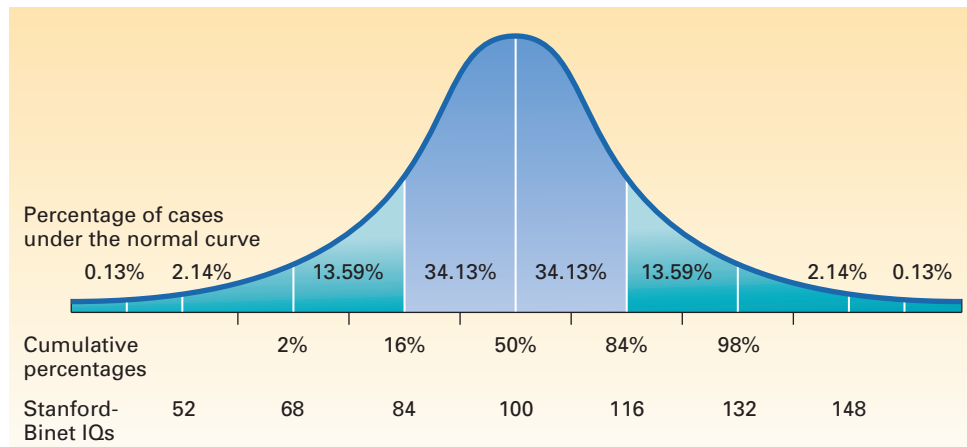
Alfred Binet constructed the first intelligence test after being asked to create a measure to determine which children would benefit from instruction in France's schools.

**mental age (MA)** An individual's level of mental development relative to others.

**intelligence quotient (IQ)** An individual's mental age divided by chronological age multiplied by 100; devised in 1912 by William Stern.

**FIGURE 8.1** The Normal Curve and Stanford-Binet IQ Scores

The distribution of IQ scores approximates a normal curve. Most of the population falls in the middle range of scores, between 84 and 116. Notice that extremely high and extremely low scores are rare. Only about 1 in 50 individuals has an IQ of more than 132 or less than 68.



that the scores approximate a normal distribution (see figure 8.1). A **normal distribution** is a symmetrical, bell-shaped curve with a majority of the cases falling in the middle of the range of possible scores and few scores appearing toward the extremes of the range. The Stanford-Binet continues to be one of the most widely used individual tests of intelligence.

**The Wechsler Scales** Besides the Stanford-Binet, the other most widely used intelligence tests are the Wechsler scales, developed by David Wechsler. In 1939, Wechsler introduced the first of his scales, designed for use with adults (Wechsler, 1939). Now in its third edition, the Wechsler Adult Intelligence Scale–III (WAIS-III), was followed by the Wechsler Intelligence Scale for Children–III (WISC-III) for children between the ages of 6 and 16, and the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) for children from the ages of 4 to 6½.

The Wechsler scales not only provide an overall IQ score but also scores on six verbal and five nonverbal measures. This allows the examiner to separate verbal and nonverbal IQ scores and to see quickly the areas in which the individual is below average, average, or above average. The inclusion of a number of nonverbal subscales makes the Wechsler test more representative of verbal and nonverbal intelligence; the Binet test includes some nonverbal items, but not as many as the Wechsler scales. Several of the Wechsler subscales are shown in figure 8.2.

**Group Tests** The Stanford-Binet and Wechsler tests are individually administered intelligence tests. The psychologist has an opportunity to sample the behavior of the individual being tested. During testing the psychologist observes the ease with which rapport is established, the energy and enthusiasm of the individual, and the tolerance of frustration and persistence that the individual shows in performing difficult tasks. Each of these observations helps the psychologist understand the individual.

On some occasions, it is necessary to administer group intelligence tests, which are more convenient and economical than individual tests. But group tests have some significant disadvantages. When a test is given to a large group, the examiner cannot establish rapport, determine the level of anxiety, and so on.

Most testing experts recommend that, when important decisions are to be made about an individual, a group intelligence test should be supplemented by other information about the individual's abilities. For example, if a decision is to be made about placing a child in a special education class, it is a legal requirement that the decision not be based on a group intelligence test. The psychologist must administer an individual intelligence test, such as the Stanford-Binet or Wechsler, and obtain extensive information about the child's abilities outside the testing situation.

**normal distribution** A symmetrical distribution with a majority of the cases falling in the middle of the possible range of scores and few scores appearing toward the extremes of the range.



David Wechsler

### Verbal Subscales

#### Similarities

A child must think logically and abstractly to answer a number of questions about how things might be similar.

Example: "In what way are a lion and a tiger alike?"

#### Comprehension

This subscale is designed to measure an individual's judgment and common sense.

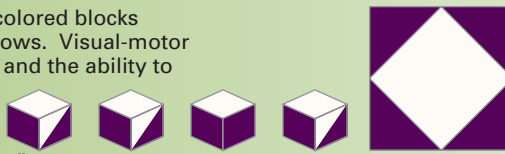
Example: "What is the advantage of keeping money in a bank?"

### Nonverbal Subscales

#### Block Design

An child must assemble a set of multicolored blocks to match designs that the examiner shows. Visual-motor coordination, perceptual organization, and the ability to visualize spatially are assessed.

Example: "Use the four blocks on the left to make the pattern on the right."



The Wechsler includes 11 subscales, 6 verbal and 5 nonverbal. Three of the subscales are shown here.

**FIGURE 8.2** Sample Subscales of the Wechsler Intelligence Scale for Children (WISC-III)

Simulated items similar to those in the Wechsler Intelligence Scale for Children, Third Edition. Copyright © 1981 by The Psychological Corporation, a Harcourt Assessment Company. Reproduced by permission. All rights reserved. "Wechsler Intelligence Scale for Children" and "WISC-R" are trademarks of The Psychological Corporation registered in the United States of America and/or other jurisdictions.

**The Use and Misuse of Intelligence Tests** Psychological tests are tools. Like all tools, their effectiveness depends on the knowledge, skill, and integrity of the user. A hammer can be used to build a beautiful kitchen cabinet or it can be used as a weapon of assault. Like a hammer, psychological tests can be used for positive purposes or they can be abused.

Intelligence tests have real-world applications as predictors of school and job success (Brody, 2000). For example, scores on tests of general intelligence are substantially correlated with school grades and achievement test performance, both at the time of the test and years later (Brody, 2000). IQ in the sixth grade correlates about .60 with the number of years of education the individual will eventually obtain (Jencks, 1979).

Intelligence tests are moderately correlated with work performance (Lubinski, 2000). Individuals with higher scores on tests designed to measure general intelligence tend to get higher-paying, more prestigious jobs (Wagner, 1997). However, general IQ tests predict only about one-fourth of the variation in job success, with the majority of job success due to motivation, education, and other factors (Wagner & Sternberg, 1986). Further, the correlations between IQ and achievement decrease the longer people work at a job, presumably because as they gain more job experience they perform better (Hunt, 1995).

Thus, although there are correlations between IQ scores and academic achievement and occupational success, many other factors contribute to success in school and work. These include the motivation to succeed, physical and mental health, and social skills (Sternberg, 2003).

The single number provided by many IQ tests can easily lead to false expectations about an individual (Rosnow & Rosenthal, 1996). Sweeping generalizations are too often made on the basis of an IQ score. For example, imagine that you are a teacher in the teacher's lounge the day after school has started in the fall. You mention a student—Johnny Jones—and a fellow teacher remarks that she had Johnny in class last year; she comments that he was a real dunce and points out that his IQ is 78. You cannot help but remember this information, and it might lead

to thoughts that Johnny Jones is not very bright so it is useless to spend much time teaching him. In this way, IQ scores are misused and can become self-fulfilling prophecies (Rosenthal & Jacobsen, 1968).

Intelligence tests can help teachers group children who function at roughly the same level in such subject areas as math or reading so they can be taught the same concepts together. However, extreme caution is necessary when test scores are used to place children in tracks, such as “advanced,” “intermediate,” and “low.” Periodic assessment is required. Intelligence tests measure *current* performance, and maturational changes or enriched experiences may advance a child’s intelligence, indicating that he or she should be moved to a higher-level group.

Even though they have limitations, tests of intelligence are among psychology’s most widely used tools. To be effective, they should be used in conjunction with other information about an individual. For example, an intelligence test alone should not determine whether a child is placed in a special education or gifted class. The child’s developmental history, medical background, performance in school, social competencies, and family experiences should be taken into account too.

Despite their limitations, when used judiciously, intelligence tests provide valuable information. There are not many alternatives to these tests. Subjective judgments about individuals simply reintroduce the bias that the tests were designed to eliminate.

## Theories of Multiple Intelligences

The use of a single score to describe how people perform on intelligence tests suggests intelligence is a general ability, a single trait. Wechsler scales provide scores for a number of intellectual skills, as well as an overall score. Do people have some general mental ability that determines how they perform on all of these tests? Or is intelligence a label for a combination of several distinct abilities? And do conventional intelligence tests measure everything that should be considered part of intelligence? Psychologists disagree about the answers to these questions.

Wechsler was not the first psychologist to break down intelligence into a number of abilities. Nor was he the last. A number of contemporary psychologists continue to search for specific components that make up intelligence. Some do not rely on traditional intelligence tests in their conceptualization of intelligence. Let’s explore several key alternative conceptions of intelligence, beginning with Wechsler’s predecessor, Charles Spearman.

**Factor Approaches** Some time before Wechsler analyzed intelligence in terms of general and specific abilities, Charles Spearman (1927) proposed that intelligence has two factors. **Two-factor theory** is Spearman’s theory that individuals have both general intelligence, which he called *g*, and a number of specific abilities, or *s*. Spearman believed that these two factors account for a person’s performance on an intelligence test. Spearman developed his theory by applying a technique called **factor analysis** to a number of intelligence tests. Factor analysis is a statistical procedure that correlates test scores to identify underlying clusters, or factors.

L. L. Thurstone (1938) also used factor analysis in analyzing a number of intelligence tests, but he concluded that the tests measure only a number of specific factors, and not general intelligence. **Multiple-factor theory** is Thurstone’s theory that intelligence consists of seven primary mental abilities: verbal comprehension, number ability, word fluency, spatial visualization, associative memory, reasoning, and perceptual speed.

**Gardner’s Theory of Multiple Intelligences** Both Spearman and Thurstone relied on traditional types of intelligence tests in their attempts to clarify the nature of intelligence. In contrast, Howard Gardner argues that these tests are far too narrow. Imagine someone who has great musical skills but does not do well in math

**two-factor theory** Spearman’s theory that individuals have both general intelligence, which he called *g*, and a number of specific intelligences, referred to as *s*.

**factor analysis** A statistical procedure that correlates test scores to identify underlying clusters, or factors.

**multiple-factor theory** L. L. Thurstone’s theory that intelligence consists of seven primary mental abilities: verbal comprehension, number ability, word fluency, spatial visualization, associative memory, reasoning, and perceptual speed.



or English. The famous composer, Ludwig van Beethoven, was just such a person. Would you call Beethoven “unintelligent?” Unlikely!

According to Gardner, people have multiple intelligences, and IQ tests measure only a few of these. These intelligences are independent of each other. For evidence of the existence of multiple intelligences, Gardner uses information about the ways in which certain cognitive abilities survive particular types of brain damage. He also points to child prodigies and to some individuals who are retarded or autistic but have an extraordinary skill in a particular domain. An example was portrayed by Dustin Hoffman in the movie *Rain Man*. Hoffman’s character was autistic but had a remarkable computing ability. In one scene, he helped his brother successfully gamble in Las Vegas by keeping track of all the cards that had been played.

**From Verbal Intelligence to Naturalist Intelligence** Gardner (1983, 1993, 2001, 2002) has proposed eight types of intelligence. They are described here along with examples of the occupations in which they are reflected as strengths (Campbell, Campbell, & Dickson, 2003):

- *Verbal Skills*: The ability to think in words and use language to express meaning.  
Occupations: Authors, journalists, speakers.
- *Mathematical Skills*: The ability to carry out mathematical operations.  
Occupations: Scientists, engineers, accountants.
- *Spatial Skills*: The ability to think three-dimensionally.  
Occupations: Architects, artists, sailors.
- *Bodily-Kinesthetic Skills*: The ability to manipulate objects and be physically adept.  
Occupations: Surgeons, craftspeople, dancers, athletes.
- *Musical Skills*: A sensitivity to pitch, melody, rhythm, and tone.  
Occupations: Composers, musicians, and sensitive listeners.
- *Interpersonal Skills*: The ability to understand and effectively interact with others.  
Occupations: Successful teachers, mental health professionals.
- *Intrapersonal Skills*: The ability to understand oneself.  
Occupations: Theologians, psychologists.
- *Naturalist Skills*: The ability to observe patterns in nature and understand natural and human-made systems.  
Occupations: Farmers, botanists, ecologists, landscapers.

Gardner believes that each of the eight intelligences can be destroyed by brain damage, that each involves unique cognitive skills, and that each shows up in exaggerated fashion in the gifted and in individuals who have mental retardation or autism. According to Gardner, everyone has all of these intelligences but to varying degrees. As a result, we prefer to learn and process information in different ways. People learn best when they can apply their strong intelligences to the task.

**Multiple Intelligences in the Classroom** Currently there is considerable interest in applying Gardner’s theory of multiple intelligences to children’s education (Kornhaber, Fierros, & Veenema, 2004). The goal is to allow students to discover and then explore the domains in which they have natural curiosity and talent. According to Gardner, if teachers give students opportunities to use their bodies, imaginations, and different senses, almost every student finds that she or he is good at something. Even students who are not outstanding in any single area will find that they have relative strengths. Thus, at the Key School in Indianapolis, each day every student is exposed to materials that are designed to stimulate a range of human abilities, including art, music, language skills, math skills, and physical games. In addition, attention is given to understanding oneself and others. Another Gardner-based program is Project Spectrum (Gardner, 1993). To read about Project Spectrum, see the Applications in Life-Span Development interlude.

If by 2013 [the 30th anniversary of the publication of Gardner’s *Frames of Mind*] there is a wider acceptance of the notion that intelligence deserves to be pluralized, I will be pleased.

—HOWARD GARDNER  
*Contemporary Psychologist,*  
*Harvard University*



Multiple Intelligences  
Multiple Intelligences Links





## Applications in Life-Span Development

### *Project Spectrum*

What is a Spectrum classroom like? Teachers do not try to evoke intelligences directly by using materials that are labeled “spatial” or “verbal.” But the classroom has rich and engaging materials that can stimulate a range of intelligences. For example, in a naturalist corner there are biological specimens that students can explore and compare. This area stimulates students’ sensory capacities and logical thinking skills. In a story-telling area, students create imaginative tales with stimulating props and design their

own storyboards. This area encourages children to use their linguistic, dramatic, and imaginative skills. In a building corner, students can construct a model of their classroom and arrange small-scale photographs of the students and the teachers in their class using spatial and personal skills. In all, the Spectrum classroom has 12 such areas that are designed to bring out students’ multiple intelligences.

The Spectrum classroom can identify skills that typically are not tapped in a regular classroom. In one first-grade Spectrum classroom, a boy who was a product of a highly conflicted broken home was at risk for school failure. However, when Project Spectrum was introduced the boy was identified as especially skilled in one area. He was the best student in the class at taking apart and putting together common objects, such as a doorknob and a food grinder. His teacher became encouraged when she found that he possessed this skill and his overall school performance began to improve.

In addition to identifying unexpected strengths in students, Project Spectrum also can pinpoint undetected weaknesses. Gregory, who was especially skilled in math computation and conceptual knowledge, was doing very well in the first grade. However, he performed poorly in a number of Spectrum areas. Gregory did well only in the areas in which he needed to give a correct answer and a person in authority gave it to him. As a result of the Spectrum Project, Gregory’s teacher began to search for ways to encourage him to take risks on more open-ended tasks, to try different ways of doing things, and to realize that it is okay to make mistakes.



Student in a Spectrum classroom engaged in a science project. *What combinations of materials might you expect to find in other corners of a Spectrum classroom?*

**Sternberg’s Triarchic Theory** Like Gardner, Robert J. Sternberg (1986, 1999, 2002, 2003) believes that traditional IQ tests fail to measure some important dimensions of intelligence. Sternberg proposes a **triarchic theory of intelligence** with three main types of intelligence: analytical, creative, and practical.

**Analytical, Creative, and Practical Intelligence** To understand what analytical, creative, and practical intelligence mean, let’s look at examples of people who reflect these three types of intelligence:

- Consider Latisha, who scores high on traditional intelligence tests such as the Stanford-Binet and is a star analytical thinker. Sternberg calls Latisha’s analytical thinking and abstract reasoning *analytical intelligence*. It is the closest to what has traditionally been called intelligence and what is commonly assessed by intelligence tests. In Sternberg’s view of analytical intelligence, the basic unit of analytical intelligence is a *component*, which is a basic unit of information process-

**triarchic theory of intelligence** Sternberg’s theory that intelligence consists of com-poten-tial intelligence, experiential intelligence, and contextual intelligence.

ing. Sternberg's components include the ability to acquire or store information; to retain or retrieve information; to transfer information; to plan, make decisions, and solve problems; and to translate thoughts into performance.

- Todd does not have the best test scores but has an insightful and creative mind. The type of thinking at which Todd excels is called *creative intelligence* by Sternberg. According to Sternberg, creative people like Todd have the ability to solve new problems quickly, but they also learn how to solve familiar problems in an automatic way so their minds are free to handle other problems that require insight and creativity.
- Finally, consider Emanuel, a person whose scores on traditional IQ tests are low but who quickly grasps real-life problems. He easily picks up knowledge about how the world works. Emanuel's "street smarts" and practical know-how indicate that he has what Sternberg calls *practical intelligence*. Practical intelligence includes the ability to get out of trouble and a knack for getting along with people. Sternberg describes practical intelligence as all of the important information about getting along in the world that you are not taught in school.



"You're wise, but you lack tree smarts."

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**Assessing Triarchic Intelligence** Sternberg (1993) developed the Sternberg Triarchic Abilities Test (STAT) that assesses analytical, creative, and practical intelligence. The three kinds of abilities are examined in four different ways: (1) verbal, (2) quantitative, (3) figural multiple-choice items, and (4) essays. The goal is to obtain a more complete assessment of intelligence than is possible with a conventional test.

The memory-analytical section is much like a conventional test with individuals required to provide the meanings of words, complete number series, and complete matrices. The creative and practical sections are much different than conventional tests. For example, in the creative section, individuals are required to write an essay on designing an ideal school. The practical section requires individuals to solve practical everyday problems that involve such matters as planning routes and purchasing tickets to an event.

An increasing number of studies are investigating the effectiveness of the STAT in predicting such important aspects of life as success in school. For example, in one recent study of 800 college students, scores on the STAT were effective in predicting college grade point average (Sternberg & others, 2001a). However, more research is needed to determine the validity and reliability of the STAT.

**Triarchic Theory in the Classroom** Sternberg (1997) says that students with different triarchic patterns look different in school. Students with high analytic ability tend to be favored in conventional schools. They often do well in classes in which the teacher lectures and gives objective tests. They often are considered smart students, typically get good grades, do well on traditional IQ tests and the SAT, and later gain admission to competitive colleges.

Students who are high in creative intelligence often are not in the top rung of their class. Creatively intelligent students might not conform to the expectations that teachers have about how assignments should be done. They give unique answers, for which they might get reprimanded or marked down.

Like students high in creative intelligence, students who are practically intelligent often do not relate well to the demands of school. However, these students frequently do well outside the classroom's walls. Their social skills and common sense may allow them to become successful managers, entrepreneurs, or politicians, despite undistinguished school records.



Sternberg's Theory



Middle and Later Childhood;  
Young Brazilian Street  
Vendor's Math Skills

Gardner	Sternberg	Salovey/Mayer
Verbal Mathematical	Analytical	
Spatial Movement Musical	Creative	
Interpersonal Intrapersonal	Practical	Emotional
Naturalistic		

**FIGURE 8.3** Comparing Gardner's, Sternberg's, and Salovey/Mayer's Intelligences

Sternberg (1999) believes that few tasks are purely analytic, creative, or practical. Most tasks require some combination of these skills. For example, when students write a book report, they might (1) analyze the book's main themes, (2) generate new ideas about how the book could have been written better, and (3) think about how the book's themes can be applied to people's lives. Sternberg argues that it is important for classroom instruction to give students opportunities to learn through all three types of intelligence.

**Emotional Intelligence** Both Gardner's and Sternberg's theories include one or more categories related to social intelligence. In Gardner's theory, the categories are interpersonal intelligence and intrapersonal intelligence; in Sternberg's theory, practical intelligence. Another theory that emphasizes interpersonal, intrapersonal, and practical aspects of intelligence is called **emotional**

**intelligence**, which has been popularized by Daniel Goleman (1995) in his book *Emotional Intelligence*. The concept of emotional intelligence was initially developed by Peter Salovey and John Mayer (1990), who define it as the ability to perceive and express emotion accurately and adaptively (such as taking the perspective of others), to understand emotion and emotional knowledge (such as understanding the roles that emotions play in friendship and marriage), to use feelings to facilitate thought (such as being in a positive mood, which is linked to creative thinking), and to manage emotions in oneself and others (such as being able to control one's anger).

Recently, the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) was developed to measure the four aspects of emotional intelligence just described: perceiving emotions, understanding emotions, facilitating thought, and managing emotions (Mayer, Salovey, & Caruso, 2002). The test consists of 141 items, can be given to individuals 17 years of age and older, and takes about 30 to 45 minutes to administer. Because the MSCEIT has only been available since 2001, there are few studies that have been conducted to examine its ability to predict outcomes (Salovey & Pizarro, 2003). One recent study that used the MSCEIT found that youths with higher emotional intelligence were less likely to have smoked cigarettes or to have used alcohol (Trinidad & Johnson, 2002).

**Do People Have One Intelligence or Many Intelligences?** Figure 8.3 provides a comparison of Gardner's, Sternberg's, and Mayer/Salovey's views. Notice that Gardner includes a number of types of intelligence that are not addressed by the other views and that Sternberg is unique in emphasizing creative intelligence. These theories of multiple intelligence have much to offer. They have stimulated us to think more broadly about what makes up people's intelligence and competence. And they have motivated educators to develop programs that instruct students in different domains.

Theories of multiple intelligences also have many critics. Many argue that the research base to support these theories has not yet developed. In particular, some critics say that Gardner's classification seems arbitrary. For example, if musical skills represent a type of intelligence, why don't we also refer to chess intelligence, prizefighter intelligence, and so on?

A number of psychologists still support Spearman's concept of *g* (general intelligence). For example, one expert on intelligence, Nathan Brody (2000) argues that people who excel at one type of intellectual task are likely to excel in other intellectual tasks. Thus, individuals who do well at memorizing lists of digits are also likely to be good at solving verbal problems and spatial layout problems. This general intelligence includes abstract reasoning or thinking, the capacity to acquire knowledge, and problem-solving ability (Brody, 2000; Carroll, 1993).

**emotional intelligence** The ability to perceive and express emotions accurately and adaptively, to understand emotion and emotional knowledge, to use feelings to facilitate thought, and to manage emotions in oneself and others.

Some experts who argue for the existence of general intelligence believe that individuals also have specific intellectual abilities (Brody, 2000). In one study, John Carroll (1993) conducted an extensive examination of intellectual abilities and concluded that all intellectual abilities are related to each other, which supports the concept of general intelligence, but that there are many specialized abilities as well. Some of these specialized abilities, such as spatial abilities and mechanical abilities, are not adequately reflected in the curriculum of most schools.

## Review and Reflect: Learning Goal 1

### 1 Explain the nature of intelligence

#### REVIEW

- What is intelligence?
- What are the main individual tests of intelligence? What are some issues in the use of group tests of intelligence?
- What theories of multiple intelligence have been developed? Do people have one intelligence or many intelligences? What are some criticisms of the multiple intelligences concept?

#### REFLECT

- A CD-ROM is being sold to parents for testing their child's IQ. What are some potential problems with parents giving their child an IQ test and interpreting the results?

## 2 CONTROVERSIES AND GROUP COMPARISONS

### The Influence of Heredity and Environment

### Group Comparisons and Issues

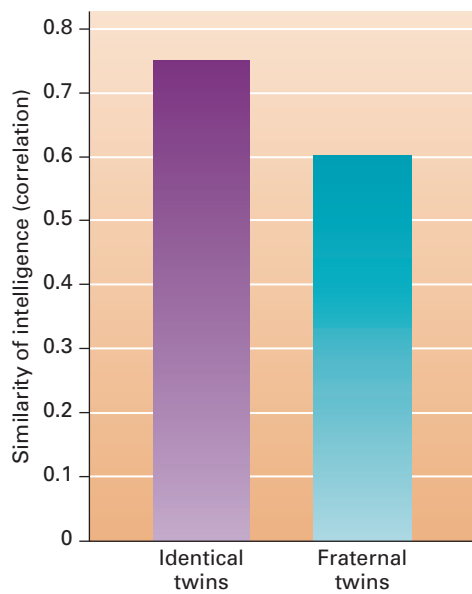
We have seen that intelligence is a slippery concept with competing definitions, tests, and theories. It is not surprising, therefore, that attempts to understand the concept of intelligence are filled with controversy. In some cases, the controversies involve comparisons of the intelligence of different groups, such as people from different cultures or ethnic groups.

### The Influence of Heredity and Environment

One of the hottest areas in the study of intelligence centers on the extent to which intelligence is influenced by genetics and the extent to which it is influenced by environment. In chapter 2, we indicated how difficult it is to tease apart these influences, but that has not kept psychologists from trying to unravel them.

**Genetic Influences** The issue with respect to genetics and intelligence is the degree to which our genes make us smart (Petrill, 2003). At one end of the debate, Arthur Jensen (1969) argued that intelligence is primarily inherited and that environment plays only a minimal role in intelligence. Jensen reviewed the research on intelligence, much of which involved comparisons of identical and fraternal twins, and which also used IQ as the indicator of intelligence. Identical twins have exactly the same genetic makeup; if intelligence is genetically determined, Jensen reasoned, identical twins' IQs should be more similar than the intelligence of fraternal twins.





**FIGURE 8.4** Correlation Between Intelligence Test Scores and Twin Status

The graph represents a summary of research findings that have compared the intelligence test scores of identical and fraternal twins. An approximate .15 difference has been found, with a higher correlation (.75) for identical twins and a lower correlation (.60) for fraternal twins.

The studies on intelligence in identical twins that Jensen examined showed an average correlation of .82, a very high positive association. Investigations of fraternal twins, however, produced an average correlation of .50, a moderately high positive correlation. A difference of .32 is substantial. However, a more recent research review that included many studies conducted since Jensen's original review found that the difference in intelligence between identical and fraternal twins was .15, substantially less than what Jensen found (Grigorenko, 2000) (see figure 8.4).

Jensen also compared the correlation of IQ scores for identical twins reared together with those reared apart. The correlation for those reared together was .89, and for those reared apart was .78, a difference of .11. Jensen argued that if environmental factors were more important than genetic factors, the difference should have been greater.

Adoption studies have been inconclusive about the relative importance of heredity in intelligence. In most *adoption studies*, researchers determine whether the behavior of adopted children is more like that of their biological parents or their adopted parents. In one study, the educational levels attained by biological parents were better predictors of children's IQ scores than were the IQs of the children's adopted parents (Scarr & Weinberg, 1983). Because of the stronger genetic link between the adopted children and their biological parents, the implication is that heredity is more important than environment. Environmental effects also have been found in studies of adoption. For example, moving children into an adopted family with a better environment than the child had in the past increased the children's IQs by an average of 12 points (Lucurto, 1990).

How strong is the effect of heredity on intelligence? The concept of heritability attempts to tease apart the effects of heredity and environment in a population. **Heritability** is the fraction of the variance in a population that is attributed to genetics. The heritability index is computed using correlational techniques. Thus, the highest degree of heritability is 1.00 and correlations of .70 and above suggest a strong genetic influence. A committee of respected researchers convened by the American Psychological Association concluded that by late adolescence, the heritability of intelligence is about .75, which reflects a strong genetic influence (Neisser & others, 1996).

An important point to keep in mind about heritability is that it refers to a specific group (population), *not* to individuals. Researchers use the concept of heritability to try to describe why people differ. Heritability says nothing about why a single individual, like yourself, has a certain intelligence; nor does it say anything about differences *between* groups.

Most research on heredity and environment does not include environments that differ radically. Thus, it is not surprising that many genetic studies show environment to be a fairly weak influence on intelligence (Fraser, 1995).

Interestingly, researchers have found that the heritability of intelligence increases from as low as .45 in infancy to as high as .80 in late adulthood (McGue & others, 1993; Petrill, 2003; Plomin & others, 1997). Why might hereditary influences on intelligence increase with age? Possibly as we grow older, our interactions with the environment are shaped less by the influence of others and the environment on us and more by our ability to choose our environments to allow the expression of genetic tendencies (Neisser & others, 1996). For example, sometimes children's parents push them into environments that are not compatible with their genetic inheritance (wanting to be a doctor or an engineer, for example), but as adults these individuals may select their own career environments.

The heritability index has several flaws. It is only as good as the data that are entered into its analysis and the interpretations made from it. The data are virtually all from traditional IQ tests, which some experts believe are not always the best indicator of intelligence (Gardner, 2002; Sternberg, 2002). Also, the heritability index assumes that we can treat genetic and environmental influences as factors that can be separated, with each part contributing a distinct amount of influence.

**heritability** The fraction of the variance in a population that is attributed to genetics.

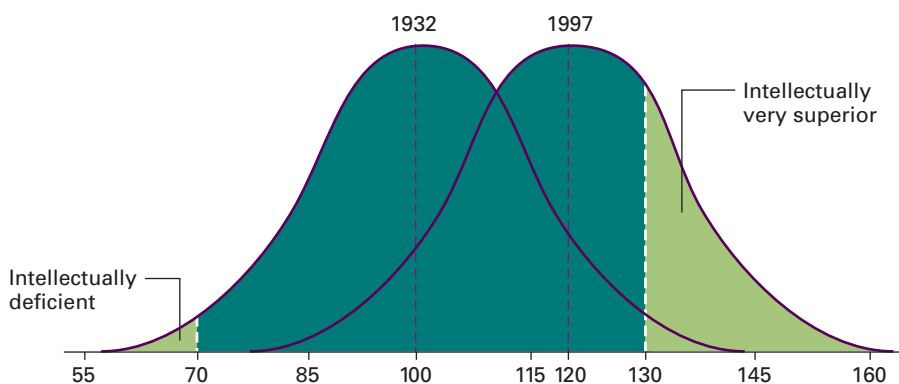
As we discussed in chapter 2, genes and the environment always work together. Genes always exist in an environment, and the environment shapes their activity.

**Environmental Influences** Today, most researchers agree that heredity does not determine intelligence to the extent Jensen claimed (Ceci, 1996; Grigorenko, 2000). For most people, this means modifications in environment can change their IQ scores considerably (Campbell & others, 2001). Although genetic endowment may always influence a person's intellectual ability, the environmental influences and opportunities we provide children and adults do make a difference.

In one study, researchers went into homes and observed how extensively parents from welfare and middle-income professional families talked and communicated with their young children (Hart & Risley, 1995). They found that the middle-income professional parents were much more likely to communicate with their young children than the welfare parents were. And how much the parents communicated with their children in the first three years of their lives was correlated with the children's Stanford-Binet IQ scores at age 3. The more parents communicated with their children, the higher the children's IQs were. Other studies also have found substantial socioeconomic status differences in intelligence (Seifer, 2001).

Schooling also influences intelligence (Ceci & Gilstrap, 2000; Christian, Bachnan, & Morrison, 2001). The biggest effects have been found when large groups of children have been deprived of formal education for an extended period, resulting in lower intelligence. One study examined the intellectual functioning of Indian children in South Africa whose schooling was delayed for four years because of the unavailability of teachers (Ramphal, 1962). Compared with children in nearby villages who had teachers, the Indian children whose entry into school was delayed by four years experienced a decrement of 5 IQ points for every year of delay.

Another possible effect of education can be seen in rapidly increasing IQ test scores around the world (Flynn, 1999). IQ scores have been increasing so fast that a high percentage of people regarded as having average intelligence at the turn of the last century would be considered below average in intelligence today (Howard, 2001) (see figure 8.5). If a representative sample of people today took the Stanford-Binet test used in 1932, about one-fourth would be defined as having very superior intelligence, a label usually accorded to fewer than 3 percent of the population (Horton, 2001). Because the increase has taken place in a relatively short time, it can't be due to heredity, but rather may be due to increasing levels of education attained by a much greater percentage of the world's population or to other environmental factors such as the explosion of information to which people are exposed. The worldwide



**FIGURE 8.5** The Increase in IQ Scores from 1932 to 1997

As measured by the Stanford-Binet intelligence test, American children seem to be getting smarter. Scores of a group tested in 1932 fell along a bell-shaped curve with half below 100 and half above. Studies show that if children took that same test today, half would score above 120 on the 1932 scale. Very few of them would score in the “intellectually deficient” end, on the left side, and about one-fourth would rank in the “very superior” range.

increase in intelligence test scores that has occurred over a short time frame has been called the *Flynn effect*, after the researcher who discovered it—James Flynn.

Keep in mind that environmental influences are complex (Neisser & others, 1996; Sternberg, 2001) ◀ P. 64. Growing up with all the “advantages,” for example, does not guarantee success. Children from wealthy families may have easy access to excellent schools, books, travel, and tutoring, but they may take such opportunities for granted and fail to develop the motivation to learn and to achieve. In the same way, “poor” or “disadvantaged” does not automatically equal “doomed.”

Researchers increasingly are interested in manipulating the early environment of children who are at risk for impoverished intelligence (Ramey, Ramey, & Lanzi, 2001; Sternberg & Grigorenko, 2001). The emphasis is on prevention rather than remediation. Many low-income parents have difficulty providing an intellectually stimulating environment for their children. Programs that educate parents to be more sensitive caregivers and better teachers, as well as support services such as quality child-care programs, can make a difference in a child’s intellectual development.

A recent review of the research on early interventions concluded that (1) high-quality center-based interventions (such as the Abecedarian Project) improve children’s intelligence and school achievement; (2) the effects are strongest for poor children and for children whose parents have little education; (3) the positive benefits continue into the late middle and late childhood, and adolescence, although the effects are smaller than in early childhood or the beginning of elementary school; and (4) the programs that are continued into elementary school have the most sustained long-term effects (Brooks-Gunn, 2003). To read further about environmental influences on intelligence, see the Research in Life-Span Development interlude.



## Research in Life-Span Development

### *The Abecedarian Project*

Each morning a young mother waited with her child for the bus that would take the child to school. The child was only 2 months old, and “school” was an experimental program at the University of North Carolina at Chapel Hill. There the child experienced a number of interventions designed to improve her intellectual development—everything from bright objects dangled in front of her eyes while she was a baby to language instruction and counting activities when she was a toddler (Wickelgren, 1999). The child’s mother had an IQ of 40 and could not read signs or determine how much change she should receive from a cashier. Her grandmother had a similarly low IQ.

Today, at age 20, the child’s IQ measures 80 points higher than her mother’s did when the child was 2 months old. Not everyone agrees that IQ can be affected this extensively, but environment can make a substantial difference in a child’s intelligence. As behavior geneticist Robert Plomin (1999) says, even something that is highly heritable (like intelligence) may be malleable through interventions.

The child we just described was part of the Abecedarian Intervention program at the University of North Carolina at Chapel Hill conducted by Craig Ramey and his associates (Ramey & Campbell, 1984; Ramey & Ramey, 1998). They randomly assigned 111 young children from low-income, poorly educated families to either an intervention group, which received full-time, year-round child care along with medical and social work services, or a control group, which received medical and social benefits but no child care. The child-care program included gamelike learning activities aimed at improving language, motor, social, and cognitive skills.

The success of the program in improving IQ was evident by the time the children were 3 years of age. At that age, the experimental group showed normal IQs

The highest-risk children often benefit the most cognitively when they experience early interventions.

—CRAIG RAMEY  
*Contemporary Psychologist,*  
*University of Alabama–Birmingham*

averaging 101, a 17-point advantage over the control group. Recent follow-up results suggest that the effects are long-lasting. More than a decade later, at 15, children from the intervention group still maintained an IQ advantage of 5 points over the control-group children (97.7 to 92.6) (Campbell & others, 2001; Ramey, Ramey, & Lanzi, 2001). They also did better on standardized tests of reading and math, and were less likely to be held back a year in school. Also, the greatest IQ gains were made by the children whose mothers had especially low IQs—below 70. At age 15, these children showed a 10-point IQ advantage over a group of children whose mothers' IQs were below 70 but did not experience the child-care intervention.

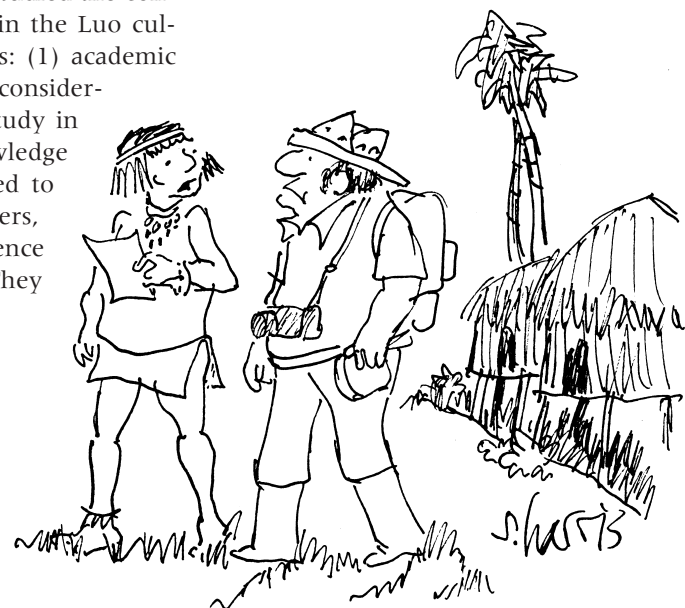
## Group Comparisons and Issues

Among the ways that group comparisons in intelligence can be made involve cultures, ethnic groups, and gender.

**Cross-Cultural Comparisons** Cultures vary in the way they describe what it means to be intelligent (Benson, 2003; Greenfield, Keller, & Fulgini, 2003). People in Western cultures tend to view intelligence in terms of reasoning and thinking skills while people in Eastern cultures see intelligence as a way for members of a community to successfully engage in social roles (Nisbett, 2003). One study found that Taiwanese-Chinese conceptions of intelligence emphasize understanding and relating to others, including when to show and when not to show one's intelligence (Yang & Sternberg, 1997).

Robert Serpell (1974, 1982, 2000) has studied concepts of intelligence in rural African communities since the 1970s. He has found that people in rural African communities, especially those in which Western schooling is not common, tend to blur the distinction between being intelligent and being socially competent. In rural Zambia, for example, the concept of intelligence involves being both clever and responsible. Elena Grigorenko and her colleagues (2001) have also studied the concept of intelligence among rural Africans. They found that people in the Luo culture of rural Kenya view intelligence as consisting of four domains: (1) academic intelligence; (2) social qualities such as respect, responsibility, and consideration; (3) practical thinking; and (4) comprehension. In another study in the same culture, children who scored highly on a test of knowledge about medicinal herbs—a measure of practical intelligence—tended to score poorly on tests of academic intelligence (Sternberg & others, 2001b). These results indicated that practical and academic intelligence can develop independently and may even conflict with each other. They also suggest that the values of a culture may influence the direction in which a child develops. In a cross-cultural context, then, intelligence depends a great deal on environment.

**Cultural Bias in Testing** Many of the early intelligence tests were culturally biased, favoring people who were from urban rather than rural environments, middle-socioeconomic status rather than low-socioeconomic status, and White rather than African American (Miller-Jones, 1989; Provenzo, 2002; Watras, 2002). For example, one question on an early test asked what you should do if you find a 3-year-old child in the street. The correct answer was “call the police.” But children from inner-city families who perceive the police as adversaries are unlikely to choose this answer. Similarly, children from rural areas might not choose this answer if there is no police force nearby. Such questions clearly do not measure the knowledge necessary to adapt to one's environment or to be “intelligent” in an



*“You can't build a hut, you don't know how to find edible roots and you know nothing about predicting the weather. In other words, you do terribly on our I.Q. test.”*

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inner-city neighborhood or in rural America (Scarr, 1984). Also, members of minority groups who do not speak English or who speak nonstandard English are at a disadvantage in trying to understand questions framed in standard English (Gibbs & Huang, 1989). The Contexts of Life-Span Development interlude examines some of the ways intelligence testing can be culturally biased.



## Contexts of Life-Span Development

### *Larry P.: Intelligent, But Not on Intelligence Tests*

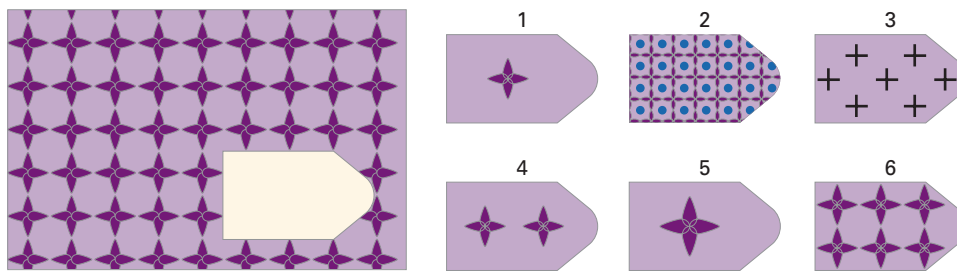
Larry P. is African American and poor. When he was 6 years old, he was placed in a class for the “educable mentally retarded” (EMR), which to school psychologists means that Larry learned much more slowly than average children. The primary reason Larry was placed in the EMR class was his very low score of 64 on an intelligence test.

Is there a possibility that the intelligence test Larry was given was culturally biased? Psychologists still debate this issue. A major class-action suit challenged the use of standardized IQ tests to place African American elementary school students in EMR classes. The initial lawsuit, filed on behalf of Larry P., claimed that the IQ test he took underestimated his true learning ability. The lawyers for Larry P. argued that IQ tests place too much emphasis on verbal skills and fail to account for the backgrounds of African American children. Therefore, it was argued, Larry was incorrectly labeled mentally retarded and might forever be saddled with that stigma.

As part of the lengthy court battle involving Larry P., six African American EMR students were independently retested by members of the Bay Association of Black Psychologists in California. The psychologists made sure they established good rapport with the students and made special efforts to overcome the students’ defeatism and distraction. For example, items were rewarded in terms more consistent with the children’s social background, and recognition was given to nonstandard answers that showed a logical, intelligent approach to problems. This testing approach produced scores of 79 to 104—17 to 38 points higher than the scores the students received when initially tested by school psychologists. In every case, the retest scores were above the ceiling for placement in an EMR class.

What was the state’s argument for using intelligence tests as one criterion for placing children in EMR classes? Testimony by intelligence testing experts supported the *predictive validity* (using a measure, such as an intelligence test, to predict performance on another measure, such as grades in school) of IQ for different ethnic groups. In Larry’s case, the judge ruled that IQ tests are biased and that their use discriminates against ethnic minorities. IQ tests cannot be used now in California to place children in EMR classes. The decision in favor of Larry P. was upheld by an appeals panel. However, in another court case, *Pace v. Hannon* in Illinois, a judge ruled that IQ tests are not culturally biased.

A specific case illustrating how cultural bias in intelligence tests can affect people is that of Gregory Ochoa. When Gregory was a high school student, he and his classmates took an IQ test. Gregory understood only a few words on the test because he did not speak English very well and spoke Spanish at home. Several weeks later, Gregory was placed in a special class for mentally retarded students. Many of the students in the class, it turns out, had last names such as Ramirez and Gonzales. Gregory lost interest in school, dropped out, and eventually joined the Navy. In the



**FIGURE 8.6** Sample Item from the Raven Progressive Matrices Test

Individuals are presented with a matrix arrangement of symbols, such as the one at the left of this figure, and must then complete the matrix by selecting the appropriate missing symbol from a group of symbols.

Navy, Gregory took high school courses and earned enough credits to attend college later. He graduated from San Jose City College as an honor student, continued his education, and became a professor of social work at the University of Washington in Seattle.

As a result of cases like Gregory Ochoa's, researchers have developed **culture-fair tests**, which are intelligence tests that are intended not to be culturally biased. Two types of culture-fair tests have been developed. The first includes questions that are familiar to people from all socioeconomic and ethnic backgrounds. For example, a child might be asked how a bird and a dog are different, on the assumption that virtually all children are familiar with birds and dogs. The second type of culture-fair test contains no verbal questions. Figure 8.6 shows a sample question from the Raven Progressive Matrices Test. Even though tests such as the Raven Progressive Matrices are designed to be culture-fair, people with more education still score higher than those with less education do (Greenfield, 2003).

Why is it so hard to create culture-fair tests? Most tests tend to reflect what the dominant culture thinks is important (Aiken, 2003; Greenfield & others, 2003). If tests have time limits, that will bias the test against groups not concerned with time. If languages differ, the same words might have different meanings for different language groups. Even pictures can produce bias because some cultures have less experience than others with drawings and photographs (Anastasi & Urbina, 1996). Within the same culture, different groups could have different attitudes, values, and motivation, and this could affect their performance on intelligence tests. Items that ask why buildings should be made of brick are biased against children who have little or no experience with brick houses. Questions about railroads, furnaces, seasons of the year, distances between cities, and so on can be biased against groups who have less experience than others with these contexts.

**Ethnic Comparisons** Comparisons of the IQ scores of ethnic groups were at the heart of the controversy that erupted in response to the book *The Bell Curve: Intelligence and Class Structure in American Life* (1994) by Richard Herrnstein and Charles Murray. Recall that the bell curve is the shape of a normal distribution graph, which represents large numbers of people who are sorted according to some shared characteristic, such as weight, taste in clothes, or IQ. Herrnstein and Murray note that predictions about any individual based exclusively on the person's IQ are virtually useless. Weak correlations between IQ and job success have predictive value only when they are applied to large groups of people. But within large groups, say Herrnstein and Murray, the pervasive influence of IQ on human society becomes apparent. The authors argued that America is developing a huge underclass of intellectually deprived individuals whose cognitive abilities will never match the future needs of most employers. They believe that this underclass, a large proportion of which is African American, may be doomed by their shortcomings to welfare dependency, poverty, and crime.

Significant criticisms have been leveled at *The Bell Curve*. The average score of African Americans is lower than the average score of Whites on IQ tests. On the average, African American schoolchildren score 10 to 15 points lower on standardized



Cultural Bias and Testing

**culture-fair tests** Intelligence tests that are intended to not be culturally biased.

intelligence tests than White American schoolchildren do (Brody, 2000; Lynn, 1996). These are *average scores*, however. About 15 to 25 percent of African American schoolchildren score higher than half of White schoolchildren do, and many Whites score lower than most African Americans. The reason is that the distribution of scores for African Americans and Whites overlap.

As African Americans have gained social, economic, and educational opportunities, the gap between African Americans and Whites on standardized intelligence tests has begun to narrow (Ogbu & Stern, 2001; Onwuegbuzi & Daley, 2001). This gap especially narrows in college, where African American and White students often experience more similar environments than in the elementary and high school years (Myerson & others, 1998). Also, when children from disadvantaged African American families are adopted into more-advantaged middle-socioeconomic status families, their scores on intelligence tests more closely resemble national averages for middle-socioeconomic status children than for lower-socioeconomic status children (Scarr & Weinberg, 1983).

Furthermore, as we have discussed, many experts raise serious questions about the ability of IQ tests to accurately measure a person's intelligence. One potential influence on intelligence test performance is **stereotype threat**, the anxiety that one's behavior might confirm a negative stereotype about one's group. For example, when African Americans take an intelligence test, they may experience anxiety about confirming the old stereotype that Blacks are "intellectually inferior." In one study, the verbal part of the Graduate Record Exam was given individually to African American and White students at Stanford University (Steele & Aronson, 1995). Half the students of each ethnic group were told that the researchers were interested in assessing their intellectual ability. The other half were told that the researchers were trying to develop a test and that it might not be reliable and valid (therefore, it would not mean anything in relation to their intellectual ability). The White students did equally well on the test in both conditions. However, the African American students did more poorly when they thought the test was assessing their intellectual ability. When they thought the test was just in the development stage and might not be reliable or valid, the African American students performed as well as the White students.

Other studies have confirmed the existence of stereotype threat. African American students do more poorly on standardized tests if they believe they are being evaluated. If they believe the test doesn't count, they perform as well as White students (Aronson, 2002; Aronson & others, 1999; Aronson, Fried, & Good, 2002). However, some critics believe the extent to which stereotype threat explains the testing gap has been exaggerated (Sackett, 2003).

**Gender Comparisons** The average scores of males and females do not differ on intelligence tests, but variability in their scores does differ (Brody, 2000). For example, males are more likely than females to have extremely high or extremely low scores.

There also are gender differences in specific intellectual abilities (Brody, 2000). Males score better than females in some nonverbal areas, such as spatial reasoning, and females score better than males in some verbal areas, such as the ability to find synonyms for words. However, there often is extensive overlap in the scores of females and males in these areas, and there is debate about just how strong the differences are (Brabeck & Shore, 2003; Hyde & Mezulis, 2001).

## Review and Reflect: Learning Goal 2

### 2 Outline key controversies about differences in IQ scores

#### REVIEW

- What evidence suggests that genetics influences IQ scores? What evidence suggests that the environment influences IQ scores?

**stereotype threat** The anxiety that one's behavior might confirm a negative stereotype about one's group.

- What do IQ tests tell us about intelligence among people in different cultures and ethnic groups? What do IQ tests tell us about the intelligence of males and females?

#### REFLECT

- Do you think your performance on standardized tests has provided an accurate reflection of your intelligence?

### 3 THE DEVELOPMENT OF INTELLIGENCE

#### Tests of Infant Intelligence

#### Stability and Change in Intelligence Through Adolescence

#### Intelligence in Adulthood

How can the intelligence of infants be assessed? Is intelligence stable through childhood? Does intelligence decline in older adults and, if so, how much and when? These are some of the questions we will explore as we examine the development of intelligence.

#### Tests of Infant Intelligence

The infant-testing movement grew out of the tradition of IQ testing. However, tests that assess infants are necessarily less verbal than IQ tests for older children. Tests for infants contain far more items related to perceptual-motor development. They also include measures of social interaction.

The most important early contributor to the testing of infants was Arnold Gesell (1934). He developed a measure that helped sort out potentially normal babies from abnormal ones. This was especially useful to adoption agencies, which had large numbers of babies awaiting placement. Gesell's examination was used widely for many years and still is frequently employed by pediatricians to distinguish normal and abnormal infants. The current version of the Gesell test has four categories of behavior: motor, language, adaptive, and personal-social. The **developmental quotient (DQ)** combines subscores in these categories to provide an overall score.

The **Bayley Scales of Infant Development** are widely used in assessing infant development. They have three components: a mental scale, a motor scale, and the infant behavior profile. Initially created by Nancy Bayley (1969), the second edition of the Bayley Scales was recently developed (Black & Matula, 1999). What do they measure? On the Bayley mental scale, for example, the 6-month-old infant should be able to vocalize pleasure and displeasure, persistently search for objects that are just out of immediate reach, and approach a mirror that is placed in front of the infant. By 12 months of age, the infant should be able to inhibit behavior when commanded to do so, imitate words the examiner says (such as *Mama*), and respond to simple requests (such as "Take a drink").

Among the uses of the Bayley scales are the diagnosis of developmental delays and the planning of intervention strategies. The Bayley scales can be used to assess infants from 1 to 42 months of age.

Overall scores on such tests as the Gesell and the Bayley scales do not correlate highly with IQ scores obtained later in childhood. In one study conducted by Nancy Bayley, no relation was found between the Bayley scales and intelligence as measured by the Stanford-Binet at the ages of 6 and 7 (Bayley, 1943). This is not surprising: Remember that the components tested in infancy are not the same as the components tested by IQ tests.



#### Bayley Scales of Infant Development (2nd ed.)

**developmental quotient (DQ)** An overall developmental score that combines subscores on motor, language, adaptive, and personal-social domains in the Gesell assessment of infants.

#### Bayley Scales of Infant Development

Developed by Nancy Bayley, these scales are widely used in assessing infant development. The current version has three parts: a Mental Scale, a Motor Scale, and the Infant Behavior Profile.





Toosje Thyssen Van Beveren, conducting an infant assessment. Van Beveren is a developmental psychologist at the University of Texas Medical Center in Dallas. Her main current work involves a program called “New Connections,” a 12-week program for infants who have been affected by substance abuse prenatally and for their caregivers. Van Beveren conducts assessments of infants’ developmental status and progress, identifying delays and deficits.

The explosion of interest in infant development has produced many new measures, especially tasks that evaluate the ways infants process information (Rose, Feldman, & Wallace, 1992). The Fagan Test of Infant Intelligence is increasingly being used (Fagan, 1992). This test focuses on the infant’s ability to process information in such ways as encoding the attributes of objects, detecting similarities and differences between objects, forming mental representations, and retrieving these representations. For example, it uses the amount of time babies look at a new object compared with the amount of time they spend looking at a familiar object to estimate their intelligence.

The Fagan Test of Infant Intelligence elicits similar performances from infants in different cultures and, unlike the Gesell and Bayley scales, is correlated with measures of intelligence in older children. In fact, evidence is accumulating that measures of habituation and dishabituation predict intelligence in childhood (Bornstein & Sigman, 1986; DiLalla, 2000; Sigman, Cohen, & Beckwith, 2000). Recall from our discussion in chapter 7 that *habituation* is reduced responsiveness to a stimulus after repeated presentations of the stimuli and *dishabituation* is recovery of a habituated response after a change in stimulation ◀ P. 237. Quicker habituation and greater amounts of looking in dishabituation reflect more efficient information processing. When measured in the first six months of infancy, both are related to higher IQ scores on tests given at various times between infancy and adolescence.

### Stability and Change in Intelligence Through Adolescence

One study examined correlations between the IQs of children at a number of different ages (Honzik, MacFarlane, & Allen, 1948). There was a strong relation between IQ scores obtained at the ages of 6, 8, and 9 and IQ scores obtained at the age of 10. For example, the correlation between IQ at the age of 8 and IQ at the age of 10 was .88. The correlation between IQ at the age of 9 and IQ at the age of 10 was .90. These figures show a very high relation between IQ scores obtained in these years. The correlation between IQ in the preadolescent years and IQ at the age of 18 was slightly less but still statistically significant. For example, the correlation between IQ at the age of 10 and IQ at the age of 18 was .70.

What has been said so far about the stability of intelligence has been based on measures of *groups* of individuals. The stability of intelligence also can be evaluated through studies of individuals. Robert McCall and his associates (McCall, Applebaum, & Hogarty, 1973) studied 140 children between the ages of 2½ and 17. They found that the average range of IQ scores was more than 28 points. The scores of one out of three children changed by as much as 40 points.

What can we conclude about the stability and change of intelligence in childhood? Intelligence test scores can fluctuate dramatically across the childhood years. Intelligence is not as stable as the original intelligence theorists envisioned. Children are adaptive beings. They have the capacity for intellectual change but they do not become entirely new intelligent beings. In a sense, children’s intelligence changes but has connections to early points in development.

### Intelligence in Adulthood

Does intelligence increase or decrease in adulthood? Might older adults have greater wisdom than younger adults? These are among the questions that we will explore in this section.

**Fluid and Crystallized Intelligence** John Horn believes that some abilities increase throughout the life span while others steadily decline from middle adulthood



Early Adulthood: Fluid and Crystallized Intelligence

on (Horn & Donaldson, 1980). Horn argues that **crystallized intelligence**, an individual's accumulated information and verbal skills, continues to increase throughout the life span. However, he believes that **fluid intelligence**, the ability to reason abstractly, begins to decline in middle adulthood (see figure 8.7).

Horn's data were collected in a cross-sectional manner. Remember from chapter 1 that a *cross-sectional study* assesses individuals of different ages at the same point in time ◀ P. 37. For example, a cross-sectional study might assess the intelligence of groups of 40-, 50-, and 60-year-olds in one evaluation, such as in 1990. The average 40-year-old and the average 60-year-old were born in different eras, which offered different economic and educational opportunities. For example, as the 60-year-olds grew up they likely had fewer educational opportunities, which probably influenced their scores on intelligence tests. Thus, if we find differences between 40- and 60-year-olds on intelligence tests when they are assessed cross-sectionally, these differences might be due to *cohort effects* (due to an individual's time of birth or generation but not to age) related to educational differences rather than to age.

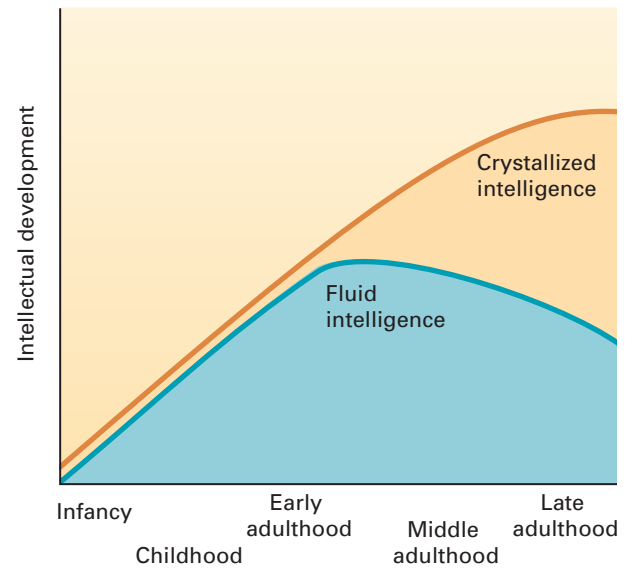
In contrast, in a *longitudinal study*, the same individuals are studied over a period of time. Thus, a longitudinal study of intelligence in middle adulthood might consist of giving the same intelligence test to the same individuals when they are 40, when they are 50, and when they are 60 years of age. Whether data are collected cross-sectionally or longitudinally makes a difference in what is found about intellectual decline.

**The Seattle Longitudinal Study** K. Warner Schaie (1983, 1996, 2000) is conducting an extensive study of intellectual abilities in the adulthood years. Five hundred individuals initially were tested in 1956. New waves of participants are added periodically. The main mental abilities tested in the Seattle Longitudinal Study are:

- *Vocabulary* (ability to understand ideas expressed in words)
- *Verbal memory* (ability to encode and recall meaningful language units, such as a list of words)
- *Number* (ability to perform simple mathematical computations such as addition, subtraction, and multiplication)
- *Spatial orientation* (ability to visualize and mentally rotate stimuli in two- and three-dimensional space)
- *Inductive reasoning* (ability to recognize and understand patterns and relationships in a problem and use this understanding to solve other instances of the problem)
- *Perceptual speed* (ability to quickly and accurately make simple discriminations in visual stimuli)

As shown in figure 8.8, the highest level of functioning for four of the six intellectual abilities occurred in the middle adulthood years (Willis & Schaie, 1999). For both women and men, performance on vocabulary, verbal memory, inductive reasoning, and spatial orientation peaked in middle age. Only two of the six abilities—numerical ability and perceptual speed—declined in middle age. Perceptual speed showed the earliest decline, with this beginning in early adulthood.

When Schaie (1994) assessed intellectual abilities both cross-sectionally and longitudinally, he found decline more likely to occur in the cross-sectional than in the longitudinal assessments. For example, as shown in figure 8.9, when assessed longitudinally, inductive reasoning increased until toward the end of middle adulthood, when it began to show a slight decline. In contrast, when assessed cross-sectionally, inductive reasoning showed a consistent decline in the middle



**FIGURE 8.7 Fluid and Crystallized Intellectual Development Across the Life Span**

According to Horn, crystallized intelligence (based on cumulative learning experiences) increases throughout the life span, but fluid intelligence (the ability to perceive and manipulate information) steadily declines from middle adulthood.

The peaking of some important mental abilities in mental age suggests that substantial improvement in these abilities has occurred since early adulthood.

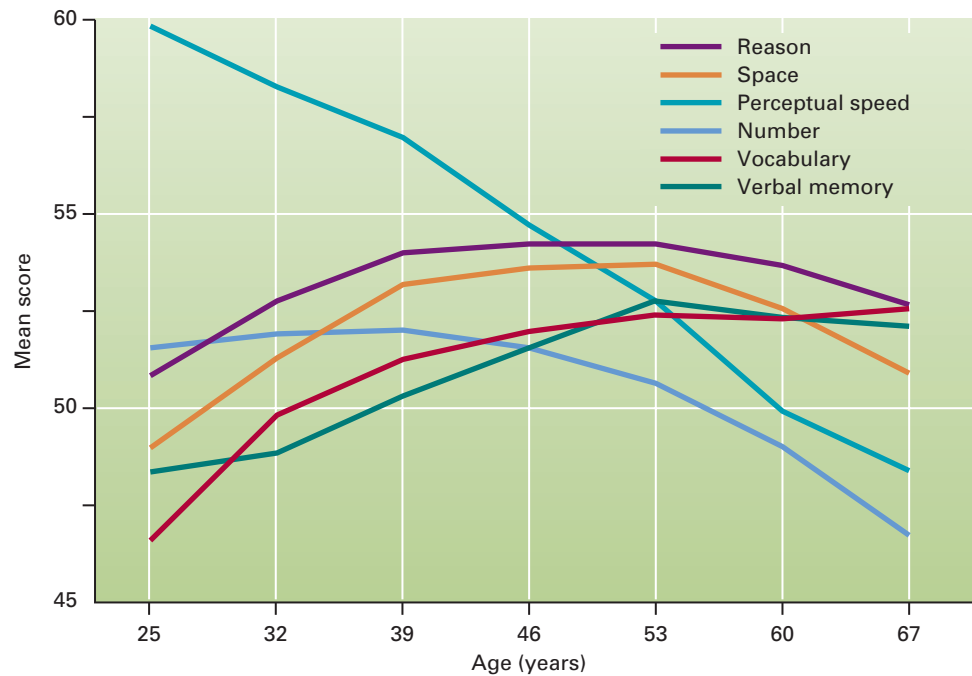
—K. WARNER SCHAIE  
Contemporary Psychologist,  
Pennsylvania State University



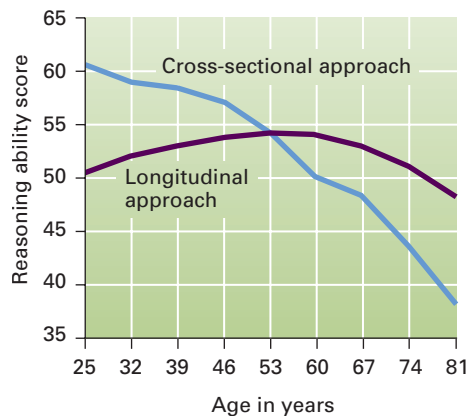
**K. Warner Schaie**  
Midlife Baby-Boomer Characteristics

**crystallized intelligence** Accumulated information and verbal skills, which increase with age, according to Horn.

**fluid intelligence** The ability to reason abstractly, which steadily declines from middle adulthood on, according to Horn.



**FIGURE 8.8** Longitudinal Changes in Six Intellectual Abilities from Age 25 to Age 67



**FIGURE 8.9** Cross-Sectional and Longitudinal Comparisons of Reasoning Ability Across the Adulthood Years

In Schaie’s most recent research, the cross-sectional approach revealed declining scores with age; the longitudinal approach showed a slight rise of scores in middle adulthood and only a slight decline beginning in the early part of late adulthood.

**wisdom** Expert knowledge about the practical aspects of life that permits excellent judgment about important matters.

adulthood years. Interestingly, for the participants in the Seattle Longitudinal Study, middle age was a time of peak performance for both some aspects of crystallized intelligence (vocabulary) and fluid intelligence (spatial orientation and inductive reasoning).

**Wisdom** Some experts believe that an important aspect of intelligence in adulthood is wisdom (Kramer, 2003; Shedlock & Cornelius, 2003). Much of the interest in research on wisdom has been generated by Paul Baltes and his colleagues (Baltes, 1993, 2000; Baltes, Glück, & Kunzmann, 2002; Baltes & Kunzmann, 2003; Baltes, Staudinger, & Lindenberger, 1999; Kunzmann & Baltes, 2003). Does wisdom, like good wine, improve with age? What is this thing we call “wisdom”?

**Wisdom** is expert knowledge about the practical aspects of life that permits excellent judgment about important matters. This practical knowledge involves exceptional insight about human development and life matters, good judgment, and understanding how to cope with difficult life problems. Thus, wisdom, more than standard conceptions of intelligence, focuses on life’s pragmatic concerns and human conditions (Baltes, Staudinger, & Lindenberger, 1999).

In regard to wisdom, research by Baltes and his colleagues (Baltes, Glück, & Kunzmann, 2002; Baltes & Kunzmann, 2003) has found that:

- High levels of wisdom are rare. Few people, including older adults, attain a high level of wisdom (Baltes & Smith, 1990). That only a small percentage of adults show wisdom supports the contention that it requires experience, practice, or complex skills (Kramer, 2003).
- The time frame of late adolescence and early adulthood is the main age window for wisdom to emerge. No further advances in wisdom have been found for middle-aged and older adults beyond the level they attained as young adults.
- Factors other than age are critical for wisdom to develop to a high level. For example, certain life experiences, such as being trained and working in a field concerned with difficult life problems and having wisdom-enhancing mentors, contribute to higher levels of wisdom. Also, people higher in wisdom have

values that are more likely to consider the welfare of others rather than their own happiness.

- Personality-related factors, such as openness to experience, generativity, and creativity, are better predictors of wisdom than cognitive factors such as intelligence.

### Review and Reflect: Learning Goal 3

#### 3 Discuss the development of intelligence across the human life span

##### REVIEW

- How is intelligence assessed during infancy?
- How much does intelligence change through childhood and adolescence?
- To what extent does intelligence change as adults age? What is wisdom and how can it be characterized?

##### REFLECT

- What do you think are the most important cohort effects that can influence the development of intelligence in middle and late adulthood? How are these likely to change in the future?



Older adults might not be as quick with their thoughts or behavior as younger adults, but are they likely to be wiser than younger adults? This elderly woman shares the wisdom of her experiences with a classroom of children.

## 4 THE EXTREMES OF INTELLIGENCE AND CREATIVITY

### Mental Retardation

### Giftedness

### Creativity

Mental retardation and intellectual giftedness are the extremes of intelligence. Often intelligence tests are used to identify exceptional individuals. Let's explore the nature of mental retardation and giftedness. Then we'll explore how creativity differs from intelligence.

### Mental Retardation

The most distinctive feature of mental retardation is inadequate intellectual functioning. Long before formal tests were developed to assess intelligence, individuals with mental retardation were identified by a lack of age-appropriate skills in learning and caring for themselves. Once intelligence tests were developed, they were used to identify degrees of mental retardation. But of two individuals with mental retardation who have the same low IQ, one might be married, employed, and involved in the community and the other require constant supervision in an institution. Such differences in social competence led psychologists to include deficits in adaptive behavior in their definition of mental retardation.

**Mental retardation** is a condition of limited mental ability in which the individual (1) has a low IQ, usually below 70 on a traditional intelligence test; (2) has difficulty adapting to everyday life; and (3) first exhibits these characteristics by age 18. The age limit is included in the definition of mental retardation because, for example, we don't usually think of a college student who suffers massive brain damage in a car accident, resulting in an IQ of 60, as being "mentally retarded." The low IQ and low adaptiveness should be evident in childhood, not after normal functioning is interrupted by damage of some form. About 5 million Americans fit this definition of mental retardation.

There are several ways of classifying degrees of mental retardation (Hallahan & Kaufmann, 2003). Most school systems use the classifications shown in figure 8.10. It uses IQ scores to categorize retardation as mild, moderate, severe, or profound.



Mental Retardation

Type of Mental Retardation	IQ Range	Percentage of Mentally Retarded Individuals
Mild	55 to 70	89
Moderate	40 to 54	6
Severe	25 to 39	4
Profound	Below 25	1

**FIGURE 8.10** Classification of Mental Retardation Based on IQ

**mental retardation** A condition of limited mental ability in which the individual (1) has a low IQ, usually below 70 on a traditional intelligence test; (2) has difficulty adapting to everyday life; and (3) has an onset of these characteristics by age 18.



**FIGURE 8.11** Classification of Mental Retardation Based on Levels of Support Needed

<b>Intermittent</b>	Supports are provided “as needed.” The individual may need episodic or short-term support during life-span transitions (such as job loss or acute medical crisis). Intermittent supports may be low or high intensity when provided.
<b>Limited</b>	Supports are intense and relatively consistent over time. They are time-limited but not intermittent. Require fewer staff members and cost less than more intense supports. These supports likely will be needed for adaptation to the changes involved in the school-to-adult period.
<b>Extensive</b>	Supports are characterized by regular involvement (for example, daily) in at least some setting (such as home or work) and are not time-limited (for example, extended home-living support).
<b>Pervasive</b>	Supports are constant, very intense, and are provided across settings. They may be of a life-sustaining nature. These supports typically involve more staff members and intrusiveness than the other support categories.



A child with Down syndrome. *What causes Down syndrome?*

**gifted** Having high intelligence (an IQ of 130 or higher) or superior talent for something.

Note that a large majority of individuals diagnosed with mental retardation fit into the mild category. However, these categories are not perfect predictors of functioning. The American Association of Mental Retardation (1992) developed a different classification based on the degree of support required for a person with mental retardation to function at the highest level. As shown in figure 8.11, these categories of support are intermittent, limited, extensive, and pervasive.

Some cases of mental retardation have an organic cause. *Organic retardation* is mental retardation caused by a genetic disorder or by brain damage. Down syndrome is one form of organic mental retardation and it occurs when an extra chromosome is present ◀ P. 58. Other causes of organic retardation include fragile X syndrome, an abnormality in the X chromosome that was discussed in chapter 2; prenatal malformation; metabolic disorders; and diseases that affect the brain. Most people who suffer from organic retardation have IQs between 0 and 50.

When no evidence of organic brain damage can be found, cases of mental retardation are labeled *cultural-familial retardation*. Individuals with this type of retardation have IQs between 55 and 70. Psychologists suspect that these mental deficits often result from growing up in a below-average intellectual environment. Children who are familially retarded can be identified in schools, where they often fail, need tangible rewards (candy rather than praise), and are highly sensitive to what others expect of them. However, as adults, the familially retarded are usually invisible, perhaps because adult settings don't tax their cognitive skills as sorely. It may also be that the familially retarded increase their intelligence as they move toward adulthood.

## Giftedness

There have always been people whose abilities and accomplishments outshine others'—the whiz kid in class, the star athlete, the natural musician. People who are **gifted** have high intelligence (an IQ of 130 or higher) or superior talent for something. Programs for the gifted in most school systems select children who have intellectual superiority and academic aptitude. They tend to overlook children who are talented in the arts or athletics or who have other special aptitudes (Olszewski-Kublius, 2003).

Until recently, giftedness and emotional distress were thought to go hand in hand. English novelist Virginia Woolf, Sir Isaac Newton, Vincent van Gogh, Ann Sexton, Socrates, and Sylvia Plath all had emotional problems. However, these individuals are the exception rather than the rule. In general, no relation between giftedness and mental disorder has been found. Recent studies support the conclusion that gifted people tend to be more mature and have fewer emotional problems than others, and to grow up in a positive family climate (Feldhusen, 1999; Feldman, 1997).

**Characteristics of Children Who Are Gifted** What about children who are gifted? Aside from their abilities, do they have distinctive characteristics? Lewis Terman (1925) conducted an extensive study of 1,500 children whose Stanford-Binet IQs averaged 150. Contrary to the popular myth that children who are gifted are maladjusted, Terman found that they were socially well adjusted.

Ellen Winner (1996) described three criteria that characterize gifted children, whether in art, music, or academic domains:

1. *Precocity.* Gifted children are precocious. They begin to master an area earlier than their peers. Learning in their domain is more effortless for them than for ordinary children. In most instances, these gifted children are precocious because they have an inborn high ability.
2. *Marching to their own drummer.* Gifted children learn in a qualitatively different way than ordinary children. For one thing, they need minimal help from adults to learn. In many cases, they resist explicit instruction. They also often make discoveries on their own and solve problems in unique ways.
3. *A passion to master.* Gifted children are driven to understand the domain in which they have high ability. They display an intense, obsessive interest and an ability to focus. They do not need to be pushed by their parents. They motivate themselves, says Winner.

**Life Course of the Gifted** As a 10-year-old, Alexandra Nechita was described as a child prodigy. She paints quickly and impulsively on large canvases, some as large as 5 feet by 9 feet. It is not unusual for her to complete several of these large paintings in a week's time. Her paintings sell for up to \$80,000 apiece. When she was only 2 years of age, Alexandra colored in coloring books for hours. She had no interest in dolls or friends. Once she started school, she would start painting as soon as she got home. And she continues to paint—relentlessly and passionately. It is, she says, what she loves to do.

Is giftedness, like Alexandria Nechita's artistic talent, a product of heredity or environment? Likely both. Individuals who are gifted recall that they had signs of high ability in a particular area at a very young age, prior to or at the beginning of formal training (Howe & others, 1995). This suggests the importance of innate ability in giftedness. However, researchers also have found that individuals with world-class status in the arts, mathematics, science, and sports all report strong family support and years of training and practice (Bloom, 1985). Deliberate practice is an important characteristic of individuals who become experts in a particular domain. For example, in one study, the best musicians engaged in twice as much deliberate practice over their lives as the least successful ones did (Ericsson, Krampe, & Tesch, 1993).

Do gifted children become gifted and highly creative adults? In Terman's research on children with superior IQs, the children typically became experts in a well-established domain, such as medicine, law, or business. However, they did not become major creators (Winner, 2000). That is, they did not create a new domain or revolutionize an old domain.

One reason that some gifted children do not become gifted adults is that they have been pushed too hard by overzealous parents and teachers. As a result, they lose their intrinsic (internal) motivation (Winner, 1996). As adolescents, they may ask themselves, "Who am I doing this for?" If the answer is not for one's self, they may not want to do it anymore.

## Creativity

We brought up the term "creative" on several occasions in our discussion of giftedness. What does it mean to be creative? **Creativity** is the ability to think about something in novel and unusual ways and come up with unique solutions to problems.



Art prodigy Alexandra Nechita. What are some characteristics of gifted children?



Children Who Are Gifted  
National Association of Gifted Children

**creativity** The ability to think in novel and unusual ways and come up with unique solutions to problems.

Intelligence and creativity are not the same thing (Lubart, 2003; Sternberg, 2002). Most creative people are quite intelligent, but the reverse is not necessarily true. Many highly intelligent people (as measured by high scores on conventional tests of intelligence) are not very creative (Sternberg & O'Hara, 2000). Many highly intelligent people produce large numbers of products but they are not necessarily novel.

Why don't IQ scores predict creativity? Creativity requires divergent thinking (Guilford, 1967). **Divergent thinking** produces many answers to the same question. In contrast, conventional intelligence tests require **convergent thinking**. For example, a typical item on a conventional intelligence test is, "How many quarters will you get in return for 60 dimes?" There is only one correct answer to this question. In contrast, a question such as, "What image comes to mind when you hear the phrase 'sitting alone in a dark room?'" has many possible answers; it calls for divergent thinking.

**Steps in the Creative Process** The creative process has often been described as a five-step sequence:

1. *Preparation.* You become immersed in a problem or an issue that interests you and arouses your curiosity.
2. *Incubation.* You churn ideas around in your head. This is the point at which you are likely to make some unusual connections in your thinking.
3. *Insight.* You experience the "Aha!" moment when all pieces of the puzzle seem to fit together.
4. *Evaluation.* Now you must decide whether the idea is valuable and worth pursuing. Is the idea really novel or is it obvious?
5. *Elaboration.* This final step often covers the longest span of time and the hardest work. This is what the famous twentieth-century American inventor Thomas Edison was talking about when he said that creativity is 1 percent inspiration and 99 percent perspiration. Elaboration may require a great deal of perspiration.

Mihaly Csikszentmihalyi (pronounced ME-high CHICK-sent-me-high-ee) (1996) believes that this five-step sequence provides a helpful framework for thinking about how creative ideas are developed. However, he argues that creative people don't always go through the steps in a linear sequence. For example, elaboration is often interrupted by periods of incubation. Fresh insights may appear during incubation, evaluation, and elaboration. And insight might take years or only a few hours. Sometimes the creative idea consists of one deep insight. Other times it's a series of small ones.

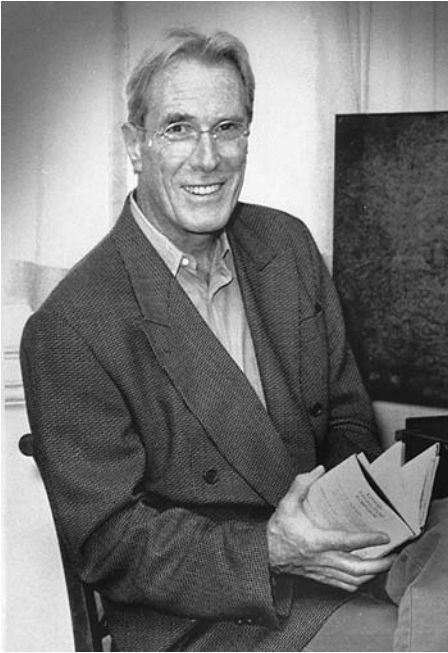
**Characteristics of Creative Thinkers** Creative thinkers tend to have these characteristics (Perkins, 1994):

- *Flexibility and playful thinking.* Creative thinkers are flexible and play with problems, which gives rise to a paradox. Although creativity takes hard work, the work goes more smoothly if you take it lightly. In a way, humor greases the wheels of creativity (Goleman, Kaufmann, & Ray, 1993). When you are joking around, you are more likely to consider any possibility. Having fun helps to disarm your inner censor, which can condemn your ideas as off-base. *Brainstorming* is a technique in which members of a group are encouraged to come up with as many ideas as possible, play off each other's ideas, and say practically whatever comes to mind. Individuals usually are told to avoid criticizing others' ideas until the end of the brainstorming session.
- *Inner motivation.* Creative people often are motivated by the joy of creating. They tend to be less inspired by grades, money, or favorable feedback from others. Thus, creative people are motivated more internally than externally (Runco, 2004).

**divergent thinking** Thinking that produces many answers to the same question; characteristic of creativity.

**convergent thinking** Thinking that produces one correct answer; characteristic of the kind of thinking required on conventional intelligence tests.

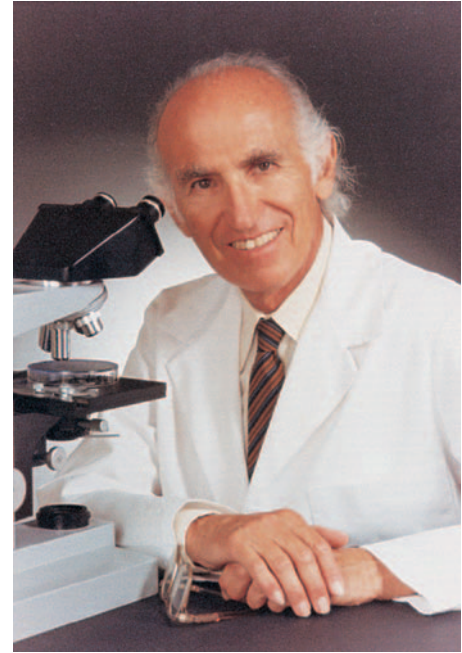




Mark Strand, former U.S. poet laureate, says that in his most creative moments he loses a sense of time and becomes absorbed in what he is doing. In this state, he feels he is dismantling meaning and remaking it. Strand comments that he can't stay in this absorbed frame of mind for an entire day. It comes and goes: His attention coils and uncoils; his focus sharpens and softens. When an idea clicks, he focuses intensely, transforming the idea into a vivid verbal image that will communicate its essence to the reader.



Nina Holton, a leading contemporary sculptor, turns playfully wild germs of ideas into stunning sculptures. She says that sculpture is a combination of wonderful, unique ideas and a lot of hard work. She comments that when she is introduced to people they often say, "It must be so exciting and wonderful being a sculptor." Holton loves her work but says that most people see only its creative side, not the hard work.



Jonas Salk, who invented the polio vaccine, says his best ideas come to him when he suddenly wakes up. After a few minutes of visualizing problems he had thought about the day before, he begins to see an unfolding, as if a painting or story is taking form. Salk also believes that many creative ideas are generated in conversations with others who have open, curious minds and positive attitudes. Salk's penchant for seeing emergent possibilities often brought him in conflict with people who had orthodox opinions.

- *Willingness to risk.* Creative people make more mistakes than their less imaginative counterparts. It's not that they are less proficient, but that they come up with more ideas, more possibilities (Lubart, 2003). They win some, they lose some. For example, the twentieth-century Spanish artist Pablo Picasso created more than 20,000 paintings. Not all of them were masterpieces. Creative thinkers learn to cope with unsuccessful projects and see failure as an opportunity to learn.
- *Objective evaluation of work.* Contrary to the stereotype that creative people are eccentric and highly subjective, most creative thinkers strive to evaluate their work objectively. They may use established criteria to make this judgment or rely on the judgments of people they respect. In this manner, they can determine whether further creative thinking will improve their work.

**Changes During Adulthood** At the age of 30, Thomas Edison invented the phonograph, Hans Christian Andersen wrote his first volume of fairy tales, and Mozart composed *The Marriage of Figaro*. One early study of creativity found that individuals' most creative products were generated in their thirties and that 80 percent of the most important creative contributions were completed by age 50 (Lehman, 1960). More recently, researchers have found that creativity often peaks in the forties before declining (Simonton, 1996). However, any generalization about a relationship between age and creative accomplishments must be qualified





Leading creativity theorist Mihaly Csikszentmihalyi, in the setting where he gets his most creative ideas.

**A** genuinely creative accomplishment is almost never the result of a sudden insight, a lightbulb flashing in the dark, but comes after years of hard work.

—MIHALY CSIKSZENTMIHALYI  
*Contemporary Psychologist,*  
*University of Chicago*

by consideration of (1) the size of the decline and (2) differences across domains (Simonton, 1996).

Even though a decline in creative contributions is often found in the fifties and later, the decline is often not great. An impressive array of creative accomplishments have occurred in late adulthood (Tahir & Gruber, 2003). Benjamin Franklin invented the bifocal lens when he was 78 years old; Goethe completed *Faust* when he was in his eighties. After a distinguished career as a physicist, Henri Chevreul switched fields in his nineties to become a pioneer in gerontological research. He published his last research paper just a year prior to his death at the age of 103!

Furthermore, the age at which creativity typically declines varies with the domain involved. In philosophy and history, for example, older adults often show as much creativity as when they were in their thirties and forties. In contrast, in lyric poetry, abstract mathematics, and theoretical physics, the peak of creativity is often reached in the twenties or thirties.

**Living a More Creative Life** Csikszentmihalyi (1996) interviewed 90 leading figures in art, business, government, education, and science to learn how creativity works. He discovered that creative people regularly engage in challenges that absorb them. Based on his interviews with some of the most creative people in the world, he concluded that the first step toward a more creative life is to cultivate your curiosity and interest. Here are his recommendations for doing this:

- *Try to be surprised by something every day.* Maybe it is something you see, hear, or read about. Become absorbed in a lecture or a book. Be open to what the world is telling you. Life is a stream of experiences. Swim widely and deeply in it, and your life will be richer.
- *Try to surprise at least one person every day.* In a lot of things you do, you have to be predictable and patterned. Do something different for a change. Ask a question you normally would not ask. Invite someone to go to a show or a museum you never have visited.
- *Write down each day what surprised you and how you surprised others.* Most creative people keep a diary, notes, or lab records to ensure that their experience is not forgotten. Start with a specific task. Each evening record the most surprising event that occurred that day and your most surprising action. After a few days, reread your notes and reflect on your experiences. After a few weeks, you might see a pattern emerging, one that suggests an area you can explore in greater depth.
- *When something sparks your interest, follow it.* Usually when something captures your attention, it is short-lived—an idea, a song, a flower. Too often we are too busy to explore the idea, song, or flower further. Or we think these areas are none of our business because we are not experts about them. Yet the world is our business. We can't know which part of it is best suited to our interests until we make a serious effort to learn as much about as many aspects of it as possible.
- *Wake up in the morning with a specific goal to look forward to.* Creative people wake up eager to start the day. Why? Not necessarily because they are cheerful, enthusiastic types but because they know that there is something meaningful to accomplish each day, and they can't wait to get started.
- *Take charge of your schedule.* Figure out which time of the day is your most creative time. Some of us are more creative late at night, others early in the morning. Carve out some time for yourself when your creative energy is at its best.
- *Spend time in settings that stimulate your creativity.* In Csikszentmihalyi's (1996) research, he gave people an electronic pager and beeped them randomly at different times of the day. When he asked them how they felt, they reported the highest levels of creativity when walking, driving, or swimming. "I do my most creative thinking when I'm jogging." These activities are semiautomatic in that

they take a certain amount of attention while leaving some time free to make connections among ideas. Another setting in which highly creative people report coming up with novel ideas is the half-asleep, half-awake state we are in when we are deeply relaxed or barely awake.

## Review and Reflect: Learning Goal 4

### 4 Describe the characteristics of mental retardation, giftedness, and creativity

#### REVIEW

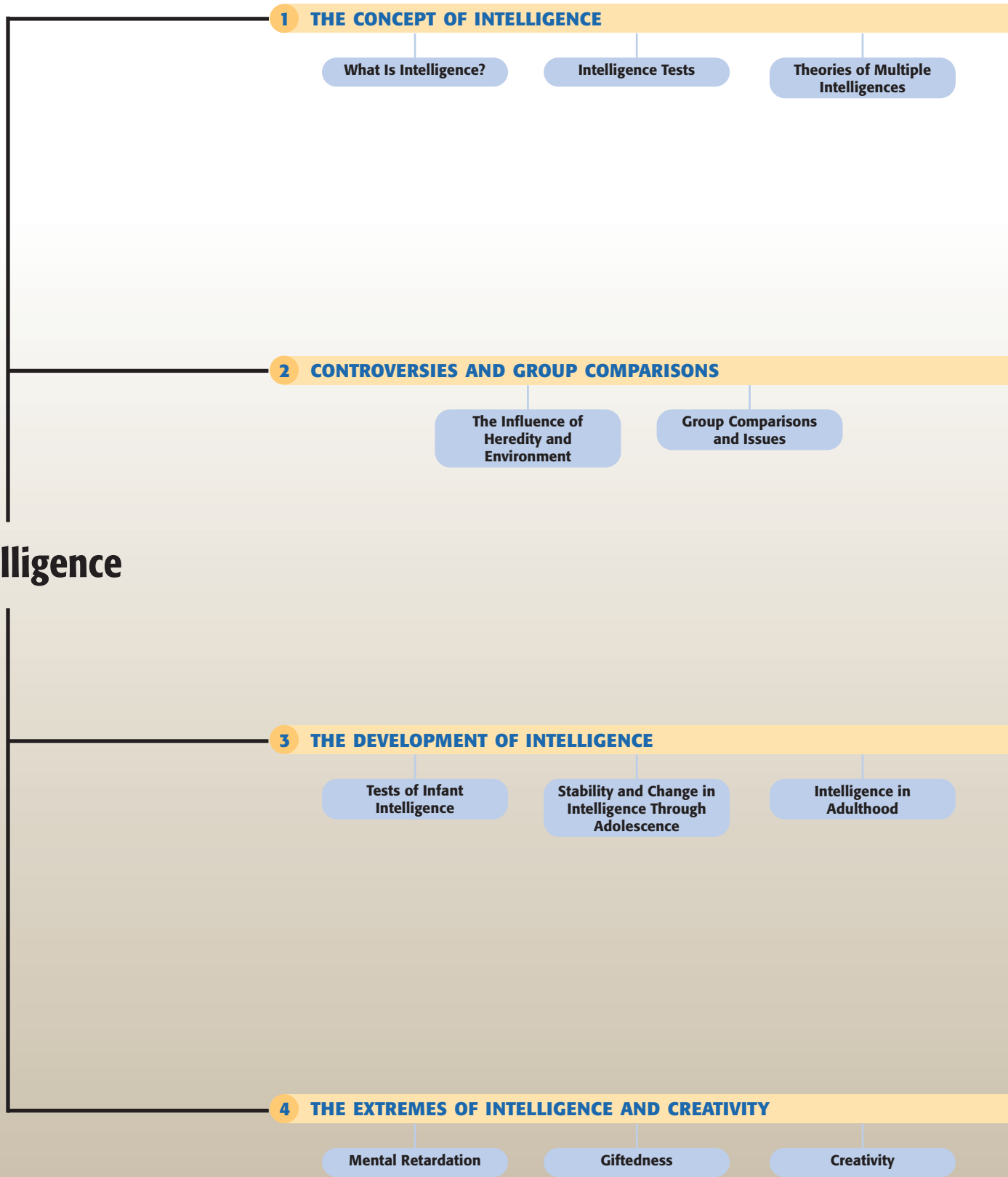
- What is mental retardation and what are its causes?
- What makes people gifted?
- What makes people creative?

#### REFLECT

- How many of the tips in the section on “Living a More Creative Life” do you practice? How might you benefit from these suggestions, in addition to becoming more creative?

# Reach Your Learning Goals

## Intelligence



## Summary

### 1 Explain the nature of intelligence

- Intelligence consists of the ability to solve problems and to adapt and learn from everyday experiences. A key aspect of intelligence focuses on its individual variations. Traditionally, intelligence has been measured by tests designed to compare people's performance on cognitive tasks.
- Sir Frances Galton is the father of mental tests. Alfred Binet developed the first intelligence test and created the concept of mental age. William Stern developed the concept of IQ for use with the Binet test. Revisions of the Binet test are called the Stanford-Binet. The test scores on the Stanford-Binet approximate a normal distribution. The Wechsler scales, created by David Wechsler, are the other main intelligence assessment tool. These tests provide an overall IQ, verbal and performance IQs, and information about 11 subtests. Group intelligence tests are convenient and economical, but they do not allow an examiner to monitor the testing closely. When used by a judicious examiner, tests can be valuable tools for determining individual differences in intelligence. Test scores should be only one type of information used to evaluate an individual. IQ scores can produce unfortunate stereotypes and expectations. Ability tests can help divide children into homogeneous groups but periodic testing should be done to ensure that the groupings are appropriate.
- Factor analysis is a statistical procedure that compares various items or measures and identifies underlying factors that are correlated with each other. Spearman (two-factor theory of  $g$  and  $s$ ) and Thurstone (multiple-factor theory) used factor analysis in developing their views of intelligence. Gardner believes there are eight types of intelligence: verbal skills, mathematical skills, spatial skills, bodily-kinesthetic skills, musical skills, interpersonal skills, intrapersonal skills, and naturalist skills. Sternberg's triarchic theory states that there are three main types of intelligence: analytical, creative, and practical. Sternberg created the Sternberg Triarchic Abilities Test to assess these three types of intelligence and has described applications of triarchic theory to children's education. Emotional intelligence is the ability to perceive and express emotion accurately and adaptively, to understand emotion and emotional knowledge, to use feelings to facilitate thought, and to manage emotions in oneself and others. The multiple intelligences approaches have broadened the definition of intelligence and motivated educators to develop programs that instruct students in different domains. Critics maintain that the multiple intelligence theories include factors that really aren't part of intelligence, such as musical skills and creativity. Critics also say that there isn't enough research to support the concept of multiple intelligences.

### 2 Outline key controversies about differences in IQ scores

- Genetic similarity might explain why identical twins show stronger correlations on intelligence tests than fraternal

twins do. Some studies indicate that the IQs of adopted children are more similar to the IQs of their biological parents than to those of their adoptive parents. Many studies show that intelligence has a reasonably strong heritability component. Criticisms of the heritability concept have been made. Intelligence test scores have risen considerably around the world in recent decades—called the Flynn effect—and this supports the role of environment in intelligence. Researchers have found that how much parents talk with their children in the first three years of life is correlated with the children's IQs and that being deprived of formal education lowers IQ scores. Ramey's research revealed the positive effects of educational child care on intelligence.

- Cultures vary in the way they define intelligence. Early intelligence tests favored White, middle-socioeconomic status urban individuals. Tests may be biased against certain groups because they are not familiar with a standard form of English, with the content tested, or with the testing situation. Tests are likely to reflect the values and experience of the dominant culture. In the United States, children from African American and Latino families score below children from White families on standardized intelligence tests. Males are more likely than females to have extremely high or extremely low IQ scores. There also are gender differences in specific intellectual abilities.

### 3 Discuss the development of intelligence across the human life span

- Tests designed to assess infant intelligence include the widely used Bayley scales and a test developed by Gesell was an important early contributor to the developmental testing of infants. The Fagan Test of Infant Intelligence, which assesses how effectively infants process information, is increasingly being used. Infant information-processing tasks that involve attention—especially habituation and dishabituation—are related to standardized scores of intelligence in childhood.
- Although intelligence is more stable across the childhood and adolescent years than are many other attributes, many children's and adolescents' scores on intelligence tests fluctuate considerably.
- Horn argued that crystallized intelligence continues to increase in middle adulthood, while fluid intelligence declines. Schaie found that when assessed longitudinally, intellectual abilities are less likely to decline and more likely to even improve than when assessed cross-sectionally in middle adulthood. The highest level of four intellectual abilities (vocabulary, verbal memory, inductive reasoning, and spatial ability) occur in middle adulthood. Wisdom is expert knowledge about the practical aspects of life that permits excellent judgment about important matters. Baltes and his colleagues have found that high levels of wisdom are rare, the time frame of late adolescence and early adulthood is the main window for the wisdom to emerge, factors other than age



are critical for wisdom to develop, and personality-related factors are better predictors of wisdom than cognitive factors such as intelligence.

#### 4 Discuss the characteristics of mental retardation, giftedness, and creativity

- Mental retardation is a condition of limited mental ability in which the individual (1) has a low IQ, usually below 70; (2) has difficulty adapting to everyday life; and (3) has an onset of these characteristics by age 18. Most affected individuals have an IQ in the 55 to 70 range (mild retardation). Mental retardation can have an organic cause (called organic retardation) or be social and cultural in origin if there is no evidence of organic brain damage (called cultural-familial retardation).
- People who are gifted have high intelligence (an IQ of 130 or higher) or superior talent for something. Three characteristics of gifted children are precocity, marching to their own drum-

mer, and a passion to master in their domain. Giftedness is likely a consequence of both heredity and environment.

- Creativity is the ability to think about something in novel and unusual ways and come up with unique solutions to problems. Although most creative people are intelligent, individuals with high IQs are not necessarily creative. Creative people tend to be divergent thinkers; traditional intelligence tests measure convergent thinking. Creativity has often been described as occurring in a five-step process: preparation, incubation, insight, evaluation, and elaboration. Characteristics of creative thinkers include flexibility and playful thinking, inner motivation, a willingness to take risks, and interest in objective evaluation. Creativity often peaks in the forties and then declines, but the decline may be slight and the peak age varies across domains. Csikszentmihalyi believes that cultivating curiosity and interest is the first step toward a more creative life.

### Key Terms

intelligence 270  
 mental age (MA) 271  
 intelligence quotient (IQ) 271  
 normal distribution 272  
 two-factor theory 274  
 factor analysis 274  
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## E-Learning Tools

Connect to [www.mhhe.com/santrockltd2](http://www.mhhe.com/santrockltd2) to research the answers and complete these exercises. In addition, you'll find a number of other resources and valuable study tools for chapter 8, "Intelligence," on the Student CD-ROM that came with this book.

### **Taking It to the Net**

1. Penny teaches fifth grade in a school that has received a grant to pilot a Creative Classrooms Project. The principal has asked Penny to create one month of lesson plans utilizing the project's model of creative teaching. What are some main aspects of teaching with this method?
2. Crystal, age 25, is having a discussion with her 60-year-old grandmother, Jean, about which of them would make the better contestant on *Jeopardy!* and *Who Wants to Be a Millionaire*. Crystal says that she would naturally be a better contestant because she is quicker to understand the question and come up with an answer. Jean counters that she might be slower, but she knows more of the answers. Who is right?

3. Juan and Carmen's 7-year-old gifted son, Nicholas, is in a school without a gifted program, but one where teachers try to create challenging learning situations within the normal classroom. Nicholas' teacher wants to meet with Juan and Carmen to discuss Nicholas' classroom behavior problems. What types of behavioral challenges do gifted children present in the classroom?

### **Self-Assessment**

To evaluate yourself on various aspects of intelligence and creativity, complete these self-assessments:

- *Evaluating Myself on Gardner's Eight Types of Intelligence*
- *How Emotionally Intelligent Am I?*
- *Examining My Creative Thinking*

### **Health and Well-Being, Parenting, and Education**

Build your decision-making skills by trying your hand at the health and well-being, parenting, and education "Scenarios."