Key Question Chapter Outline

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- Standardization and Norms
- Types of Tests
- Ethics and Standards in Testing

How Is Intelligence Measured?

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CORE CONCEPTS

Measuring individual differences is an essential component of psychology, but strict guidelines and ethical standards must be followed to ensure that results and conclusions are valid and appropriate.

Intelligence testing has a history of controversy, but most psychologists now view intelligence as a normally distributed trait that can be measured by performance on a variety of tasks—both verbal and nonverbal.

Some psychologists believe that the essence of intelligence is a single, general factor, while others believe that intelligence is best described as a collection of distinct abilities.

While most psychologists agree that both heredity and environment affect intelligence, they disagree on the source of IQ differences among racial and social groups.

Psychology in Your Life

Testing in Education

"Tracking" and "mainstreaming" are two very different approaches to high school education.

What Can You Do for an Exceptional Child?

In both mental retardation and giftedness, children should be encouraged to capitalize on their abilities.

Test Scorers and the Self-Fulfilling Prophecy

An IQ score can create expectations that have a life of their own.

Helping Others Think Critically about Group Differences

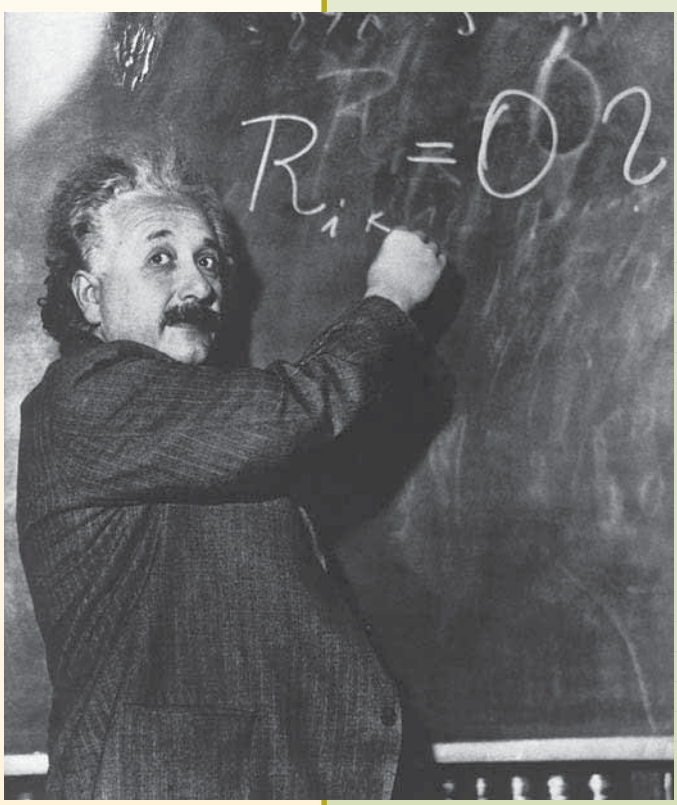
There are many reasons why the heritability of intelligence doesn't mean that group differences are genetic.

USING PSYCHOLOGY TO LEARN PSYCHOLOGY:
Developing Expertise in Psychology—or Any Other Subject

Chapter

11

Testing and Individual Differences



AL WAS A STUDENT who enjoyed mathematics and the violin. At the age of 16 he took and failed an entrance exam for a prestigious university, which prevented him from studying to become an electrical engineer, his lifelong goal. Following this setback, he enrolled at a less renowned college and, at the age of 21, graduated as a teacher of math and physics.

Al applied for a teaching job at a college but was rejected. He even asked some well-connected friends to try and help him secure a position, all to no avail. For over a year he wrote to different colleges seeking a teaching job, but he eventually gave up his ambition to teach college math. Taking a low-level government job while working on furthering his education part-time, he eventually earned a doctoral degree. While in his government post, he continued to write and study and began publishing a number of papers in scientific journals.

A few years later he earned a position at a university, and he excelled there. From Al's early history, it would be impossible to tell that the little boy who failed his first college entrance exam would persevere and go on to become one of the most influential thinkers of the 20th century, and arguably one of the most well known—Albert Einstein.

What does this story tell us about testing and individual differences? Clearly, one thing it tells us is that testing can be flawed. There are some psychologists, known as psychometricians, who study testing and measurement to help improve these systems of assessment. What happened to Einstein was most likely an error in

determining and measuring individual differences. The entrance exam that Albert took was designed to measure a student's ability to succeed in an academic setting and to determine the differences among students. This leads to the first key question of the present chapter.

HOW DO WE MEASURE INDIVIDUAL DIFFERENCES?

As you can see from what happened to Einstein, testing can be used ineffectively and inappropriately. Testing can also serve useful and valuable purposes. The essential aspect of testing in psychology is best evaluated by looking at our core concept for this section:

Measuring individual differences is an essential component of psychology, but strict guidelines and ethical standards must be followed to ensure results and conclusions are valid and appropriate.

Validity and Reliability

When psychologists measure or test individual differences or aptitudes, psychologists use two methods to determine whether the results have significance. They assess the validity and reliability of the tests used to make these measurements. **Validity** is the term we use when asking whether the test actually measures what it purports to measure. For example, if you were to take a psychology test on which all the questions were related to chemistry, it would have a very low validity score. Psychologists also look at **reliability,** which reflects whether a test yields the same results over time. If you were to take a test twice and get 70% right the first time and 30% right the second time, that test would be revealed to have very low reliability.

Psychologists have developed a number of ways to test for both validity and for reliability. When we look at validity, we first examine what is called **face validity.** That is, does it appear, "on the face of it," that the test tests what it is supposed to test? If your test were written in a language you did not understand, it would have no face validity. The second type of validity we look at is called **content validity.** In this type of validity, each item is representative of the larger body of knowledge about a subject. Consider, for example, the AP Psychology Exam. It does not test everything in psychology but, rather, has questions that are representative of the knowledge that constitutes mastery of the subject. This type of validity is measured by a methodology called **item analysis.** In item analysis, each question is specifically examined to see how it is related back to the learning objectives being tested. Another form of validity is **criterion validity.** In tests with this form of validity, performance on the test is measured against a performance goal. In other words, in order to get a particular score, you have to meet a certain criterion, or level of proficiency. A simple way to think about criterion validity is to associate it with an achievement test (which measures knowledge) rather than an aptitude test (which ostensibly measures native abilities).

Next we look at reliability, the second measure of a good test. In essence, reliability means consistency. The important thing here is to ensure that on a particular test, a test taker would get about the same score each time he or she takes it. There are a number of ways to determine whether a test is reliable. Perhaps the most basic type of reliability is **test–retest reliability.** In this

- **Validity** A property exhibited by a test that measures what it purports to measure.
- **Reliability** A property exhibited by a test that yields the same results over time.
- **Face validity** Measures whether a test looks like it tests what it is supposed to test.
- **Content validity** A property exhibited by a test in which each item is representative of the larger body of knowledge about the subject that the test covers.
- **Item analysis** The process of examining each question on a test to see how it is related to the objectives being tested.
- **Criterion validity** A property exhibited by a test that accurately measures performance of the test taker against a specific learning goal.
- **Test–retest reliability** A property exhibited by a test on which people get about the same scores when they take the test more than once.

method, we simply give the test again to check and see whether people get the same score when they retake the test. Of course, you can only take your AP exam once, so we need alternative methods to test for reliability. The methodology used most in this situation is called **split-half reliability.** To apply the split-half method, you would take a test, split it into two parts, and compare the scores that an individual got on the two halves. For example, the AP Psychology Exam has 100 questions. To measure reliability, you would take the score someone had on the odd-numbered questions and compare it to the score the same person earned on the even-numbered questions. If the scores were the same (or very similar), the test would have a high degree of reliability.

Standardization and Norms

Now that we have established both validity and reliability, we need to see how a test can be used to compare individuals. The way we do that is to look at standardization and norms. You have heard the term *standardized test.* What does that mean? In the most basic sense, it means (1) that the administration and scoring guidelines are the same for each student and (2) that the results of the test can be used to draw conclusions about the test takers in regard to the objectives of the test.

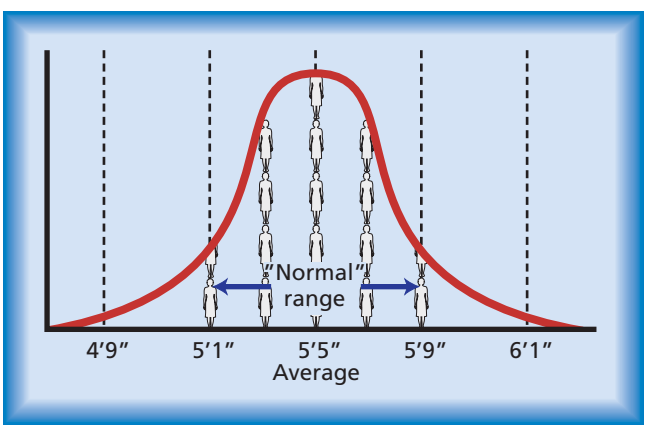
One of the main questions that arises here is "How can results between test takers be compared?" Well, to answer that, we need to discuss norms and norm setting. The method used most frequently to establish norms relies on the statistics we discussed in Chapter 2. We use statistics to establish what is called a normal curve, or bell curve. This standard curve can be used to describe most phenomena. In our examples we will use women's height and, later in the chapter, intelligence quotient (IQ). If you sample enough women, you will find that the majority of women (roughly 67%) fall within a range of 5 feet 1 inch to 5 feet 9 inches tall, with an average height of 5 feet 5 inches. As you move further away from the average, there are fewer and fewer people. For example there are many women who are 5 feet 5 inches, but very few who are 6 feet 4 inches. (See Figure 11.1.)

When the normal curve is applied to testing, in order to establish norms (and the curve) a test must be pretested and then the scores plotted. When a statistically significant sample of the population has been tested, you can feel confident in drawing conclusions. The most readily available example of this is in IQ scores.

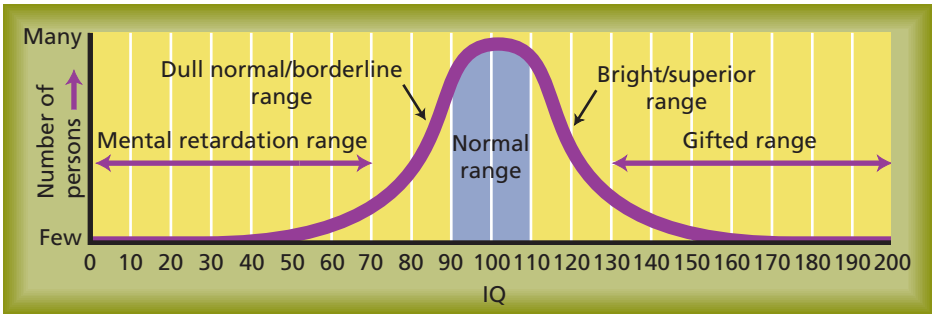
■ **Split-half reliability** A measure of reliability in which a test is split into two parts and an individual's scores on both halves are compared.

■ **Normal range** Scores falling near the middle of a normal distribution.

Applying this same concept to intelligence, psychologists find that people's IQ test scores (like the women's heights we considered above) fit a normal distribution. (See Figure 11.2.) More precisely, when IQ tests are given to large numbers of individuals, the scores of those at each age level are normally distributed. (Adults are placed in their own group, regardless of age, and the distribution of their scores also fits the bell-shaped curve.) Instead of using the old IQ formula, IQs are now determined from tables that indicate where test scores fall on the normal curve. The scores are statistically adjusted so that the average for each age group is set at 100. Scores near the middle of the distribution (usually between 90 and 110) are considered to be in the **normal range** (see Figure 11.2). At the extreme ends of the distribution, scores below 70 are often said to be in the *mentally retarded range,* and those above 130 are sometimes said to indicate *giftedness.*



● **FIGURE 11.1** An (Imaginary) Normal Distribution of Women's Heights



● **FIGURE 11.2** The Normal Distribution of IQ Scores Among a Large Sample
(*Source:* from WESCHLER'S MEASUREMENT AND APPRAISAL OF ADULT INTELLIGENCE, 5th ed., by Joseph D. Matarazzo. Copyright © 1972 by Oxford University Press. Reprinted by permission of Oxford University Press, Inc.)

Thus IQ scores are no longer calculated by dividing mental age by chronological age. The concept of a "ratio" expressed as a multiple of 100 (a percentage-like number that is easy to understand) is retained, however. This solves the problem of calculating adult IQs by comparing adults with adults.

Types of Tests

When we look at assessment in general, aside from intelligence testing, we find two general types of tests: objective tests and subjective tests. **Objective tests** are generally multiple-choice/selected-response tests that can be scored easily by machine. The Minnesota Multiphasic Personality Inventory (MMPI) and the Myers Briggs Type Indicator (MBTI) are good examples of objective tests. These tests can be easily scored and the results presented and interpreted quite quickly. The second type of test is called a **subjective test,** in which individuals are given an ambiguous figure and asked to describe what they see, or are given an open-ended situation and asked to finish a story about it. Examples of subjective tests include the Thematic Apperception Test (TAT) developed by David McClelland and the Rorschach Inkblot test. In these tests individuals are either shown a picture and asked to describe/write down what is taking place (TAT), or shown an inkblot and asked to tell the examiner what they see. In the case of the Rorschach, how the subjects pick up, hold, and look at the card, and how long it takes them to make a response, are also considered.

One of the issues that arises with subjective tests is **inter-rater reliability,** a measure of how similarly two different test scorers would score the test. Some studies of the Rorschach suggest that its inter-rater reliability is very low, while others dispute this claim.

Ethics and Standards in Testing

There are other very important and fundamental questions related to testing. These concern the confidentiality of the information elicited on tests and of test results, how to report the results, how to use the tests to compare individuals, and the impact of tests on society as a whole.

Let's begin by examining what to do with the results of a test. In most cases, such as in IQ testing, individual results are never released. Individual results are reported to test developers and scorers to ensure that IQ scales remain constant, but the only data that are released are group data, and, except for a confidential report of his or her own scores supplied to each test taker, the individual test taker's scores cannot be identified.

However, simply sending results back to the test taker without describing or explaining their significance or relevance should be avoided. For example, if you were told that you earned a 48 on your latest psychology test, what would that mean to you? Is that a raw score of 48? What was the mean? Was

■ **Objective tests** Tests that can be scored easily by machine, such as multiple-choice tests and selected-response tests.
■ **Subjective tests** Tests in which individuals are given an ambiguous figure or an open-ended situation and asked to describe what they see or finish a story.
■ **Inter-rater reliability** A measure of how similarly two different test scorers would score a test.

it the high score? Was it the low one? All of those questions are very important when trying to measure your actual performance.

In addition, for a test to be useful, it needs to be interpreted properly. As you will see when we discuss *The Bell Curve* later in this chapter, sometimes tests and their results can be interpreted improperly and/or inaccurately. Aside from the negative impact on the individual test takers, tests used improperly can affect how people look at, value, and relate to others in a larger context. This social impact has to be considered very carefully. In fact, a great deal of IQ testing, as well as the SAT II and AP exams have been scrutinized to control for culture bias or anything else that may skew the results of a test.

What does this have to do with ethics and standards in testing? In all testing, results need to be properly and appropriately reported and interpreted to test takers and also to other interested parties (such as colleges, as in the case of the AP Psychology Exam). Ethics in a testing situation refers not only to how tests are administered (the standards component) but also to how they are used and by whom. And abuses *have* occurred. In the early 20th century, for example, the eugenics movement misused and misinterpreted test results.

PSYCHOLOGY IN YOUR LIFE: TESTING IN EDUCATION

Years ago, testing used to be used in order to not only assess students, but to track them into educational programs which were designed to fit their educational needs and potential. Over time, it has been argued that "tracking" or placing students in classes based on their assessed ability is not necessarily the best way to approach education. Over the last few years, a movement toward inclusion has taken hold. While inclusion has been used mostly in the special education community to ensure that students with special needs can spend as much time in "mainstreamed" classes as possible, the idea of an inclusive classroom has been expanded to, in some cases, do away with honors-level classes. The logic behind this effort is as follows: If all classes incorporate all students, those at the top of the performance curve will be able to assist and help students at the lower ends.

Think about how this would (or does) affect your education? Would you be better off in a class having all levels of students or one which is solely geared for AP/College-Bound, high-achieving students? What role does or should testing play in this debate?

CHECK YOUR UNDERSTANDING

1. **APPLICATION:** When we check to see whether a test will yield the same results over time, we are assessing its
   - **a.** reliability.
   - **b.** validity.
   - **c.** normality.
   - **d.** objectivity.
   - **e.** subjectivity.

2. **APPLICATION:** The Thematic Apperception Test is a(n) _____ test?
   - **a.** short-answer
   - **b.** essay
   - **c.** multiple-choice
   - **d.** objective
   - **e.** subjective

3. **UNDERSTANDING THE CORE CONCEPT:** All of the following are components of ethical testing *except*
   - **a.** item analysis.
   - **b.** validity.
   - **c.** reliability.
   - **d.** objectivity.
   - **e.** instinct.

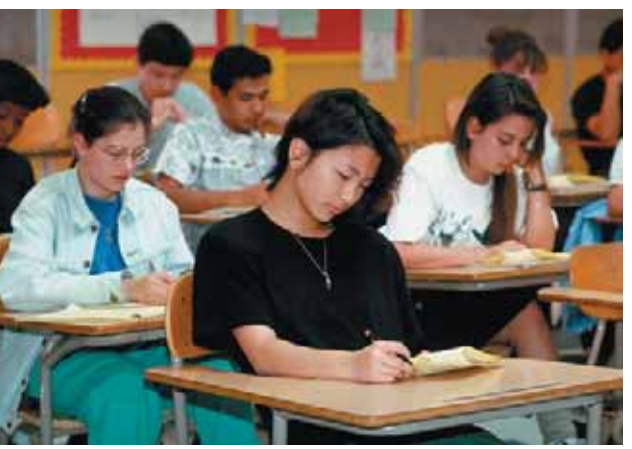
ANSWERS: 1. a 2. e 3. e

KEY QUESTION

HOW IS INTELLIGENCE MEASURED?

Psychologists have long been fascinated by the ways people differ in their abilities to reason, solve problems, and think creatively. The assessment of individual differences, however, did not begin with modern psychology. Historical records show that sophisticated mental testing methods were used in ancient China. Over 4000 years ago, the Chinese employed a program of civil service testing that required government officials to demonstrate their competence every third year at an oral examination. Later, applicants were required to pass written civil service tests to assess their knowledge of law, the military, agriculture, and geography. British diplomats and missionaries assigned to China in the early 1800s described the selection procedures so admiringly that the British, and later the Americans, adopted modified versions of China's system for the selection of civil service personnel (Wiggins, 1973).

Unlike the historical Chinese, however, modern Americans seem to be more interested in how "smart" people are, than in how much they have learned. It is the interest in this sort of "native intelligence" that spurred the development of intelligence testing as we know it today. But despite the long history of mental testing and the widespread use of intelligence tests in our society, the exact meaning of the term *intelligence* is still disputed (Neisser et al., 1996). Most psychologists would probably agree with the general definition that we gave earlier—that intelligence involves abilities to acquire knowledge, reason, and solve problems. They would also agree that a complete picture of an individual's intelligence must be obtained from measurements across a variety of tasks. However, they disagree on exactly what these abilities are or whether they are many or few in number.



Even though the SAT tests are far from perfect predictors of college success, they are widely used. Many items on the SAT are similar to those found on intelligence tests.

Everyone does agree that intelligence is relative. That is, an individual's level of intelligence is defined in relation to the same abilities in a comparison group, usually of the same age range. Everyone also agrees that intelligence is a *hypothetical construct:* a characteristic that is not directly observable, but is, instead, inferred from behavior. In practice, this means that intelligence is measured from an individual's responses on an intelligence test. The individual's scores are then compared to those of a reference group. Exactly what these tests should assess is the source of much controversy—and the focus of this section of this chapter. Our Core Concept says:

CORE CONCEPT

Intelligence testing has a history of controversy, but most psychologists now view intelligence as a normally distributed trait that can be measured by performance on a variety of tasks—both verbal and nonverbal.

We begin our survey of intelligence and intelligence testing by introducing you to the people who founded the field of intelligence testing.

Binet and Simon Invent a School Abilities Test

Alfred Binet (*Bi-NAY*) and his colleague Théodore Simon stepped into history in 1904. At that time, a new law required all French children to attend school, and the government needed a means of identifying those who needed remedial help. Binet and Simon were asked to design a test for this purpose. They responded with 30 problems sampling a variety of abilities that seemed necessary for school (Figure 11.3). The new approach was a success. It did, indeed, predict which children could, or could not, handle normal schoolwork.

Four important features distinguish the Binet-Simon approach (Binet, 1911):

1. Binet and Simon interpreted scores on their test as an estimate of *current performance,* not as a measure of innate intelligence.
2. They wanted the test scores to be used to identify children who needed special help, not merely to categorize or label them as bright or dull.
3. They emphasized that training and opportunity could affect intelligence, and they wanted to identify areas of performance in which special education could help the children identified by their test.
4. They constructed the test *empirically*—based on how children were observed to perform—rather than tying the test to a particular theory of intelligence.

On the original Binet-Simon test, a child was asked to perform tasks such as the following:

- Name various common objects (such as a clock or a cat) shown in pictures.
- Repeat a 15-word sentence given by the examiner.
- Give a word that rhymes with one given by the examiner.
- Imitate gestures (such as pointing to an object).
- Comply with simple commands (such as moving a block from one location to another).
- Explain the differences between two common objects.
- Use three words (given by the examiner) in a sentence.
- Define abstract terms (such as *friendship*).

● **FIGURE 11.3** Sample Items from the First Binet-Simon Test

French children of various ages were assessed with this test, and the average for children at each age was computed. Then each child's performance was compared to the averages for children of various ages. Scores were expressed in terms of **mental age (MA):** the average age at which individuals achieve a particular score. So, for example, when a child's score was the same as the average score for a group of 5-year-olds, the child was said to have a mental age of 5, regardless of his or her actual **chronological age (CA),** the number of years since the individual's birth. Binet and Simon decided that those most needing remedial help were students whose MA was two years behind CA.

American Psychologists Borrow Binet and Simon's Idea

Less than a decade after the French began testing their school children, American psychologists imported the Binet-Simon test of school abilities and changed it into the form we now call the *IQ test.* They did this by first modifying the scoring procedure, expanding the test's content, and obtaining scores from a large normative group of people, including adults. Soon "intelligence testing" was widely accepted as a technique by which Americans were defining themselves—and each other.

The Appeal of Intelligence Testing in America Why did tests of intelligence become so popular in the United States? Three forces that were changing the face of the country early in the 20th century conspired to make intelligence testing seem like an orderly way out of growing turmoil and uncertainty. First, the United States was experiencing an unprecedented wave of immigration, resulting from global economic, social, and political crises. Second, new laws requiring universal education—schooling for all children—were flooding schools with students. And third, when World War I began, the military needed a way of assessing and classifying the new recruits. Together, these events resulted in a need for large numbers of people to be identified, documented, and classified (Chapman, 1988). Assessment of intelligence was seen not only as a way to bring some order to the tumult of rapid social change, but also as an inexpensive and democratic way to separate those who could benefit from education or military leadership training from those who could not.

One consequence of the large-scale group-testing program in America was that the public came to accept the idea that intelligence tests could accurately differentiate people in terms of their mental abilities. This acceptance soon led

■ **Mental age (MA)** The average age at which normal (average) individuals achieve a particular score.

■ **Chronological age (CA)** The number of years since the individual's birth.

to the widespread use of tests in schools and industry. Another, more unfortunate consequence was that the tests were used to reinforce prevailing prejudices. Specifically, Army reports suggested that differences in test scores were linked to race and country of origin (Yerkes, 1921). Of course, the same statistics could have been used to demonstrate that environmental disadvantages limit the full development of people's intellectual abilities. Instead, immigrants with limited facility in English or even little understanding of how to take such tests were labeled "morons," "idiots," and "imbeciles" (terms used at the time to specify different degrees of mental retardation).

While these problems are more obvious to us now (with the help of hindsight), at the time they were obscured by the fact that the tests did what most people wanted: They were simple to administer, and they provided a means of assessing and classifying people according to their scores. Never mind that there were some built-in biases and that some people were treated unfairly. In general, the public perceived the tests as objective and democratic.

The Stanford-Binet Intelligence Scale The most respected of the new American tests of intelligence was developed by Stanford University professor Lewis Terman. His approach was to adapt the Binet and Simon test for U.S. schoolchildren by standardizing its administration and its age-level norms. The result was the Stanford-Binet Intelligence Scale (Terman, 1916), which soon became the standard by which other measures of intelligence were judged. Because it had to be administered individually, Terman's test was less economical than the group tests. Nevertheless, it was better suited for spotting learning problems. Even more important, the Stanford-Binet test was designed both for children and adults.

With his new test Terman introduced the concept of the **intelligence quotient (IQ),** a term coined originally by German psychologist William Stern in 1914. The IQ was the ratio of mental age (MA) to chronological age (CA), multiplied by 100 (to eliminate decimals):

$$\text{IQ} = \frac{\text{Mental Age}}{\text{Chronological Age}} \times 100$$

Please follow us through the IQ equation with these examples: Consider a child with a chronological age of 8 years whose test scores reveal a mental age of 10. Dividing the child's mental age by chronological age (MA/CA = 10/8) gives 1.25. Multiplying that result by 100, we obtain an IQ of 125. In contrast, another 8-year-old child who performs at the level of an average 6-year-old (MA = 6) has an IQ of $6/8 \times 100 = 75$, according to Terman's formula. Those whose mental age is the same as their chronological age have IQs of 100, which is considered to be the average or "normal" IQ.

Within a short time, the new Stanford-Binet test became a popular instrument in clinical psychology, psychiatry, and educational counseling. With the publication of this test, Terman also promoted his belief that intelligence is largely innate and that his IQ test could measure it precisely. The implicit message was that an IQ score reflected something fundamental and unchanging about people.

Although the Stanford-Binet became the "gold standard" of intelligence testing, it had its critics. The loudest objection was that it employed an inconsistent concept of intelligence because it measured different mental abilities at different ages. For example, 2- to 4-year-olds were tested on their ability to manipulate objects, whereas adults were tested almost exclusively on verbal items. Test makers heeded these criticisms, and as the scientific understanding of intelligence increased, psychologists found it increasingly important to measure multiple intellectual abilities at all age levels. A modern revision of

Intelligence quotient (IQ)
A numerical score on an intelligence test, originally computed by dividing the person's mental age by chronological age and multiplying by 100.

the Stanford-Binet now provides separate scores for several mental skills (Vernon, 1987).

● A psychologist administers an intelligence test to a 4-year-old child. The performance part of this test includes a block design task, an object completion task, and a shape identification task.

IQ Testing Today

The success of the Stanford-Binet test encouraged the development of other IQ tests. As a result, psychologists now have a wide choice of instruments for measuring intelligence. The most prominent of these alternatives are the Wechsler Adult Intelligence Scale (WAIS), the Wechsler Intelligence Scale for Children (WISC), and the Wechsler Preschool and Primary Scale of Intelligence (WPPSI). With these instruments, psychologist David Wechsler offers a family of tests that measure many skills that are presumed to be components of intelligence, including vocabulary, verbal comprehension, arithmetic ability, similarities (the ability to state how two things are alike), digit span (repeating a series of digits after the examiner), and block design (the ability to reproduce designs by fitting together blocks with colored sides). As our Core Concept noted, these tests measure intelligence by assessing performance on a variety of tasks.

Like the Stanford-Binet, the Wechsler tests are *individual* tests. That is, they are given to one person at a time. Also available are *group* tests of intelligence that can be administered to large numbers of students simultaneously. Unlike the Stanford-Binet and the Wechsler tests, these group tests are primarily paper-and-pencil measures, involving booklets of questions and computer-scorable answer sheets. The convenience of group tests—even though they are not as precise as individual tests—has made IQ testing, along with other forms of academic assessment, widespread. It is quite likely that you took such tests several times as you went through grades 1 through 8, perhaps without realizing what they were. The items in the "Do It Yourself!" box are similar to items in many commonly used group tests of mental abilities.

DO IT YOURSELF! Sample IQ Test Items

Try your hand at the following items adapted from group tests of intelligence. Some of the items are more challenging than others. You will find the correct answers at the end.

VOCABULARY: Select the best definition for each word:

1. **viable**
   a. traveled b. capable of living
   c. V-shaped d. can be bent
2. **imminent**
   a. defenseless b. expensive
   c. impending d. notorious

ANALOGIES: Examine the relationship between the first two words. Then, find an answer that has the same relationship with the word in **bold letters:**

3. Washington: Lincoln
   July: a. January b. April
   c. May d. October
4. ocean: canoe
   verse: a. poem b. pen
   c. water d. serve

SIMILARITIES: Which letter on the right belongs to the same category as the one on the left?

5. **J** A M S Z T
6. **A** S D U V X

SEQUENCES: Choose the answer that best completes the sequence:

7. a z b y c x d? e s u w f
8. 1 3 6 10 15? 16 18 21 27 128

MATHEMATICAL REASONING

9. Portland and Seattle are actually 150 miles apart, but on a map they are two inches apart. If Chicago and Norfolk are five inches apart on the same map, what is the actual distance between those two cities?
   a. 125 miles b. 250 miles
   c. 375 miles d. 525 miles

ANSWERS: 1. **b** 2. **c** 3. **d** (October comes after July) 4. **d** (*verse* and *serve* have the same letters) 5. S (the only one with a curve in it) 6. U (the only vowel) 7. W 8. 21 9. **c**

Problems with the IQ Formula

A problem in calculating IQ scores became apparent as soon as psychologists began to use their formula with adults. Here's what happens: By the mid- to late teenage years, gains in mental age scores usually level off, as people develop mentally in many different directions. Consequently, mental growth, as measured by a test, appears to slow down. So Terman's formula for computing IQs makes normal children appear to become mentally retarded adults—at least as far as their test scores are concerned! Note what happens to the average 30-year-old's score if mental age, as measured by a test, stays at the same level as it was at age 15:

$$IQ = \frac{\text{Mental Age}}{\text{Chronological Age}} = \frac{15}{30} \times 100 = 50$$

Psychologists quickly realized that this paints an erroneous picture of adult mental abilities. People do not grow less intelligent as they become adults (even though their children sometimes think so). Rather, adults develop in different directions, which their IQ scores do not necessarily reflect. Prudently, psychologists decided to abandon the original IQ formula and to find another means of calculating IQs. Their solution was similar to the familiar practice of "grading on the curve."

PSYCHOLOGY IN YOUR LIFE: WHAT CAN YOU DO FOR AN EXCEPTIONAL CHILD?

■ **Mental retardation** Often conceived as representing the lower 2% of the IQ range, commencing about 30 points below average (below about 70 points). More sophisticated definitions also take into account an individual's level of social functioning and other abilities.

■ **Giftedness** Often conceived as representing the upper 2% of the IQ range, commencing about 30 points above average (at about 130 IQ points).

As we have noted, mental retardation and giftedness lie at the opposite ends of the intelligence spectrum. As traditionally conceived, **mental retardation** occupies the IQ range below IQ 70—taking in the scores achieved by approximately 2% of the population (see Figure 11.2). Arbitrarily, **giftedness** begins 30 points above average, at 130 IQ points, comprising another 2% of the population. Now, bearing in mind all we have learned about the limitations of IQ tests, let's take a brief look at these two categories.

Mental Retardation

The current view of mental retardation deemphasizes IQ scores by focusing on practical abilities to get along in the world (Baumeister, 1987; Detterman, 1999; Greenspan, 1999; Robinson et al., 2000). In fact, the American Association of Mental Retardation now offers a definition of mental retardation that does not even mention an IQ cutoff score. According to this new perspective, mental retardation involves "significantly subaverage intellectual functioning" that becomes apparent before age 18. It also involves limitations in at least two of the following areas: "communication, self-care, home living, social skills, community use, self-direction, health and safety, functional academics, leisure and work" (Turkington, 1993, p. 26).

Causes of Mental Retardation

Mental retardation has many causes (Daily et al., 2000; Scott & Carran, 1987). Some are known to be genetic because we can point to a specific genetically controlled defect. This is the case, as we have noted, in people who have Down syndrome. Some causes are environmental, as in fetal alcohol syndrome, which involves brain damage incurred before birth, resulting from the mother's abuse of alcohol during pregnancy. Other environmental causes include postnatal accidents that damage the cognitive regions of the brain. Still other causes involve conditions of deprivation or neglect, which fail to give the developing child the experiences needed for advancement up the intellectual ladder. Some cases have no known cause.

CONNECTION: CHAPTER 1

Down syndrome produces both physical symptoms and mental retardation; it arises from a chromosomal defect.

Dealing with Mental Retardation We have no cures, although research has found some preventive measures for certain types of mental retardation. For example, a simple test performed routinely on newborn babies can identify a hidden genetic disorder known as PKU. If detected early, the mental retardation usually associated with PKU can be prevented by a special diet. More generally, genetic counseling, pregnancy care services, and education of new parents are other preventive strategies (Scott & Carran, 1987).

Aside from prevention, special education programs can help those who develop mental retardation to learn vocational and independent living skills. Meanwhile, biological scientists hope that one day they will be able to treat genetically based forms of mental retardation with therapies that are just now being conceived. Genetic treatment may involve splicing a healthy gene into a benign virus that would "infect" all of a retarded person's cells and replace the defective gene. At present, genetic therapy is being tried experimentally for the treatment of certain physical diseases, but it is at least a few years away in the treatment of mental retardation.

For now, what can you do if you have a mentally retarded child? Dealing with mental retardation usually means making the best of a difficult situation. Parents of a retarded child should realize that, because the nervous system is so immature at birth and because so much physical and mental development occurs during the first years of life, interventions that begin early will have the greatest payoffs. Realistically, however, the most intellectual improvement one can expect from an optimal educational program is an IQ gain of about 15 points (Robinson et al., 2000).

Psychological approaches that involve sensory stimulation and social interaction can be enormously important. In fact, an enriched environment may be just as helpful to a mentally retarded child as it is to a gifted child. Teams of special education teachers, speech therapists, educational psychologists, physicians, and other specialists can devise programs that enable mentally retarded persons to capitalize on the abilities they have, rather than being held prisoner of their disabilities (see Schroeder et al., 1987). Behavior modification programs have been especially successful. As a result, many retarded citizens have learned to care for themselves and have learned vocational skills that enable them to live independently (Landesman & Butterfield, 1987).

The Special Olympics offers mentally retarded children (and others with disabilities) an opportunity to capitalize on their abilities and to build self-esteem.

CONNECTION: CHAPTER 13

Behavior modification therapies are based on behavioral learning principles derived from operant and classical conditioning.

Giftedness At the other end of the intelligence spectrum we find the "gifted," with their especially high IQs, typically defined as being in the top 1 or 2% (Robinson et al., 2000). But, you might wonder, what do such people eventually do with their superior intellectual abilities? Does a high IQ give its owner an advantage in life? A long look at gifted individuals suggests that it does.

Terman's Studies of Giftedness The most extensive project ever undertaken to study gifted individuals began in 1921 under the direction of Lewis Terman, the same person who brought Binet and Simon's IQ test to the United States (Leslie, 2000). From a large pool of children tested in the California schools, Terman selected 1528 children who scored near the top of the IQ range. His longitudinal research program followed these children as they went through school and on into adulthood. Periodically through their lives, Terman retested them and gathered other information on their achievements and adjustment patterns. The resulting decades of data have taught us much about the nature of giftedness. Almost uniformly, Terman's gifted children excelled in school—as one might expect from the strong correlation between IQ and academic achievement. Terman also remarked on the good health and

happiness of the children in his sample, although newer evidence suggests that highly gifted children are susceptible to certain physical and psychological disorders (Winner, 2000).

As they moved into adulthood, the gifted group continued on the path of success. An unusually high number of scientists, writers, and professionals emerged from its ranks. Together they published more than 2000 scientific articles, patented 235 inventions, and wrote 92 books. By middle age, more than 86% of the men in Terman's sample had entered high-status professions (Terman & Oden, 1959).

Yet, for all their achievements, no one in this high-IQ sample achieved the level of an Einstein, a Picasso, or a Martha Graham. Nor did a high IQ turn out to be a guarantee of wealth or stature. In fact, many from Terman's sample led ordinary, undistinguished lives. The ones who were most visibly successful seemed to have, in addition to their high IQs, extraordinary motivation and someone at home or at school who was especially encouraging to them (Goleman, 1980; Oden, 1968). You will remember that we previously found these same characteristics to be markers of "genius."

Dealing with Giftedness Imagine that you are the parent of a child with a very high IQ score, say 145. Which one of the following would be the best course of action?

- Enroll your child in special after-school classes.
- Hire a tutor to help the child with his or her homework.
- Send the child to a private school.
- Do nothing special.

What do the experts say?

Don't rush out to enroll your child in special classes or provide other "help" because of his or her IQ score (Csikszentmihalyi et al., 1993; Wong & Csikszentmihalyi, 1991). Parents can destroy the spark of curiosity by pushing a child toward goals that do not hold the child's interest. Chances are you have already provided an environment in which your child's native ability could thrive. So do not make any rash and radical changes.

Above all, avoid making the child feel like a freak because of his or her unusual abilities and high IQ score. In part because of the personality traits common in gifted children—especially a tendency to spend time alone, working on their interests—they are more likely than other children to suffer social and emotional disorders (Winner, 2000). Nor should you feel smug about your genetic contribution to your child's intellect. Remember that IQ tests sample only a small fraction of human abilities. Other people's kids may have equally amazing abilities in untested regions of their intellects. In fact, many gifted individuals may go unrecognized by the schools because they have an outstanding talent that shows up primarily in art or music—domains in which formal abilities testing is rarely done.

Remember, also, that a high IQ is no guarantee of high motivation, high creativity, or success in life. All it guarantees is an intellectual opportunity. So, what should you do with a bright child? Nothing special that you would not have done before you knew the IQ score.

CHECK YOUR UNDERSTANDING

1. **RECALL:** One of Binet's great ideas was that of mental age, which was defined as
   - **a.** the average age at which people achieve a particular score on an intelligence test.
   - **b.** an individual's biological age plus the score he or she achieves on a mental test.
   - **c.** an individual's level of emotional maturity, as judged by the examiner.
   - **d.** the variability in scores seen when an individual is tested repeatedly.
   - **e.** a means of measuring performance on a test against a specific learning goal.

2. **APPLICATION:** You have tested a 12-year-old child and found that she has a mental age of 15. Using the original IQ formula, what is her IQ?
   - **a.** 50
   - **b.** 75
   - **c.** 100
   - **d.** 115
   - **e.** 125

3. **RECALL:** A problem with the original IQ formula is that it gave a distorted picture of the intellectual abilities of
   - **a.** adults.
   - **b.** children.
   - **c.** retarded persons.
   - **d.** gifted students.
   - **e.** the elderly.

4. **UNDERSTANDING THE CORE CONCEPT:** If intelligence is a normally distributed characteristic, then you would expect to find it
   - **a.** to be different abilities in different people.
   - **b.** to be spread throughout the population, but with most people clustered near the middle of the range.
   - **c.** to a significant degree only in people whose IQ scores are above 100.
   - **d.** to be determined entirely by hereditary factors.
   - **e.** to be determined entirely by environmental factors.

ANSWERS: 1. a 2. e 3. a 4. b

WHAT ARE THE COMPONENTS OF INTELLIGENCE?

KEY QUESTION

People who show aptitude in one area—language, for example—often score high on tests of other domains, such as mathematics or spatial relationships. This fact argues for the idea of a single, general intellectual ability. But there are some glaring exceptions. Persons with **savant syndrome** represent the most extreme exceptions of this sort. These rare individuals have a remarkable-but-limited talent, such as the ability to multiply numbers quickly in their heads or to determine the day of the week for any given date, even though they are mentally slow in other ways (Treffert & Wallace, 2002). Typically, they also show symptoms of autism (Winner, 2000), as you may remember from Dustin Hoffman's portrayal of one such person in the film *Rainman.* Such cases raise a serious question about the whole concept of a single, general intelligence factor. Obviously, there is no simple solution to the problem of one or many intelligences. Different psychologists have dealt with the issue in different ways, as our Core Concept suggests:

CORE CONCEPT

Some psychologists believe that the essence of intelligence is a single, general factor, while others believe that intelligence is best described as a collection of distinct abilities.

We will first examine this issue from the viewpoint of psychologists in the *psychometric tradition:* those who have been interested in developing tests to measure mental abilities. Following that excursion, we will look at intelligence from the standpoint of cognitive psychologists who have recently brought a fresh perspective to the problem.

Psychometric Theories of Intelligence

Psychometrics is the field of "mental measurements." It is the psychological specialty that has given us most of our IQ tests, along with achievement tests,

■ **Savant syndrome** Found in individuals who have a remarkable talent (such as the ability to determine the day of the week for any given date) even though they are mentally slow in other domains.

CONNECTION: CHAPTER 1

Psychologists in the specialty of psychometrics often subscribe to the *trait perspective.*

personality tests, the SAT, and a variety of other assessment instruments. Many pioneers in psychology carved their professional niches with contributions to psychometrics, including Alfred Binet and Lewis Terman. Yet another famous figure in this field was Charles Spearman, a psychologist who is best known for his work suggesting that intelligence is a single factor.

Spearman's *g* Factor By the 1920s, there were many tests of intelligence available, and British psychologist Charles Spearman was able to show that individuals' scores on different tests, involving problems of many kinds, are often highly correlated (1927). This, he said, points to a single, common factor of *general intelligence* underlying performance across all intellectual domains. Spearman did not deny that some people have outstanding talents or deficits in certain areas. But, he said, these individual differences should not blind us to a single general intelligence factor at work behind all our mental activity. Spearman called this general intellectual ability the ***g* factor.** He assumed that this general factor is innate, and most psychologists at the time agreed with him (Tyler, 1988, p. 128).

Recently, neuroscientists have found some support for Spearman's theory. John Duncan and his colleagues (2000) have shown that various tests of *g* all involve a portion of the brain's frontal lobes. This suggests, they say, a single brain mechanism that controls various forms of intelligent behavior. Could this site be the locus of *g*? Although Duncan and his group think so, others believe this explanation oversimplifies both the nature of intelligence and that of the brain (McArdle et al., 2002; Sternberg, 1999, 2000b).

Cattell's Fluid and Crystallized Intelligence Using sophisticated mathematical techniques, Raymond Cattell (1963) determined that general intelligence can be broken down into two relatively independent components that he called *crystallized* and *fluid intelligence.* **Crystallized intelligence** consists of the knowledge a person has acquired, plus the ability to access that knowledge. Thus, crystallized intelligence reflects the person's ability to store and retrieve information from semantic memory. It is measured by tests of vocabulary, arithmetic, and general information. In contrast, **fluid intelligence** is the ability to see complex relationships and solve problems—abilities that involve using algorithms and heuristics, which we discussed earlier in this chapter. Fluid intelligence is often measured by tests of block design and spatial visualization, tests that do not rely on the individual possessing certain "crystallized" background information in order to solve a problem. For Cattell, both types of intelligence were essential to adaptive living.

CONNECTION: CHAPTER 7

Much of our general knowledge is stored in *semantic memory,* a partition of long-term memory.

Cognitive Theories of Intelligence

Late in the 20th century, when the cognitive view emerged as a major force in psychology, it produced some radical new ideas about intelligence. In brief, the cognitive view of intelligence went well beyond the emphasis on vocabulary, logic, problem solving, and other skills that had been measured to predict school success (see Table 11.1). *Intelligence,* said cognitive psychologists, involves cognitive processes that contribute to success in many areas of life—not just school (Sternberg, 2000b). We will focus on two of these cognitive theories.

Sternberg's Triarchic Theory You may know someone who seems to have plenty of "book smarts" but who has never been very successful in life. Such people often don't know how to "read" others or to deal with unexpected events. Psychologist Robert Sternberg says that they lack **practical intelligence:** the ability to cope with the people and events in their environment. Practical intelligence is sometimes called "street smarts," although it applies just as well

- ***g* factor** A general ability, proposed by Spearman as the main factor underlying all intelligent mental activity.
- **Crystallized intelligence** The knowledge a person has acquired, plus the ability to access that knowledge.
- **Fluid intelligence** The ability to see complex relationships and solve problems.
- **Practical intelligence** According to Sternberg, the ability to cope with the environment; sometimes called "street smarts."

TABLE 11.1 Theories of Intelligence Compared

Spearman	Cattell	Sternberg	Gardner
	Crystallized intelligence		
"g" factor	Fluid intelligence	Analytical intelligence	Naturalistic intelligence Logical-mathematical intelligence
		Creative intelligence	Linguistic intelligence Spatial intelligence Musical intelligence Bodily-kinesthetic intelligence
		Practical intelligence	Interpersonal intelligence Intrapersonal intelligence
			Spiritual intelligence Existential intelligence

Note: Different theorists see intelligence as having different components, as shown in the columns of this table. The rows show roughly comparable components of intelligence described by various theories (although the reader should be aware that the correspondences are not exact). For example, Sternberg's *practical intelligence* is similar to Gardner's two components called *interpersonal intelligence* and *intrapersonal intelligence,* while Spearman's *g* ignores these abilities.

at home, on the job, or at school as it does on the street. One study suggests that it can also be thought of as "horse sense": Researchers found that, among regular visitors to racetracks, those who were most successful at picking winning horses had IQs no higher than those who were less successful. This suggests that this very practical ability to pick winners is something different from the form of intelligence measured on standard IQ tests (Ceci & Liker, 1986).

In contrast with practical intelligence, Sternberg refers to the ability measured by most IQ tests as **analytical intelligence** (also called *logical reasoning*). It includes the ability to analyze problems and find correct answers. Your grades in college are likely to be closely related to your logical reasoning abilities.

Creative intelligence, a third form of intelligence described by Sternberg's theory, helps people develop new ideas and see new relationships among concepts. Creative intelligence is what Picasso used to develop the new form of painting called *cubism.* It is also the form of intelligence that Sternberg used to develop his new theory of intelligence.

This formulation is often called the **triarchic theory** because it combines three (*tri* = three) intelligences. For Sternberg each one in this trio of abilities—practical intelligence, analytical intelligence, and creative intelligence—is relatively independent of the others. That is, a person's ability in one of the three areas doesn't necessarily predict his or her intelligence in the other two. Each represents a different dimension for describing and evaluating human performance. This theory reminds us that it is inaccurate to think of a single IQ score as summarizing all that is important or valuable about people's mental abilities (Sternberg, 1999; Sternberg et al., 1995).

Gardner's Multiple Intelligences Like Sternberg, Harvard psychologist Howard Gardner believes that traditional IQ tests measure only a limited range of human mental abilities. But he argues that we have at least seven separate

■ **Analytical intelligence** According to Sternberg, the ability measured by most IQ tests; includes the ability to analyze problems and find correct answers.

■ **Creative intelligence** According to Sternberg, the form of intelligence that helps people see new relationships among concepts; involves insight and creativity.

■ **Triarchic theory** The term for Sternberg's theory of intelligence; so called because it combines three ("tri-") main forms of intelligence.

One of Gardner's seven intelligences is bodily-kinesthetic intelligence, the ability to coordinate one's body movements with grace and control, as demonstrated by dancers, athletes, and surgeons.

CONNECTION: CHAPTER 8

Emotional intelligence involves the ability to understand and use emotions effectively.

mental abilities, which he calls **multiple intelligences** (Ellison, 1984; Gardner, 1983, 1999b):

1. *Linguistic intelligence:* Often measured on traditional IQ tests by vocabulary tests and tests of reading comprehension
2. *Logical-mathematical intelligence:* Also measured on most IQ tests with analogies, math problems, and logic problems
3. *Spatial intelligence:* The ability to form mental images of objects and to think about their relationships in space
4. *Musical intelligence:* The ability to perform, compose, and appreciate musical patterns, including patterns of rhythms and pitches
5. *Bodily-kinesthetic intelligence:* The ability for controlled movement and coordination, such as that needed by a dancer or a surgeon
6. *Interpersonal intelligence:* The ability to understand other people's intentions, emotions, motives, and actions, as well as to work effectively with others
7. *Intrapersonal intelligence:* The ability to know oneself, to develop a satisfactory sense of identity, and to regulate one's life

Each of these intelligences arises from a separate module in the brain, Gardner claims. The latter two, interpersonal and intrapersonal intelligence, are similar to a capacity that some psychologists call *emotional intelligence.* People who are high in emotional intelligence are good at "reading" other people's emotional states, as well as being especially aware of their own emotional responses.

In addition to these, Gardner's book *Intelligence Reframed* (1999a) proposes three more intelligences. *Naturalistic intelligence* allows people to classify living things as members of diverse groups (e.g., dogs, petunias, bacteria). *Spiritual intelligence* involves the ability to think in abstract spiritual terms and to put oneself in a spiritual frame of mind. And, finally, *existential intelligence* permits individuals to think about the largest and smallest components of the universe, the purpose of existence, and the meaning of death and to deal with profound emotional experiences such as love. The evidence that these latter three involve independent abilities based in specific brain modules, however, is not as strong as for the previous seven intelligences.

Like Sternberg, Gardner sees all the components of intelligence as equally important. Yet the value of each is also culturally determined, according to what is needed by, useful to, and prized by a given society. Gardner notes that Western society promotes the first two intelligences, while other societies value one or more of the other kinds of intelligence. For example, in small, isolated communities, people often place a high value on getting along with others (Gardner's *interpersonal ability*). In these restricted social settings, people have no place to go if they get into a quarrel and want to escape or part ways. In such societies, people generally avoid quarrels by recognizing potential problems at an early stage and modifying behaviors to solve problems quickly.

Assessing these newly recognized kinds of intelligence demands more than the usual paper-and-pencil tests. Gardner's approach requires that examinees be observed and assessed in a variety of life situations. On its face, the notion of multiple intelligences appears to be sound, but it awaits verification through tests that are still in the process of development.

Cultural Definitions of Intelligence

Multiple intelligences A term used to refer to Gardner's theory, which proposes that there are seven (or more) forms of intelligence.

If you had been socialized in a Pacific island culture, which would matter more: your SAT scores or your ability to navigate a boat on the open ocean? With such examples, cross-cultural psychologists have called our attention to the notion

that "intelligence" can have different meanings in different cultures (Kleinfeld, 1994; Neisser et al., 1996; Rogoff, 1990; Segall et al., 1999; Serpell, 1994; Vernon, 1969). In fact, many languages have no word at all for intelligence as we conceive of it: the mental processes associated with logic, vocabulary, mathematical ability, abstract thought, and academic success (Matsumoto, 1996).

On the other hand, people in all cultures prize certain mental abilities—although those abilities are not the same in different cultures. Western cultures often associate intelligence specifically with *quick* solutions to problems. This contrasts with the Buganda people in Uganda, who associate intelligence with slow and thoughtful responses. Yet another view is found among the Djerma-Sonhai in Niger (West Africa), who think of intelligence as a combination of social skills and good memory. And for the Chinese, intelligence involves, among other things, extensive knowledge, determination, social responsibility, and ability for imitation.

A Native American Concept of Intelligence John Berry (1992) has extensively studied the kinds of mental abilities considered valuable among Native Americans. He began by asking adult volunteers among the Cree in northern Ontario to provide him with Cree words that describe aspects of thinking, starting with examples like "smart" or "intelligent." The most frequent responses translate roughly to "wise, thinks hard, and thinks carefully."

Although Cree children attend schools introduced by the dominant Anglo (English-European) culture, the Cree themselves make a distinction between "school" intelligence and the kind of "good thinking" valued in the Cree culture. Such thinking seems to center on being "respectful." As one respondent explained, intelligence "is being respectful in the Indian sense. You need to really know the other person and respect them for what they are" (Berry, 1992, p. 79). This attitude of "respect for others" is widespread in Native American cultures, Berry found.

For this Native American teacher and his students, "intelligence" may have a different meaning from that used by Anglo Americans. In the Cree culture, intelligence involves wisdom and respect for others.

"Backwards Knowledge" One term Berry's respondents offered as an example of the opposite of intelligence translates as "lives like a white." This refers disparagingly to behaviors the Cree have observed among some Anglo people. The Cree define "lives like a white" as a combination of being "stupid" and having "backwards knowledge." A "stupid" person does not know the necessary skills for survival and does not learn by respecting and listening to elders. One has "backwards knowledge" if he or she disrupts relationships, creating disharmony instead of encouraging smooth interactions with others. Such disruption is not necessarily intentional or malicious. For example, an English teacher may ask Cree students to write an essay that would persuade others to change certain behaviors. However, in the Cree culture the concept of "persuading" can interfere with the traditional Cree value of "accepting others as they are." By encouraging such questioning of elders and traditions—a common practice in Anglo education—the teacher promotes disruption, which may be a path to "wisdom" in Anglo culture but is "backwards" in Cree views of intelligence.

As you can see from these examples, different cultures may define intelligence quite differently (Sternberg, 2000b). In order to understand and cooperate with people of diverse heritages, we would be most "intelligent" if we resisted the impulse to impose our own definition of "intelligence" on others. Within psychology, cross-cultural psychologists have led the way in urging us to see what is valued—and what devalued—in other people's experience.

PSYCHOLOGY IN YOUR LIFE: TEST SCORES AND THE SELF-FULFILLING PROPHECY

If you have ever been called "dumb" or "slow," "shy," "plain," "bossy," or "uncoordinated," you know, first hand, the powerful effect that labels and expectations can have. An IQ score is a label too, and in our test-conscious society, an IQ score can alter the course of a life. As a nation of test takers, we sometimes forget that test scores are, at best, statistical measures of current functioning. People too often think of themselves as being "an IQ of 110" or "a B student," as if scores or grades were labels stamped permanently on their brains. Such labels may become barriers to advancement, as people come to believe that their mental and personal qualities are unchangeable—that they dictate their lot in life. Two classic studies will bring this fact into stark relief.

Expectations Influence Rat Performance Robert Rosenthal and Lenore Jacobson (1968a, b) asked psychology students to run rats through a maze and record their times. The experimenters told some students that their rats were especially bright; other students heard that their rats were slow learners. (In fact, Rosenthal and Jacobson had randomly assigned rats to the "bright" and "dull" groups.) Amazingly, the students' data showed that rats that were *believed* to be bright outperformed their supposedly duller littermates. Obviously, expectations had influenced the students' observations.

Expectations Also Influence Student Performance So, Rosenthal and Jacobson wondered, could a teacher's expectations similarly affect evaluations of a student's performance in school? To find out, they arranged to give grade school teachers erroneous information about the academic potential of about 20% of their students (approximately five in each classroom). Specifically, the teachers heard that some students had been identified by a standardized test as "spurters," who would blossom academically during the coming year. In fact, testing had revealed no such thing; the "spurters" had been randomly selected by the experimenters.

Knowing what happened to the rats, you can guess what happened to these children. Those whom the teachers expected to blossom did so. The teachers rated the "spurters" as being more curious and having more potential for success in life than the other children. Socially, the teachers saw these children as happier, more interesting, better adjusted, more affectionate, and needing less social approval. Significantly, when the children again took the original test (actually an IQ test) a year later, the children in the experimental group (who had been arbitrarily assigned a high expectation of mental growth) made substantial gains in IQ points. The gains were especially pronounced among first and second graders. Rosenthal and Jacobson call this effect a **self-fulfilling prophecy.** You can see it operating anywhere that people live up to the expectations of others—or of themselves.

The Effects of Negative Expectations Did the self-fulfilling prophecy apply to the students not labeled as possible academic "spurters"? Many of these children also gained IQ points during the year of the experiment, but they gained fewer points, and they were rated less favorably by their teachers. Apparently, not receiving a promising prophecy can create negative expectations, just as a positive label can create positive expectations.

Please remember the self-fulfilling prophecy the next time you are tempted to place a label on someone.

Self-fulfilling prophecy
Observations or behaviors that result primarily from expectations.

CHECK YOUR UNDERSTANDING

1. **APPLICATION:** From the perspective of Cattell's theory, the ability to use algorithms and heuristics would be an aspect of
   a. convergent thinking.
   b. crystallized intelligence.
   c. logical thinking.
   d. divergent thinking.
   e. fluid intelligence.

2. **APPLICATION:** A friend tells you that he has found a way to improve his grades by stopping by his psychology teacher's room once a week to ask questions about the reading. If this is successful, you could say that your friend has shown
   a. practical intelligence.
   b. logical reasoning.
   c. experiential intelligence.
   d. convergent thinking.
   e. divergent thinking.

3. **RECALL:** Which of Gardner's seven intelligences is most like that measured on standard IQ tests?
   a. linguistic ability
   b. bodily-kinesthetic ability
   c. interpersonal ability
   d. intrapersonal ability
   e. spatial ability

4. **RECALL:** A self-fulfilling prophecy comes true because of
   a. innate factors.
   b. most people's lack of substantial logical-mathematical ability.
   c. the lack of precision of IQ tests.
   d. people's expectations.
   e. cultural norms.

5. **UNDERSTANDING THE CORE CONCEPT:** Which of the following most aptly characterizes the current debate about intelligence?
   a. mental age versus chronological age
   b. single versus multiple
   c. practical versus logical
   d. cognitive versus behavioral
   e. fluid versus crystalized

ANSWERS: 1. e 2. a 3. a 4. d 5. b

HOW DO PSYCHOLOGISTS EXPLAIN IQ DIFFERENCES AMONG GROUPS?

KEY QUESTION

It is a fact that a gap of approximately 15 points exists between the average IQ scores of African Americans and Caucasian Americans (Neisser et al., 1996; Vincent, 1991). A similar IQ gap separates children from middle-income homes and low-income homes (Jensen & Figueroa, 1975; Oakland & Glutting, 1990). Nobody disputes that these gaps exist. What the experts disagree about are the *causes* of these IQ discrepancies. As we will see, the disagreement is another example of the nature–nurture controversy. Our Core Concept describes the issue this way:

CORE CONCEPT

While most psychologists agree that both heredity and environment affect intelligence, they disagree on the source of IQ differences among racial and social groups.

The controversy over the source of intelligence is potentially of great importance for people's lives—and a politically hot issue. If we assume that intelligence is primarily the result of innate (hereditary) factors, we will most likely conclude that it is fixed and unchangeable. This leads some to the mistaken conclusion that a group having low IQ scores must be innately inferior and should be treated as second-class citizens. On the other hand, if we conclude that intelligence is shaped largely by experience (environment), we are more likely to make a range of educational opportunities available for everyone and to view people of all ethnic, cultural, and economic groups as equals. Either way, our conclusion may become a self-fulfilling prophecy.

In fact, neither the hereditarian nor the environmentalist view is completely right. Repeatedly in this book we have seen that psychologists now recognize that both heredity and environment play a role in all our behavior and mental processes. But there is more to the issue of group differences than this. In

The IQ scores of identical twins show a strong influence of genetics. The identical twins in this photo have gathered for the Twins Days Festival in Twinsburg, Ohio.

this chapter we add another important dimension to the heredity–environment interaction: While every individual's intelligence is determined, in part, by heredity, this fact does not mean that the IQ differences among groups have some biological basis. On the contrary, many psychologists have argued that group differences are totally environmental—although this, too, is disputed, as our Core Concept suggests. You will find out why this is so in the following pages.

Intelligence and the Politics of Immigration

In the early 1900s, Henry Goddard, an influential psychologist who believed that intelligence is a hereditary trait, proposed mental testing for all applicants for immigration and the exclusion of those who were found to be "mentally defective" (Strickland, 2000). With encouragement from Goddard and some other assessment-minded psychologists, Congress passed the 1924 Immigration Restriction Act, designed to restrict immigration of groups and nationalities in which people had been "proved" to be of inferior intellect—based largely on Goddard's data. Among the groups restricted were Jews, Italians, and Russians. What Goddard and the U.S. Congress ignored was the fact that the tests were given in English—often to people with little familiarity with the English language and the culture in which the tests were conceived. Of course many of these immigrants received low scores!

Today we are more aware of the shortcomings of intelligence tests. We also know that, while heredity has an effect on an individual's intelligence, experience does, too. And we know that Goddard used faulty reasoning when he concluded that heredity accounts for group differences in intelligence. To understand how heredity could affect individual differences but not group differences, we need to look first at the evidence supporting the hereditarian and environmentalist arguments.

What Evidence Shows That Intelligence Is Influenced by Heredity?

Many lines of research point to a hereditary influence on intelligence. For example, studies comparing the IQ scores of identical twins with fraternal twins and other siblings show a strong genetic correlation. Another common approach compares adopted children with their biological and adoptive families. These studies find that the correlation between the IQs of children and their biological parents is greater than that with their adoptive parents (Plomin & DeFries, 1998). As Table 11.2 shows, the closer the genetic relationship—from cousins to siblings to twins—the closer the relationship of IQ scores. In general, work on twins and adopted children shows genetic influences on a wide range of attributes as diverse as heart functioning (Brown, 1990), personality traits (Tellegen et al., 1988), hypnotizability (Morgan et al., 1970), and intelligence (Chorney et al., 1998; McClearn et al., 1997; Neisser et al., 1996; Petrill et al., 1998). Work coming out of the Human Genome Project has also lent support to the notion that intelligence has a genetic component. Scientists are careful to point out, however, that the genetic basis of intelligence is complex because it involves the interaction of many genes (Chorney et al., 1998).

While psychologists agree that heredity plays an important part in determining an individual's IQ scores, they also agree that it remains difficult to estimate the relative weights of heredity and environment (Plomin, 1989; Scarr, 1998; Stevenson et al., 1987). One reason for this is that children who live in

TABLE 11.2 Correlation of IQ Scores with Genetic Relationship

Genetic relationship	Correlation Between IQ scores
Identical twins	
Reared together	0.86
Reared apart	0.86
Fraternal twins	
Reared together	0.60
Siblings	
Reared together	0.47
Reared apart	0.24
Parent/child	0.40
Foster parent/child	0.31
Cousins	0.15

Note: A correlation shows the degree of association between variables–in this case, between the IQs of pairs of individuals. The closer to 1.0, the closer the connection. For example, we can see that the IQ scores of identical twins reared together are more closely correlated (.86) than the IQs of mere siblings reared together (.47). The data strongly suggest a genetic component that contributes to intelligence. (*Source:* From "Familial Studies of Intelligence: A Review," by Bouchard and McGue in *Science,* 1981, Vol. 212, pp. 1055–1059. Copyright © 1981 by the American Association for the Advancement of Science. Reprinted by permission of AAAS.)

the same family setting do not necessarily share precisely the same psychological environment. First-born children, for example, are treated differently from the youngest. You probably are aware of this fact if you have siblings.

What Evidence Shows That Intelligence Is Influenced by Environment?

The evidence that the environment influences intellectual development is persuasive, too. Even when we look for genetic effects, we find greater similarities of IQ among people who have been reared together than those reared apart. And in laboratory animals, a stimulus-enriched habitat early in life has been shown to result in a more complex, complete development of brain cells and cortical regions. The superior performance of these animals on a range of tasks persists through life. In other experiments, we find that young monkeys that are trained to solve problems and are also offered the companionship of other monkeys display more active curiosity and higher intelligence than those reared without this environmental stimulation.

Such findings hint that we might boost the intellectual functioning of human infants by enriching their environments. Indeed, we will see that early enrichment programs can raise children's IQ scores. Regular schooling also may boost IQ scores. In fact, the total amount of schooling children get is directly correlated with their IQ scores (Ceci & Williams, 1997). Even in adulthood, environmental factors, such as the cognitive complexity and intellectual demands of one's job, can influence mental abilities throughout life (Dixon et al., 1985).

The personal attention children receive can affect their intelligence. This contemporary parent is deeply involved in his children's education.

Heritability and Group Differences

Let us acknowledge, then, that heredity has an influence—perhaps a substantial influence—on intelligence. But we should also be clear about another term: *heritability*. This concept is crucial for understanding the idea that hereditary

differences among *individuals* do not imply that heredity accounts for the differences we observe among *groups.* In other words, heritability is not the same thing as heredity. Specifically, **heritability** refers to the amount of trait variation within a group that can be attributed to genetic differences. Thus, it is important to realize that *we can speak of heritable differences only within a group of individuals who have shared the same environment.*

To illustrate, suppose that we examined a group of children who were all raised in an intellectually stimulating environment, with devoted parents who spent lots of time interacting with them and reading to them—things we know improve intellectual abilities. Among these children, we would find variation in intellectual abilities. Because they were all treated in essentially the same fashion, however, we could attribute much of the differences in their IQ scores to the effects of heredity. In this group, IQ would have a high heritability.

In contrast, suppose that we examined a group of children who had been raised under conditions of neglect (given mere custodial care in an orphanage, with no intellectual stimulation from their caregivers). We would most likely find that these children have relatively little variability among their IQ scores because they are all intellectually stunted. For this group, intelligence would have low heritability—because the poor environment did not offer an opportunity for these children's genetic potential to be realized.

Now, what about the differences *between* the two groups? The IQ differences would be real. But—this is the important part—our observations could tell us nothing about the genetic differences (if any) between the groups. For all we know they might have the same genetic potential. But because the environments were so different, we cannot tell what role genetics played in determining their IQ scores. By applying this notion to groups of people who are exposed to different cultural traditions or experience different levels of wealth or discrimination, you can see that we have no way to evaluate what proportion of the differences between the groups should be attributed to heredity or to environment. To reiterate: *Heritability is a concept that refers to within-group differences, not between-group differences.* Just because intelligence may be highly heritable does not mean that the environment has no impact (Dickens & Flynn, 2001; Neisser et al., 1996).

The Jensen Controversy Despite the concerns we have just cited, a few psychologists remain unconvinced that group differences in IQ can be accounted for by environmental factors. In particular, Harvard psychologist Arthur Jensen (1969) stirred up a hornets' nest of controversy with his contention that racial differences in IQ have a genetic basis. We can boost IQ scores to some extent, said Jensen, by helping the poor and disadvantaged, but there are limits imposed by heredity.

In support of his thesis, Jensen cited several studies showing a strong influence of heredity on IQ. He also presented a complex statistical argument that showed only a weak environmental effect on IQ and achievement. Then, turning his attention to government programs that had attempted to give extra help to disadvantaged black children, Jensen claimed that, although most had shown some positive effects, none had erased racial differences in performance. What remained must be a genetic difference in abilities, he maintained.

Over the next five years, more than 100 published articles responded to Jensen's challenge. Sometimes it seemed that the Jensen controversy had generated far more heat than light. The protest occasionally became ugly, with charges of bigotry and racism nearly drowning the scientific debate. Nevertheless, it did have the positive effect of stimulating a new wave of research and theory aimed at gaining greater understanding of black–white IQ differences.

■ **Heritability** The amount of trait variation within a group, raised under the same conditions, that can be attributed to genetic differences. Heritability tells us nothing about between-group differences.

Critics pointed out several factors that Jensen had minimized or ignored, including the effects of racism, lower teacher expectations for black children, lack of opportunity, low self-esteem, and a white, middle-class bias built into IQ and achievement tests (Neisser, 1997; Neisser et al., 1996). While Jensen holds to his original position (Jensen, 1980, 1985, 1998, 2000), many (but not all) psychologists now agree that a combination of environmental factors can explain the differences on which Jensen built his case. Let us now look at some of the post-Jensen discoveries, beginning with a study of children whose environment had been altered by adoption.

The Scarr and Weinberg Adoption Study A monumental study by Sandra Scarr and Richard Weinberg confronted the issue head-on by comparing black and white children who had been adopted into similar home environments (1976, 1978). Their research focused on educational records and IQ test scores from both the biological families and the adoptive families of 115 white children and 176 black children who had been adopted in Minnesota during the 1950s. All the children had been adopted into white families. For both groups of children, the biological parents had average IQ scores (near 100), while the adoptive parents' IQs were somewhat higher, averaging above 115.

What did Scarr and Weinberg find when they reexamined the IQ scores of these two groups of adoptees in late adolescence? There were no differences! Both the black group and the white group of adoptees had scores that averaged about 110, significantly higher than their biological parents, although not quite as high as their adoptive parents. Such results testify to a powerful effect of the environment on IQ. The results also contradict Jensen's claim that group differences are genetic.

Social Class and IQ Research on the relationship between social class and IQ shows similar environmental effects. Socioeconomic class (as reflected in an individual's financial status and lifestyle) is clearly correlated with IQ. While affluence is associated with higher IQ scores, groups with the lowest average IQ scores are those for whom poverty, illiteracy, and hopelessness are most widespread. Supporters of the environmental position claim that racism and discrimination initially landed many minorities in the impoverished inner cities, and these same factors continue to keep them there today.

How does social class affect IQ? Poverty creates circumstances that limit individual potential in many ways, particularly in terms of nutrition, health care, and education (Brown & Pollitt, 1996; Neisser et al., 1996). Poverty means less-adequate health care, so it should not surprise you that researchers have traced poor health during pregnancy and low birth weight to low mental ability in children. Poverty also means less of other factors known to promote intellectual development. Poor nutrition, lack of access to books and computers, and job schedules that leave parents little time to stimulate a child's intellect all correlate with poverty and can be detrimental to performance on tasks such as those demanded by IQ tests (for example, vocabulary or sentence comprehension). Research also shows that a significant proportion of children with low IQs have been adversely affected by "environmental insults," such as living in homes with lead-based paint chips peeling from walls, causing toxic lead levels in children who ingest this material (Needleman et al., 1990).

Poverty has other crippling effects, too. In most parts of the United States, public schools are funded by revenue from local property taxes. Thus, wealthy neighborhoods can provide bigger and better school facilities and amenities, while poorer districts may suffer from crowding, physically deteriorating structures, threats to personal safety, and few "extras" such as media centers or computers. In such environments, even children with the aptitude to learn may

find it difficult to rise above their circumstances. Proponents of the view that environment has a strong influence on intelligence usually support equal-opportunity legislation, better schools, and intervention programs that help disadvantaged children build self-confidence and learn the skills necessary to succeed in school (Tirozzi & Uro, 1997; Zigler & Muenchow, 1992; Zigler & Styfco, 1994).

Head Start: A Successful Intervention Program One such intervention program is *Head Start*, originally implemented over 40 years ago to provide educational enrichment for disadvantaged children. It grew from the assumption that many children from deprived families need an intellectual boost to prepare them for school. The program is intended to head off problems on several fronts by serving children's physical as well as mental needs with nutritional and medical support, plus a year or two of preschool education. Wisely, Head Start also involves parents in making policy, planning programs, working in classrooms, and learning about parenting and child development. Head Start centers around the country currently serve about 800,000 children yearly—estimated to be 40% of the number who need it (Ripple et al., 1999).

Does it work? Again, there is some controversy (Jensen, 1969; Kantrowitz, 1992), although a great deal of research suggests that Head Start does, indeed, help disadvantaged children get ready for school (Lazar & Darlington, 1982; Lee et al., 1988; Ripple et al., 1999; Ripple & Zigler 2003; Schweinhart & Weikart, 1986; Smith, 1991). Children who were enrolled in the program score higher on IQ tests and have higher school achievement during the early grades than a matched control group who received no such intervention (Zigler & Styfco, 1994). More important, their head start lasts. Although the differences between the Head Start children and the control group diminish over time, the effects are still detectable in adolescence. Compared to the control group, Head Start children are less likely to be placed in special education classes, less likely to fail a grade, and more likely to graduate from high school.

It now appears, however, that such attempts to raise IQ by special environmental interventions may not start early enough. Studies indicate that early educational intervention, starting in the first months of life, can raise infants' scores on intelligence tests by as much as 30% compared to control groups (Ramey & Ramey, 1998a, b; Wickelgren, 1999). Although the gains may diminish with time, especially if supportive programs are withdrawn, significant differences remain when intervention starts in infancy. The best way to summarize these and other relevant findings is to say that the earlier the individual is immersed in an enriched environment, the better.

Test Biases Still other forces influence IQ scores and contribute to differences among groups. A portion of the difference between the average IQ scores of black and white children may be attributable to problems with the IQ tests themselves. Many psychologists argue that IQ test questions have built-in biases toward a middle- or upper-class background—biases that favor the white child (Garcia, 1981; Helms, 1992; Miller-Jones, 1989). For an opposing view, however, that holds that test bias does *not* contribute to group differences in IQ scores, see Jensen (2000) and Reynolds (2000).

One source of possible bias stems from the fact that most IQ tests rely heavily on vocabulary level. This gives a big advantage to children who have been read to and who are encouraged to read. We can see a related bias in a well-known IQ test that asks for a definition of "opulent" (rich), a term one is far less likely to hear in a poor household.

Because expectations can also affect IQ scores, psychologists have argued that lowered expectations among some minority groups about their own poten-

tial can contribute to racial differences in IQ scores (Schwartz, 1997). One study found that merely being asked to identify their race produced lower scores for minority students on a test of academic abilities (Steele, 1997). In another study, a group of black women faltered on an IQ test when they were told that white women usually do better on the test. These women, who expected to do poorly, received IQ scores that averaged a full 10 points lower than another group who were told that black women usually receive high scores (Thomas, 1991).

Yet another source of bias has to do with the examiner. Not only does the examiner's attitude influence IQ scores, but so do his or her gender and race. Studies have found that black children receive higher scores when tested by a black examiner (Bodmer & Cavalli-Sforza, 1970; Sattler, 1970). In brief, test takers do best when they perceive the examiner to be similar to themselves.

Finally, Janet Helms (1992) has pointed out that the attempt to explain why African American children deviate from the Caucasian norm may, itself, rest on the biased assumption that one culture is superior to another. Specifically, she says, it "assumes that white-American culture defines the most intellectually rich environment" (p. 1086). Seldom do we ask how well white children learn the norms of other cultures. Helms asks: Why should the Caucasian American norm be the standard by which everyone else is judged?

The Bell Curve: Another Hereditarian Offensive The dispute over causes of racial differences in IQ flared again in 1994. At issue was a book, *The Bell Curve: Intelligence and Class Structure in American Life,* by Richard Herrnstein and Charles Murray. The name echoes the bell-shaped "normal distribution" of IQ scores (see shape of the graph in Figure 11.2). In this volume, Herrnstein and Murray argued that racial differences in IQ have a strong genetic basis. If these innate differences were accepted, the nation could move on to more enlightened and humane social policies, they said. Critics immediately identified not only a racist bias but pointed to unsound "science" at the core of *The Bell Curve.*

How is *The Bell Curve*'s argument flawed? The answer will be familiar to you by now: While there is no doubt that heredity influences individual intelligence, Herrnstein and Murray, like hereditarians before them, have offered no proof that differences *between groups* exposed to different environments have a hereditary basis (see Coughlin, 1994; Fraser, 1995). Further, much of the "evidence" they offer is suspect (Kamin, 1994). One study cited by Herrnstein and Murray claimed to document the low IQs of black Africans, but it employed tests given in English—a language in which the Zulu subjects of the study were not fluent (Kamin, 1995). The test used in that study also assumed that subjects were familiar with electrical appliances found in urban middle-class homes (rather than Zulu villages) and equipment, such as microscopes, not typically found in Zulu schools.

Compounding the problems in their analysis of the evidence, Herrnstein and Murray commit another scientific error about which you learned early in this book: They confuse correlation with causation. In fact, the Herrnstein and Murray argument is just as plausible when turned around: Poverty and all of the social and economic disadvantages that go with it could just as well be important causes of low IQ scores.

Despite its flaws, *The Bell Curve* has struck a chord with many Americans. It resonates with the preference for simple genetic "causes" for behavior, rather than more complex explanations. It also fits with our cultural biases about educational achievement. This is seen in a study that asked Americans and Asians to account for a child's academic success. Predictably, American respondents emphasized "innate ability," whereas Asian respondents emphasized the importance of "studying hard" (Stevenson et al., 1993).

PSYCHOLOGY IN YOUR LIFE: HELPING OTHERS THINK CRITICALLY ABOUT GROUP DIFFERENCES

If someone you know were to claim that the discrepancy between IQ scores of whites and blacks is proof of the genetic intellectual superiority of whites, how would you respond? You might begin with the argument that the influence of genetics on individual intelligence tells us nothing about the influence of genetics on group differences. You could also point to the evidence showing that, while the group average IQ for African Americans is as much as 10 to 15 IQ points below the group average for U.S. whites, there is much overlapping of scores. That is, the difference *between* groups is small compared to the spread of scores of individuals *within* each group (Neisser et al., 1996). And you could say that biologists have taught us that "race" is not a valid biological concept (Beutler et al., 1996; Cohen, 1998; Yee et al., 1993). Even if we use a social definition, where people define their own racial group, the differences between the gene pools of people who claim to be of different racial groups are very small compared to the genetic differences among individual members of the same group (Bamshad & Olson, 2003; Gould, 1996; Zuckerman, 1990).

In the "separate but equal" schoolroom of 1940s Tennessee, African American children received little attention and a poor education.

Perhaps the most persuasive argument against the genetic interpretation of group differences is that many other variables are confounded with race, including racism, poverty, self-fulfilling prophecies, and differential opportunities for education—each of which can influence IQ scores. For example, in a large-scale, longitudinal study of more than 26,000 children, the best predictors of a child's IQ at age 4, for both black and white children, were the family's socioeconomic status and the level of the mother's education (Broman et al., 1975). When opportunities are made more equal, as we saw in the Scarr-Weinberg study, the differences disappear.

Unfortunately, the fact of group differences in IQ scores has been interpreted as a genetic difference and used to justify racist views. Even today, such data are used to justify discrimination against the disadvantaged poor, women, minorities, and immigrants in providing educational and career opportunities and in formulating public policy (Gould, 1996; Hirsch et al., 1990; Kamin, 1974). In the extreme, racist interpreters of the genetic argument support **eugenics** programs that would limit "breeding" by "undesirable" groups, laws restricting the immigration of certain groups, and legal inequality that favors the group in power. But the science just doesn't support such actions or the beliefs behind them.

Eugenics A philosophy and a political movement that encouraged biologically superior people to interbreed and sought to discourage biologically inferior people from having offspring.

CHECK YOUR UNDERSTANDING

1. **RECALL:** Most early American psychologists working on intelligence believed that the dominant influence on intelligence was
   a. heredity.
   b. experience.
   c. gender.
   d. the size of one's brain.
   e. environment.
2. **ANALYSIS:** It is most accurate to say that
   a. intelligence is influenced more by heredity than by environment.
   b. intelligence is influenced more by environment than by heredity.
   c. intelligence is the result of an interaction of heredity and environment.
   d. the influence of environment on intelligence is most powerful in the children of minority groups.
   e. intelligence is influenced more by family makeup than by any interactions of heredity and environment.

3. **RECALL:** The concept of heritability refers to genetic variation
   a. within an individual's sperm cells or ova.
   b. between one group and another.
   c. within an individual's immediate family.
   d. within a group of individuals who have had the same environment.
   e. between family members.

4. **UNDERSTANDING THE CORE CONCEPT:** Although everyone agrees that heredity affects _____ intelligence, there is no evidence that it accounts for differences among _____.
   a. individual /groups
   b. group/individuals
   c. high/the mentally retarded
   d. academic/practical intelligence
   e. fluid/individuals

ANSWERS: 1. a 2. c 3. d 4. a

TESTING AND INDIVIDUAL DIFFERENCES: THE STATE OF THE ART

Recent years have brought advances in our understanding of concept formation, particularly from brain imaging studies. But we still know very little about the biological basis for "higher" thinking processes, such as creativity, expertise, and intelligence—the qualities that Brin and Page used to create Google. Nor do we have precise knowledge about what environment most effectively nurture these characteristics.

Psychology in the 21st century has also seen the field of intelligence testing—once considered one of psychology's unqualified great achievements—shrouded in controversy over the extent to which it is influenced by our hereditary nature and to what degree is it is nurtured by our environment. On the brighter side, psychologists have broadened our understanding of intelligence with the concept of multiple intelligences and with the notion that intelligence has different meanings in different cultural groups.

So, where is psychology headed in the field that encompasses thinking, intelligence, creativity, expertise, and problem solving? The hottest areas of research lie in neuroscience—finding the links between thinking and brain function. The most-needed areas of research, however, may lie in finding practical applications for the home and classroom.

USING PSYCHOLOGY TO LEARN PSYCHOLOGY

Developing Expertise in Psychology—or Any Other Subject

Obviously, **experts** are people who know a lot about a particular subject. Unlike a novice, an expert confronting a problem does not have to start from scratch. Experts can often see a solution quickly because they have seen many similar problems before. That is, they are especially good at using the heuristic of finding analogies.

Another quality distinguishing expert thinkers from beginners lies in the way their knowledge is organized. While the novice possesses only a collection of disjointed facts and observations, experts have organized their knowledge into elaborate schemas (Bédard & Chi, 1992; Bransford et al., 1986; Chi et al., 1982; Glaser, 1990; Greeno, 1989; Klahr & Simon, 2001). We can see this quite clearly in a famous study of world-class chess players.

■ **Experts** Individuals who possess well-organized funds of knowledge, including the effective problem-solving strategies, in a field.

A Study of Chess Experts

Dutch psychologist Adriaan de Groot found some striking differences when he compared the ways a group of grand master chess players and another

group of merely good players responded to a chess problem. Allowed five seconds to view a configuration of pieces as they might appear on a chess board during a match, the grand masters were able to reproduce the pattern far more accurately than the less-expert subjects (de Groot, 1965). Does that mean that the grand masters had better visual memories? No. When confronted with a random pattern of pieces on the chess board—a pattern that would never happen in a match—the grand masters did no better than the other subjects. This suggests that the experts were able to draw on familiar patterns in memory, rather than trying to recall individual pieces and positions.

How to Become an Expert

Are experts born, or is expertise learned? As we saw with creativity, there is little evidence that inborn talent plays a substantial role in expert performance (Ericsson & Charness, 1994). To be objective, however, we should say that there is an opposing view that recognizes innate talent (Simonton, 2001): It is likely, from this view, that people don't usually make the huge commitment of time and energy to become an expert in a field for which they do not have some initial aptitude.

So, could you, for example, become an expert—in psychology, perhaps? The research shows that, no matter what the field, experts learn their expertise (Bédard & Chi, 1992). Aside from facts and specific skills, they also acquire a repertoire of multipurpose heuristics, such as those we discussed earlier. And they know the special problem-solving techniques, or "tricks of the trade," that are unique to their field of expertise. These heuristics help them find solutions more quickly, without having to follow so many blind alleys (Gentner & Stevens, 1983; Simon, 1992).

Expertise as Organized Knowledge

Research on experts also shows that learning facts and skills is not enough to produce real expertise (Bransford et al., 1986; Glaser, 1984; Greeno, 1989; Mayer, 1983). In addition, experts also possess a great deal of well-organized information about a field and its important concepts, which gives the expert both a fund of knowledge to apply to a problem and a familiarity with the field's common problems and solutions. That is, they know not only the facts but also how the facts are interrelated and used.

How, then, do you become an expert? A supportive environment, with good teachers and mentors, helps (Barab & Plucker, 2002). Beyond that, it's study and practice! But don't just focus on the details. Learn the important schemas and problem-solving strategies in your chosen field, too. How long will it take? Research shows that achieving world-class status in any of a wide gamut of fields—from athletics to academics to chess to music—requires about 10 years of intensive study and practice (Ericsson et al., 1993; Gardner, 1993).

What does this suggest for your learning of psychology and other disciplines? You can take the first steps in developing your expertise by attending to the way your professors and your texts organize the information they present (Gonzalvo et al., 1994). Consider such questions as the following:

- What are the terms that your psychology professor keeps mentioning over and over? These might be such concepts as "cognitive science," "behaviorism," "developmental," or "theoretical perspectives." For you they may be, at first, unfamiliar and abstract, but for the professor they may represent the core of the course. Make sure you know what the terms mean and why they are important.
- Around what concepts is the course syllabus organized? What are the new terms that are associated with the main topics?
- Around what concepts is the textbook organized? You may be able to tell this quickly by looking at the table of contents. Alternatively, the authors may lay out the organizing points in the preface at the beginning of the book. (In this book, we have attempted to help you identify the organizing principles of each chapter in the form of Core Concepts.)

If you can identify the organizing principles for the course, they will simplify your studying. This makes sense, of course, in terms of our earlier study of memory. Long-term memory (as you will remember!) is organized by meaningful associations. Accordingly, when you have a simple and effective way of organizing the material, you will have a framework that will help you store and retain it in long-term memory.

CHAPTER SUMMARY

HOW DO WE MEASURE INDIVIDUAL DIFFERENCES?

Utilizing validity and reliability, we can develop and use tests which accurately assess the information we need, and do it consistently and accurately over time. There are several types of validity, content and criterion as well as reliability, test–retest and split-half. Standardization and norms are also an essential aspect of assessment, as they allow us to clearly establish how a score compares with others in a population. Ethics not only refer to what tests test, but how the scores can be, and should be used. The ethical considerations in testing cannot be understated.

Measuring individual differences is an essential component of psychology, but strict guidelines and ethical standards must be followed to ensure that results and conclusions are valid and appropriate.

HOW IS INTELLIGENCE MEASURED?

The measurement of intelligence is both common and controversial. Assessment of mental ability has an ancient human history but was not based on scientific practice until the 20th century. In 1904, Binet and Simon developed the first workable test of intelligence, based on the assumption that education can modify intellectual performance. In America, IQ testing became widespread for the assessment of Army recruits, immigrants, and schoolchildren. The original IQ calculation was abandoned in favor of standard scores based on the normal distribution. IQ scores are a key ingredient in identifying mental retardation and giftedness, which are often seen as occupying the extremes of the IQ distribution.

Intelligence testing has a history of controversy, but most psychologists now view intelligence as a normally distributed trait that can be measured by performance on a variety of tasks—both verbal and nonverbal.

WHAT ARE THE COMPONENTS OF INTELLIGENCE?

Among the first psychometric theories of intelligence, Spearman's analysis emphasized a single, common factor known as *g*. Later, Cattell separated *g* into two components: fluid and crystallized intelligence. Modern cognitive psychologists have conceived of intelligence as a combination of several abilities. In particular, Gardner and Sternberg have taken the lead in extending the definition of intelligence beyond school-related tasks. Sternberg's triarchic theory proposes analytic, creative, and practical intelligences, while Gardner's theory of multiple intelligences has claimed at least seven components of intelligence—and possibly three more. Meanwhile, cross-cultural psychologists have shown that "intelligence" has different meanings in different cultures. In the United States much emphasis is placed on mental tests. In such a climate, however, a big danger lies in test scores becoming mere labels that influence people's behavior through the self-fulfilling prophecy.

Some psychologists believe that intelligence comprises one general factor, *g*, while others believe that intelligence is a collection of distinct abilities.

HOW DO PSYCHOLOGISTS EXPLAIN IQ DIFFERENCES AMONG GROUPS?

Hereditarian arguments maintain that intelligence is substantially influenced by genetics, a belief endorsed by the U.S. government, which at one time used IQ tests to restrict immigration. Environmental approaches argue that intelligence can be dramatically shaped by influences such as health, economics, and education. While most psychologists now agree that intelligence is heritable, they also know that heritability refers to variation within a group and does not imply that between-group differences are the result of hereditary factors. Nevertheless, the dispute over the nature and nurture of group differences in intelligence flared up again in 1969, when Jensen argued that the evidence favored a strong genetic influence. This argument was echoed in the 1994 book *The Bell Curve.* Critics have pointed out that much of the research cited by those taking the extreme hereditarian position is flawed. In addition, intelligence testing itself may be biased in favor of those with particular language and cultural experiences. Hereditarian claims, however, have stimulated much research, such as Scarr and Weinberg's research on adopted children and follow-up studies of the Head Start program. This research has shown that the racial and class differences in IQ scores can be eliminated by environmental changes.

While most psychologists agree that both heredity and environment affect intelligence, they disagree on the source of IQ differences among racial and social groups.

REVIEW TEST

For each of the following items, choose the single correct or best answer. The correct answers appear at the end.

1. Tests that yield relatively consistent results are said to be
   a. valid.
   b. reliable.
   c. normed.
   d. standardized.
   e. consistent.

2. Howard Gardner's approach to intelligence could be best represented by which of the following:
   a. multiple intelligences
   b. mental retardation is a purely genetic component
   c. general intelligence (g)
   d. IQ has no application to our daily lives
   e. IQ varies over time

3. The AP Exam relies on which test of reliability?
   a. split-half
   b. test–retest
   c. content
   d. face
   e. criterion

4. Objective tests use _____, while subjective tests use _____.
   a. ambiguous figures/selected responses
   b. images/objects
   c. hand scoring techniques/machine scoring techniques
   d. objects/images
   e. selected responses/ambiguous figures

5. Binet and Simon assumed that
   a. intelligence is inherited.
   b. mental age does not increase as fast as chronological age.
   c. social class differences in intelligence should be remedied by governmental programs.
   d. education could affect intelligence.
   e. age and intelligence are not related.

6. According to Lewis Terman's formula, a 9-year-old child with an IQ of 100 would have a mental age of
   a. 9.
   b. 10.
   c. 18.
   d. 90.
   e. 100.

7. According to Howard Gardner, there are at least seven "intelligences." Which one of these is most like an ability assessed by traditional IQ tests?
   a. musical
   b. kinesthetic
   c. linguistic
   d. intrapersonal
   e. instinctual

8. The fact that intelligence is heritable has sometimes been misunderstood by those taking an extreme hereditarian view as meaning that _____ explains _____ differences in IQ scores.
   a. environment/individual
   b. heredity/group
   c. environment/group
   d. heredity/individual
   e. nature/natural

9. The Scarr and Weinberg study supports the idea that racial differences in IQ scores are the result of
   a. genetic differences.
   b. environmental differences.
   c. test biases.
   d. unknown factors.
   e. brain mass.

10. The characteristic that most distinguishes the expert from the novice is
    a. intelligence.
    b. talent.
    c. organized knowledge.
    d. speed of problem solving.
    e. education.

ANSWERS: 1. b 2. a 3. a 4. e 5. d 6. a 7. c 8. b 9. b 10. c

KEY TERMS

Validity (p. 452)
Reliability (p. 452)
Face validity (p. 452)
Content validity (p. 452)
Item analysis (p. 452)
Criterion validity (p. 452)
Test–retest reliability (p. 452)
Split-half reliability (p. 453)
Normal range (p. 453)
Objective test (p. 454)
Subjective test (p. 454)
Inter-rater reliability (p. 454)
Mental age (MA) (p. 457)
Chronological age (CA) (p. 457)
Intelligence quotient (IQ) (p. 458)
Mental retardation (p. 460)
Giftedness (p. 460)
Savant syndrome (p. 463)
***g* factor** (p. 464)
Crystallized intelligence (p. 464)
Fluid intelligence (p. 464)
Practical intelligence (p. 464)
Analytical intelligence (p. 465)
Creative intelligence (p. 465)
Triarchic theory (p. 465)
Multiple intelligences (p. 466)
Self-fulfilling prophecy (p. 468)
Heritability (p. 472)
Eugenics (p. 476)
Experts (p. 477)

AP* REVIEW: VOCABULARY

Match each of the following vocabulary terms to its definition.

1. Validity
2. Reliability
3. Test–retest
4. Split-half
5. Inter-rater reliability
6. Mental age
7. Chronological age
8. Normal range
9. Crystallized intelligence
10. Fluid intelligence

_____ **a.** A measure of reliability in which a test is split into two parts and the scores on the halves of the test are compared.

_____ **b.** A property of a test that actually measures what it purports to measure.

_____ **c.** The average age at which normal (average) individuals achieve a particular score.

_____ **d.** A property of a test will yield consistent results over time.

_____ **e.** The ability to see complex relationships and solve problems.

_____ **f.** Scores falling near the middle of a distribution.

_____ **g.** The number of years since an individual's birth.

_____ **h.** A measure of how two different test scorers would score a test.

_____ **i.** The knowledge a person has acquired, plus the ability to access that knowledge.

_____ **j.** A measure of reliability in which a test is given again to check and see if people get the same scores when they take the test again.

AP* REVIEW: ESSAY

Use your knowledge of the chapter concepts to answer the following essay question.

If you were developing an AP test, how would the following factor into your design?

a. Face validity

b. Item analysis

c. Split-half reliability

OUR RECOMMENDED BOOKS AND VIDEOS

BOOKS

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century.* New York: Basic Books. Psychologist Howard Gardner elaborates and suggests how to apply his theory that each of us possesses seven or more basic types of intelligence to varying degrees: the familiar linguistic and logical-mathematical types that are the focus of traditional education and testing, but also intelligences of music, movement, spatial awareness, and other abilities—including new discoveries such as naturalistic intelligence (awareness of the living environment).

Gould, S. J. (1981). *The mismeasure of man.* New York: Norton. Stephen Jay Gould's book is a classic indictment of flawed assessment and testing, especially when used to discriminate against or oppress social groups.

Perkins, D. (2000). *Archimedes' bathtub: The art and logic of breakthrough thinking.* New York: W. W. Norton. Ancient Greek philosopher Archimedes shouted "Eureka!" ("I have found it") when, lowering himself into a bath, he recognized the process of water displacement. This author explains practical and entertaining strategies for producing creative inspiration in our own lives.

Plous, S. (1993). *The psychology of judgment and decision making.* Philadelphia: Temple University Press. Psychologist Scott Plous argues that common sense is an unreliable guide in modern living, showing the silly choices we make and recommending how judgments can be more logical and successful.

VIDEOS

i am sam. (2001, color, 132 min.). Directed by Jessie Nelson; starring Sean Penn, Michelle Pfeiffer. A gentle retarded man, threatened by a social services agency with losing custody of his young daughter, is helped in his battle by a high-powered attorney whose own life is also troubled. (*Rating PG-13*)

The Luzhin Defense. (2000, color, 112 min.). Directed by Marleen Gorris; starring John Turturro, Emily Watson. In the 1920s, a socially naive but intellectually brilliant Grand Master of chess, protected all his life by his manager, attends a world tournament where he meets the love of his life but finds he is emotionally unprepared to face the real world. (*Rating PG-13*)

Searching for Bobby Fischer. (1993, color, 110 min.). Directed by Steve Zaillian; starring Joe Mantegna, Max Pomeranc, Joan Allen, Ben Kingsley. In this absorbing drama based on true story, a father encourages his talented son to compete for a championship title, revealing the rewards and risks of child genius. (*Rating PG*)