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CHAPTER 12 INTELLIGENCE

T ommy was born in December 1856, In Virginia, USA, to Janet Woodrow, the daughter of a Presbyterian minister, and Joseph Ruggles Wilson, himself a Presbyterian minister who became a leader of the Presbyterian Church in the American South. Tommy's parents were educated people who highly valued learning. As a schoolboy, however, Tommy had great difficulty reading. Despite attending special schools, he still was not able to read until late childhood, around age 10 or 11. With a great deal of hard work, he was eventually able to qualify for admission to the College of New Jersey, which later became Princeton University. Even in college, however, Tommy did not excel at coursework. To this point, you might predict that Tommy's chances for success in life were only moderate. We might say today that 'he didn't look good on paper'. Our modest predictions for Tommy's future would be proven wrong, however. Tommy was Thomas Woodrow Wilson. After graduating from Princeton, he earned a law degree from the University of Virginia and a doctorate in political science from Johns Hopkins University. During periods as a professor at Bryn Mawr College, Wesleyan University, and Princeton University, Wilson wrote nine books and became a respected essayist. He was named president of Princeton in 1902 and then won the race for governor of New Jersey in a landslide election in 1910. In 1912, he ran for president of the United States against the incumbent, President William Howard Taft, and won, becoming the 28th U.S. president. During his eight years in office, Wilson led the United States through World War I and worked extensively to establish the postwar armistice and peace in Europe. In 1919, he won the Nobel Peace Prize for his efforts in establishing the League of Nations. Based on his accomplishments across the course of his life, most people would say that Thomas Woodrow Wilson was an intelligent man. If he had taken an intelligence test or some other kind of aptitude test as a boy, however, he might not have scored in the 'intelligent' range. Wilson's life story raises important questions about what we mean by intelligence. The concept of intelligence has been one of the most contentious across the history of psychology and continues to be so today. Even defining intelligence can be difficult because your definition reflects your theory of what it means to be intelligent, and theories of intelligence differ widely, as we will discuss later. Some theorists have argued that intelligence doesn't exist as a real entity, but is simply a label for what intelligence tests measure. Other theorists suggest that CHAPTER OUTLINE ASSESSMENT OF INTELLECTUAL ABILITIES Reliability Validity Early intelligence tests The Stanford-Binet Intelligence Scale The Wechsler Intelligence Scales The factorial approach CONTEMPORARY THEORIES OF INTELLIGENCE Gardner's theory of multiple intelligences Anderson's theory of intelligence and cognitive development

Sternberg's triarchic theory Ceci's bioecological theory Comparing theories of intelligence CUTTING EDGE RESEARCH: CROSSCULTURAL CONCEPTIONS OF INTELLIGENCE AND TESTING GENETICS AND INTELLIGENCE Heritability EMOTIONAL INTELLIGENCE GENERAL LEARNING DISABILITY Causes of general learning disability Treatments for general learning disability SEEING BOTH SIDES: HOW IMPORTANT IS EMOTIONAL INTELLIGENCE? 433

434 CHAPTER 12 INTELLIGENCE intelligence should be considered more broadly and that it involves the ability to learn from experience, think in abstract terms, and deal effectively with one's environment. ASSESSMENT OF INTELLECTUAL ABILITIES Some industrialized societies rely heavily on objective assessment of cognitive or intellectual abilities. Schoolchildren may be placed in instructional groups on the basis of their performances on such tests. Aptitude or ability tests are part of the admissions procedure in some universities, professional and graduate schools. In addition, many industries and government agencies select job applicants and place or promote employees on the basis of test scores. Beyond these practical concerns, methods of assessment are essential to theory and research on intelligence. Because tests and other assessment instruments play important practical and scientific roles, it is essential that they measure accurately what they are intended to measure. Specifically, they must have reliability and validity. They also must be standardized, meaning that the conditions for taking the test are the same for all test-takers. For example, the instructions accompanying the test must be the same for everyone. Reliability If a test or method of assessment has good reliability, it will yield reproducible and consistent results. If a test yielded different results when it was administered on different occasions or was scored by different people, it would be ª ISTOCKPHOTO.COM/LAURENCE GOUGH Aptitude and knowledge tests are part of admissions processes in many schools. For more Cengage Learning textbooks, visit www.cengagebrain.co.uk We will consider various conceptualizations and theories of intelligence in this chapter. First, however, we discuss how intelligence is measured. unreliable. A simple analogy is a rubber yardstick. If we did not know how much it stretched each time we took a measurement, the results would be unreliable no matter how carefully we made each measurement. Reliability is typically assessed by correlating two sets of scores. For example, the same test might be given to the same group of people on two occasions. If the test is reliable, their scores on the first occasion should correlate highly with their scores on the second. If they do, the test is said to have test-retest reliability or temporal stability. In practice, of course, we would not usually want to give the same test to the same people twice. But there are many situations in which we would want to give equivalent forms of the same test – for example, in the United States, college-bound students often take entrance exams (such as the Scholastic Assessment Test, or SAT) more than once to improve their scores. To ensure that two forms of the same test yield equivalent scores, both forms are administered to the same population and the two forms are correlated. The test is said to have alternative form reliability if the two forms of the test correlate highly. Some of the questions on the SAT do not actually count toward the student's score but are being statistically evaluated so they can be used on future equivalent forms of the test. Another common measure of reliability is internal consistency, the degree to which the separate questions or items on a test measure the same thing. This can be assessed by correlating the scores obtained by a group of individuals on each item with their total scores. Any item that does not correlate with the total score is an unreliable item that is failing to contribute to what the test is measuring. Discarding unreliable items 'purifies' a test by increasing its internal consistency. As the number of reliable items on a test increases, the reliability of the test's total score also increases. Most tests and assessment instruments are scored objectively, often by computer. But

sometimes intellectual performance or social behavior must be subjectively evaluated. An essay examination is a familiar example. To assess the reliability of such subjective judgments, two or more sets of ratings by independent judges are correlated. For example, two observers might independently rate a group of nursery school children for aggression, or two or more judges might be asked to read past inaugural addresses of British prime ministers and rate them for optimism. If the correlation between raters or judges is high, the method is said to possess interrater agreement or interjudge reliability.

In general, a well-constructed, objectively scored test of ability should have a reliability coefficient of .90 or greater. For subjective judgments, reliability coefficients of .70 can sometimes be satisfactory for research purposes, but inferences about particular individuals must be made with great caution. But as noted earlier, the reliability of a test's total score increases as the number of reliable items on the test increases. We can apply the same reasoning to subjective judgments and increase the reliability of the method by adding more judges, raters, or observers. For example, if ratings by two observers correlate only .50, the researcher can add a third, comparable observer and thereby raise the interjudge reliability of their summed ratings to .75; adding a fourth rater would raise the reliability to .80. Validity Reliability assesses the degree to which a test is measuring something, but high reliability does not guarantee that the test has good validity – that is, that it measures what it is intended to measure. For example, if the final examination in your psychology course contained especially difficult vocabulary words or trick questions, it might be a test of your verbal ability or test sophistication rather than of the material learned in the course. Such an examination might be reliable – students would achieve about the same scores on a retest, and the separate items might all be measuring the same thing – but it would not be a valid test of achievement for the course. In some instances, the validity of a test can be assessed by correlating the test score with some external criterion. This correlation is called a validity coefficient, and this kind of validity is called criterion or empirical validity. For example, the relatively strong positive correlation between scores on a university entrance exam and first year grades in university is one indication of the test's validity. Because of sensitivity to race and sex discrimination, the courts are increasingly requiring companies and government agencies that use tests for personnel selection to provide evidence that those tests correlate with on-the-job performance – in other words, that they have criterion or empirical validity. There may be aspects of intelligence for which it is not clear what the external criterion should be. How, for example, should a researcher assess the validity of a test for achievement motivation? One can think of a number of possibilities. The test could be given to business executives to see if it correlates with their salaries. Perhaps the test will correlate with teachers' ratings of their students' ambition. The problem is that there is no single criterion that the researcher is willing to accept as the ultimate 'true' answer. It would be reassuring if the test correlated with executive salaries, but if it did not, the researcher would not be willing to judge the test to be invalid. This is known as the criterion problem in assessment: There is no   measure of 'truth' against which to validate the test. Accordingly, the researcher attempts instead to establish its construct validity – to show that scores on the test correlate with outcomes that the theory says it should predict. This is done through the research process itself. The researcher uses his or her theory both to construct the test and to generate predictions from the theory. Studies using the test are then conducted to test those predictions. To the extent that the results of several converging studies confirm the theory's predictions, both the theory and the test are validated simultaneously. Most often, mixed results suggest ways in which both the theory and the test need to be modified. For example, McClelland (1987) proposed a theory of achievement motivation that was supposed to identify and explain ambitious, high-achieving individuals in any area of activity. A test for assessing achievement motivation was designed and used to test predictions from the theory. Results from several studies indicated that the predictions were confirmed for men involved in entrepreneurial activities but not for women or for individuals involved in other kinds of activities, such as academic research. Accordingly, the theory was modified to apply primarily to entrepreneurial achievement, and the test was modified so that it was more valid for women. Early intelligence tests The first attempt to develop tests of intellectual ability was made a century ago by Sir Francis Galton. A naturalist and mathematician, Galton developed an interest in individual differences after considering the evolutionary theory proposed by his cousin, Charles Darwin. Galton believed that certain families are biologically superior to others – that some people are innately stronger or smarter than others. Intelligence, he reasoned, is a question of exceptional sensory and perceptual skills, which are passed from one generation to the next. Because all information is acquired through the senses, the more sensitive and accurate an individual's perceptual apparatus, the more intelligent the person. (Galton's belief in the heritability of intelligence led him to propose that the human race's mental capacities could be enhanced through eugenics, or selective breeding. Fortunately, he is remembered more for his application of statistics to the study of intelligence than for his espousal of eugenics.) In 1884, Galton administered a battery of tests (measuring variables such as head size, reaction time, visual acuity, auditory thresholds, and memory for visual forms) to more than 9,000 visitors at the London Exhibition. To his disappointment, he discovered that eminent British scientists could not be distinguished from ordinary citizens on the basis of their head size and that measurements such as reaction time were not related to other measures of intelligence. Although his

 test did not prove very useful, Galton did invent the correlation coefficient, which – as we have already seen – plays an important role in psychology. The first tests resembling modern intelligence tests were devised by the French psychologist Alfred Binet in the late nineteenth century. In 1881, the French government passed a law making school attendance compulsory for all children. Previously, slow learners had usually been kept at home, but now teachers had to cope with a wide range of individual differences. The government asked Binet to create a test that would detect children who were too slow intellectually to benefit from a regular school curriculum. Binet assumed that intelligence should be measured by tasks that required reasoning and problem-solving abilities rather than perceptual-motor skills. In collaboration with another French psychologist, Théophile Simon, Binet published such a test in 1905 and revised it in 1908 and again in 1911. Binet reasoned that a slow or dull child was like a normal child whose mental growth was retarded. On tests, the slow child would perform like a younger normal child, whereas the mental abilities of a bright child were characteristic of older children. Binet devised a scale of test items of increasing difficulty that measured the kinds of changes in intelligence ordinarily associated with growing older. The higher a child could go on the scale in answering items correctly, the higher his or her mental age (MA). The concept of mental age was critical to Binet's method. Using this method, the MA of a child could be compared with his or her chronological age (CA) as determined by date of birth. The Stanford-Binet Intelligence Scale The test items originally developed by Binet were adapted for American schoolchildren by Lewis Terman at Stanford University. Terman standardized the administration of the test and developed age-level norms by giving the test to thousands of children of various ages. In 1916, he published the Stanford revision of the Binet tests, now referred to as the Stanford-Binet Intelligence Scale. It was revised in 1937, 1960, 1972, 1986 and most recently in 2003. Despite its age, the Stanford-Binet is still one of the most frequently used psychological tests. Terman retained Binet's concept of mental age. Each test item was age-graded at the level at which a substantial majority of the children pass it. A child's mental age could be obtained by summing the number of items passed at each level. In addition, Terman adopted a convenient index of intelligence suggested by the German psychologist William Stern. This index is the intelligence quotient (IQ), which expresses intelligence as a ratio of mental age to chronological age: IQ ¼ MA=CA 100 For more Cengage Learning textbooks, visit www.cengagebrain.co.uk ª 1986, REPRODUCED WITH PERMISSION OF THE RIVERSIDE PUBLISHING COMPANY, CHICAGO, ILLINOIS Test materials from the Stanford-Binet Intelligence Scale. The number 100 is used as a multiplier so that the IQ will have a value of 100 when MA is equal to CA. If MA is lower than CA, the IQ will be less than 100; if MA is higher than CA, the IQ will be more than 100. The most recent revision of the Stanford-Binet uses standard age scores instead of IQ scores. These can be interpreted in terms of percentiles, which show the percentage of individuals in the standardization group falling above or below a given score. And although the concept of IQ is still used in intelligence testing, it is no longer actually calculated by using this equation. Instead, tables are used to convert raw scores on the test into standard scores that are adjusted so that the mean at each age equals 100. IQ scores tend to fall in the form of a bell-shaped curve, with most people's scores hovering around 100, but some people's scores much higher or lower than 100. Figure 12.1 provides the percentages of the population who will fall in various ranges of IQ scores. In line with the current view of intelligence as a composite of different abilities, the 1986 revision of the Stanford-Binet groups its tests into four broad areas: verbal reasoning, abstract/visual reasoning, quantitative reasoning, and short-term memory (Sattler, 1988). A separate score is obtained for each area. Table 12.1 gives some examples of items, grouped by area. The Wechsler Intelligence Scales In 1939, David Wechsler developed a new test because he thought the Stanford-Binet depended too heavily on

% of population in each IQ range 0.1% 0.1% 2.2% 2.2% 13.6% 34.1% 34.1% 13.6% Severely to profoundly mentally retarded Mildly mentally retarded Borderline mentally retarded Average IQ score Superior Very superior to gifted 100 130 Figure 12.1 Frequency Distribution of IQ Scores. IQ scores fall into a normal distribution, with few scores at either the high or low extremes, and most scores falling around 100. (From A. Anastasia and S. Urbina, Psychological Testing, 7/e, © 1997 Prentice-Hall.) Table 12.1 Items from the Stanford-Binet Intelligence Scale Typical examples of items from the 1986 Stanford-Binet Intelligence Scale for a 6- to 8-year-old. Test Description Verbal reasoning Vocabulary Defines words, such as 'dollar' and 'envelope'. Comprehension Answers questions, such as 'Where do people buy food?' and 'Why do people comb their hair?' Absurdities Identifies the 'funny' aspect of a picture, such as a girl riding a bicycle on a lake or a bald man combing his hair. Verbal relations Tells how the first three items in a sequence are alike and how they differ from the fourth: scarf, tie, muffler, shirt. Quantitative reasoning Quantitative Performs simple arithmetic tasks, such as selecting a die with six spots because the number of spots equals the combination of a two-spot die and a four-spot die. Number series Gives the next two numbers in a series, such as 20 12

___. Equation building Builds an equation from the following array: 3 þ =. One correct response would be 2 þ 3 ¼ 5. Abstract/visual reasoning Pattern analysis Copies a simple design with blocks.

Copying Copies a geometrical drawing demonstrated by the examiner, such as a rectangle intersected by two diagonals. Short-term memory Bead Memory Shown a picture of different-shaped beads stacked on a stick. Reproduces the sequence from memory by placing real beads on a stick. Memory for sentences Repeats after the examiner sentences such as ‘It is time to go to sleep’ and ‘Ken painted a picture for his mother’s birthday’. Memory for digits Repeats after examiner a series of digits, such as 5–7–8–3, forward and backward. Memory for objects Shown pictures of individual objects, such as a clock and an elephant, one at a time. Identifies the objects in the correct order of their appearance in a picture that also includes extraneous objects; for example, a bus, a clown, an elephant, eggs, and a clock.

language ability and was not appropriate for adults. The Wechsler Adult Intelligence Scale, or WAIS (1939, 1955, 1981), is divided into two parts – a verbal scale and a performance scale – that yield separate scores as well as a full-scale IQ. The test items are described in Table 12.2. Wechsler later developed a similar test for children, the Wechsler Intelligence Scale for Children (WISC) (1958, 1974, 1991). Items on the performance scale require the manipulation or arrangement of blocks, pictures, or other materials. The Wechsler scales also provide scores for each subtest, so the examiner has a clearer picture of the individual’s intellectual strengths and weaknesses. For example, a discrepancy between verbal and performance scores prompts the examiner to look for specific learning problems such as reading disabilities or language handicaps. Both the Stanford-Binet and the Wechsler scales show good reliability and validity. They have test-retest reliabilities of about .90, and both are fairly valid predictors of achieve-ment in school, with validity coefficients of about .50. The factorial approach Some psychologists view intelligence as a general capacity for comprehension and reasoning that manifests itself in various ways. This was Binet’s assumption. Although his test contained many kinds of items, Binet observed that a bright child tended to score higher than dull children on all of them. He assumed, therefore, that the different tasks sampled a basic underlying ability. Similarly, despite the diverse subscales included in the WAIS, Wechsler also believed that ‘intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment’ (Wechsler, 1958). Other psychologists, however, question whether there is such a thing as ‘general intelligence’. They believe that intelligence tests sample a number of mental abilities that Table 12.2 Tests composing the Wechsler Adult Intelligence Scale The tests of the Wechsler Intelligence Scale for Children are similar to those of the adult scale, with some modifications. Test Description Verbal scale Information Questions tap a general range of information, for example, ‘What is the capital of Italy?’ Comprehension Tests practical information and ability to evaluate past experience, for example, ‘Why do we put stamps on a letter to be mailed?’ Arithmetic Verbal problems testing arithmetic reasoning. Similarities Asks in what way two objects or concepts (for example, recipe and map) are similar; assesses abstract thinking. Digit span A series of digits presented auditorily (for example, 7–5–6–3–8) is repeated in a forward or backward direction; tests attention and rote memory. Vocabulary Assesses word knowledge. Letter number sequencing Orally presented letters and numbers in a mixed-up order must be reordered and repeated, first with the numbers in ascending order and then with the letters in alphabetical order; assesses working memory. Performance scale Digit symbol A timed coding task in which numbers must be associated with marks of various shapes; assesses speed of learning and writing. Picture completion The missing part of an incompletely drawn picture must be discovered and named; assesses visual alertness, visual memory, and perceptual organization. Block design Pictured designs must be copied with blocks; assesses ability to perceive and analyze patterns. Picture arrangement A series of comic-strip pictures must be arranged in the right sequence to tell a story; assesses understanding of social situations. Matrix reasoning A geometric shape that is similar in some way to a sample shape must be selected from a set of possible alternatives; assesses perceptual organization. Object assembly Puzzle pieces must be assembled to form a complete object; assesses ability to deal with part–whole relationships Symbol search A series of paired groups of symbols are presented, a target group of two symbols and a search group. Examinee must determine if either target symbol appears in the search group; assesses processing speed. CHAPTER 12 INTELLIGENCE For more Cengage Learning textbooks, visit www.cengagebrain.co.uk

are relatively independent of one another. One method of obtaining more precise information about the kinds of abilities that determine performance on intelligence tests is factor analysis, a statistical technique that examines the intercorrelations among a number of tests and, by grouping those that are most highly correlated, reduces them to a smaller number of independent dimensions, called factors. The basic idea is that two tests that correlate very highly with each other are probably measuring the same underlying ability. The goal is to discover the minimum number of factors, or abilities, required to explain the observed pattern of correlations among an array of different tests. It was the originator of factor analysis, Charles Spearman (1904), who first proposed that all individuals possess a general intelligence factor (called g) in varying amounts. A person could be described as generally bright or generally dull, depending on the amount of g he or she possessed. According to Spearman, the g factor is the major determinant of performance on intelligence tests. In addition, special factors, each called s, are specific to particular abilities or tests. For example, tests of arithmetic or spatial relationships would each tap a separate s. An individual's tested intelligence would reflect the amount of g plus the magnitude of the various s factors possessed by that individual. Performance in mathematics, for example, would be a function of a person's general intelligence and mathematical aptitude. A later investigator, Louis Thurstone (1938), objected to Spearman's emphasis on general intelligence, suggesting instead that intelligence can be divided into a number of primary abilities by using factor analysis. After many rounds of administering tests, factor-analyzing the results, purifying the scales, and retesting, Thurstone identified seven factors, which he used to construct his Test of Primary Mental Abilities. Revised versions of this test are still widely used, but its predictive power is no greater than that of general intelligence tests such as the Wechsler scales. Thurstone's hope of discovering the basic elements of intelligence through factor analysis was not fully realized, for several reasons. For one, his primary abilities are not completely independent. Indeed, the significant intercorrelations among them provide support for the concept of a general intelligence factor underlying the specific abilities. For another, the number of basic abilities identified by factor analysis depends on the nature of the test items. Other investigators, using different test items and alternative methods of factor analysis, have identified from 20 to 150 factors representing the range of intellectual abilities (Ekstrom, French, & Harman, 1979; Ekstrom, French, Harman, & Derman, 1976; Guilford, 1982). This lack of consistency in numbers and kinds of factors raises doubts about the value of the factorial approach. Nevertheless, factor analysis remains an important technique for studying intellectual performance (Lubinski, 2000), and we will encounter it again when we discuss personality traits in Chapter 13. For more Cengage Learning textbooks, visit www.cengagebrain.co.uk ASSESSMENT OF INTELLECTUAL ABILITIES INTERIM SUMMARY l There are many different definitions of intelligence. Some theorists view it as simply what intelligence tests measure. Others view it as a set of general abilities, including the ability to learn from experience, think in abstract terms, and deal effectively with one’s environment. l A good test of intelligence must be reliable – it yields reproducible and consistent results. Alternate form reliability is shown when two forms of a test correlate highly with each other. A test has good internal consistency when various items on the test are correlated highly with each other. When more subjective assessments are used, judges rate the answers of respondents, and the researcher hopes to see interjudge reliability or interrater reliability. l A test has good validity if it measures what it is intended to measure. Criterion or empirical validity is shown when the test is highly correlated with another test of the same construct. Construct validity is shown when the scores on the test predict outcomes that the researcher’s theory suggests it should predict. l The first successful intelligence tests were developed by the French psychologist Alfred Binet, who proposed the concept of mental age. A bright child’s mental age is above his or her chronological age; a slow child’s mental age is below his or her chronological age. The concept of the intelligence quotient (IQ), the ratio of mental age to chronological age (multiplied by 100), was introduced when the Binet scales were revised to create the Stanford-Binet. Many intelligence test scores are still expressed as IQ scores, but they are no longer actually calculated according to this formula. l Both Binet and Wechsler, the developer of the Wechsler Adult Intelligence Scale (WAIS), assumed that intelligence is a general capacity for reasoning. l Similarly, Spearman proposed that a general factor (g) underlies performance on different kinds of test items. Factor analysis is a method for determining the kinds of abilities that underlie performance on intelligence tests. CRITICAL THINKING QUESTIONS 1 In order to determine the validity of an intelligence test, we have to have some outcome against which performance on the test is measured. What do you think are the right outcomes that any intelligence test should predict? 2 Why do you think some people care so much about measuring intelligence?

440 CHAPTER 12 INTELLIGENCE CONTEMPORARY THEORIES OF INTELLIGENCE Until the 1960s, research on intelligence was dominated by the factorial approach. However, with the development of cognitive psychology and its emphasis on informationprocessing models (see Chapter 9), a new approach emerged. This approach is defined somewhat differently by different investigators, but the basic idea is to try to understand intelligence in terms of the cognitive processes that operate when we engage in intellectual activities (Sternberg & Kaufman, 1998). The information-processing approach asks:

1. What mental processes are involved in the various tests of intelligence?
2. How rapidly and accurately are these processes carried out?
3. What types of mental representations of information do these processes act upon? Rather than trying to explain intelligence in terms of factors, this approach attempts to identify the mental processes that underlie intelligent behavior. It assumes that individual differences on a given task depend on the specific processes that different individuals bring into play and the speed and accuracy of those processes. The goal is to use an information-processing model of a particular task to identify appropriate measures of the processes used in performing the task. These measures may be as simple as the response to a multiple-choice item, or they may include response speed or the eye movements associated with the response. The idea is to use whatever information is needed to estimate the efficiency of each component process. Gardner’s theory of multiple intelligences Howard Gardner (2004a) developed his theory of multiple intelligences as a direct challenge to what he calls the ‘classical’ view of intelligence as a capacity for logical

reasoning. Gardner was struck by the variety of adult roles in different cultures – roles that depend on a variety of skills and abilities yet are equally important to successful functioning in those cultures. His observations led him to conclude that there is not just one underlying mental capacity or g, but a variety of intelligences that work in combination. He defines an intelligence as the 'ability to solve problems or fashion products that are of consequence in a particular cultural setting or community' (1993b, p. 15). It is these multiple intelligences that enable human beings to take on such diverse roles as physicist, farmer, shaman, and dancer. Gardner is quick to point out that an intelligence is not a 'thing', some sort of commodity inside the head, but 'a For more Cengage Learning textbooks, visit www.cengagebrain.co.uk potential, the presence of which allows an individual access to forms of thinking appropriate to specific kinds of content' (Kornhaber & Gardner, 1991, p. 155). According to Gardner's theory of multiple intelligences, there are seven distinct kinds of intelligence that are independent of one another, each operating as a separate system (or module) in the brain according to its own rules. These are (1) linguistic, (2) musical, (3) logical-mathematical, (4) spatial, (5) bodily-kinesthetic, (6) intrapersonal, and (7) interpersonal. These are described more fully in Table 12.3. Gardner analyzes each kind of intelligence from several viewpoints: the cognitive operations involved, the appearance of prodigies and other exceptional individuals, Table 12.3 Gardner's Seven Intelligences (Adapted from Gardner, Kornhaber, & Wake, 1996) Type of Intelligence Description

4. Linguistic intelligence The capacity for speech, along with mechanisms dedicated to phonology (speech sounds), syntax (grammar), semantics (meaning), and pragmatics (implications and uses of language in various settings).
5. Musical intelligence The ability to create, communicate, and understand meanings made of sound, along with mechanisms dedicated to pitch, rhythm, and timbre (sound quality). The ability to use and appreciate relationships in the absence of action or objects – that is, to engage in abstract thought.
6. Logicalmathematical intelligence
7. Spatial intelligence The ability to perceive visual or spatial information, modify it, and re-create visual images without reference to the original stimulus. Includes the capacity to construct images in three dimensions and to move and rotate those images. The ability to use all or part of the body to solve problems or fashion products; includes control over fine and gross motor actions and the ability to manipulate external objects.
8. Bodilykinesthetic intelligence
9. Intrapersonal intelligence The ability to distinguish among one's own feelings, intentions, and motivations.
10. Interpersonal intelligence The ability to recognize and make distinctions among other people's feelings, beliefs, and intentions.

evidence from cases of brain damage, manifestations in different cultures, and the possible course of evolutionary development. For example, certain kinds of brain damage can impair one type of intelligence and have no effect on the others. He notes that the capacities of adults in different cultures represent different combinations of the various intelligences. Although all normal people can apply all of the intelligences to some extent, each individual is characterized by a unique combination of relatively stronger and weaker intelligences (Gardner, 2004a), which help account for individual differences. As noted earlier, conventional IQ tests are good predictors of college grades, but they are less valid for © ISTOCKPHOTO.COM/DIGITAL SAVANT LLC © BOB DAEMMRICH/STOCK BOSTON © ISTOCKPHOTO.COM/RAPID EYE MEDIA According to Gardner's theory of multiple intelligences, these three individuals are displaying different kinds of intelligence: logical-mathematical, musical, and spatial. For more Cengage Learning textbooks, visit www.cengagebrain.co.uk CONTEMPORARY THEORIES OF INTELLIGENCE predicting later job success or career advancement. Measures of other abilities, such as interpersonal intelligence, may help explain why some people with brilliant college records fail miserably in later life while lesser students become charismatic leaders. Gardner and colleagues therefore call for 'intelligence-fair' assessments in schools that would allow children to demonstrate their abilities by other means besides paper-and-pencil tests, such as putting together gears to demonstrate spatial skills (Gardner, 2004b). Anderson's theory of intelligence and cognitive development One criticism of Gardner's theory is that high levels of ability in any of the various intelligences are usually correlated with high ability in the others; that is, no specific intellectual capacity is wholly distinct from the others (Messick, 1992; Scarr, 1985). In addition, psychologist Mike Anderson points out that Gardner's multiple intelligences are ill-defined – they are 'sometimes a behavior, sometimes a cognitive process, and sometimes a structure in the brain' (1992, p. 67). Anderson therefore has sought to develop a theory based on the idea of general intelligence proposed by Thurstone and others. Anderson's theory of intelligence holds that individual differences in intelligence and developmental changes in intellectual competence are explained by different mechanisms. Differences in intelligence result from differences in the 'basic processing mechanism' that implements thinking, which in turn yields knowledge. Individuals vary in the speed at which basic processing occurs. A person with a slower basic processing mechanism is likely to have more difficulty acquiring knowledge than a person with a faster processing mechanism. This is equivalent to saying that a low-speed processing mechanism produces low general intelligence. Anderson notes, however, that there are some cognitive mechanisms that show no individual differences. For example, people with Down syndrome may not be able to add 2 plus 2 yet can recognize that other people hold beliefs and may act on those beliefs (Anderson, 1992). The mechanisms that provide these universal capacities are 'modules'. Each module functions independently, performing complex computations. Modules are not affected by the basic processing mechanism; they are virtually automatic. According to Anderson, it is the maturation of new modules that explains the increase of cognitive abilities in the course of development. For example, the maturation of a module devoted to language would explain the development of the ability to speak in complete sentences. In addition to modules, according to Anderson, intelligence includes two 'specific abilities'. One of these deals with propositional thought (language mathematical expression) and the other with visual and spatial functioning.

442 CHAPTER 12 INTELLIGENCE Anderson suggests that the tasks associated with these abilities are carried out by 'specific processors'. Unlike modules, which carry out very particular functions, each of the specific processors handles a broad class of problems or knowledge. Also unlike modules, specific processors are affected by the basic processing mechanism. A high-speed processing mechanism enables a person to make more effective use of the specific processors to score higher on tests and accomplish more in the real world. Anderson's theory of intelligence thus suggests two different 'routes' to knowledge. The first involves using the basic processing mechanism, which operates through the specific processors, to acquire knowledge. In Anderson's view, this is what we mean by 'thinking', and it accounts for individual differences in intelligence (which, in his view, are equivalent to differences in knowledge). The second route involves the use

of modules to acquire knowledge. Modulebased knowledge, such as perception of three-dimensional space, comes automatically if the module has matured sufficiently, and this accounts for the development of intelligence. Anderson’s theory can be illustrated by the case of a 21-year-old man known as MA who suffered convulsions as a child and was diagnosed with autism (see Chapter 16 for a discussion of autism). As an adult, he could not talk and achieved very low scores on psychometric tests. However, he was found to have an IQ of 128 and had an extraordinary ability to detect prime numbers, doing so more accurately than a scientist with a degree in mathematics (Anderson, 1992). Anderson concludes that MA had an intact basic processing mechanism, which allowed him to think about abstract symbols, but had suffered damage to his linguistic modules, which hindered acquisition of everyday knowledge and communication. Sternberg’s triarchic theory In contrast to Anderson’s theory, Robert Sternberg’s triarchic theory addresses experience and context as well as basic information-processing mechanisms (Sternberg, 1985). His theory has three parts or subtheories: the componential subtheory, which deals with thought processes; the experiential subtheory, which deals with the effects of experience on intelligence; and the contextual subtheory, which considers the effects of the individual’s environment and culture. The most highly developed of these subtheories is the componential subtheory. The componential theory considers the components of thought. Sternberg has identified three types of components:

1. Metacomponents are used to plan, control, monitor, and evaluate processing during problem solving. Sternberg (1985) has relabeled these as analytical For more Cengage Learning textbooks, visit www.cengagebrain.co.uk abilities. For example, if you were going to cook Thanksgiving dinner, you would have to plan the menu and then monitor your progress toward getting all the ingredients, cooking each dish, and making sure everything was ready to serve at the same time.
2. Performance components carry out problem-solving strategies. Sternberg (1985) now calls these creative abilities. A skilled mechanic can use his creative abilities to devise a way to fix parts of a car that are not working.
3. Knowledge-acquisition components encode, combine, and compare information during the course of problem solving. Sternberg (1985) now calls these practical abilities. You are using your knowledgeacquisition or practical abilities as you read through this chapter and decide to commit certain pieces of information to memory. These components are intertwined. Each comes into play during the problem-solving process, and none of them can operate independently. Sternberg illustrates the functioning of these components with analogy problems of the following kind: lawyer is to client as doctor is to ______________ (a) medicine (b) patient A series of experiments with such problems led Sternberg to conclude that the critical components were the encoding process and the comparison process. The participant encodes each of the words in the analogy by forming a mental representation of the word – in this case, a list of attributes of the word that are retrieved from long-term memory. For example, a mental representation of the word ‘lawyer’ might include the following attributes: college-educated, versed in legal procedures, represents clients in court, and so on. Once the participant has formed a mental representation for each word in the analogy, the comparison process scans the representations looking for matching attributes that solve the analogy. Other processes are involved in analogy problems, but Sternberg has shown that individual differences on this task are determined primarily by the efficiency of the encoding and comparison processes. The experimental

evidence shows that individuals who score high on analogy problems (skilled performers) spend more time encoding and form more accurate mental representations than do individuals who score low on such problems (less-skilled performers). In contrast, during the comparison stage, the skilled performers are faster than the less-skilled performers in matching attributes, but both are equally accurate. So, the better test scores for skilled performers are based on the increased accuracy of their encoding process, but the time they require to solve the problem is a complicated mix of slow encoding speeds and fast comparisons.

The componential subtheory by itself does not provide a complete explanation of individual differences in intelligence. The experiential subtheory is needed to account for the role of experience in intelligent performance. According to Sternberg, differences in experience affect the ability to solve a given problem. A person who has not previously encountered a particular concept, such as a mathematical formula or an analogy problem, will have more difficulty applying that concept than someone who is experienced in the use of that concept. An individual's experience with a task or problem thus falls somewhere along a continuum that extends from totally novel to completely automatic (that is, totally familiar as a result of long experience). Of course, a person's exposure to particular concepts depends to a large extent on the environment. This is where the contextual subtheory comes in. This subtheory is concerned with the cognitive activity needed to fit into particular environmental contexts (Sternberg, Castejon, Prieto, Hautamaeki, & Grigorenko, 2001). It focuses on three mental processes: adaptation, selection, and shaping of real-world environments. According to Sternberg, the individual first looks for ways to adapt, or fit into, the environment. If it is not possible to adapt, the individual tries to select a different environment or to shape the existing environment in order to fit into it better. A spouse who is unhappy in a marriage may not be able to adapt to the current circumstances. He or she may therefore select a different environment (for example, through separation or divorce) or try to shape the existing environment (for example, through counseling) (Sternberg, 1985). Ceci's bioecological theory Some critics claim that Sternberg's theory has so many parts that it is not coherent (Richardson, 1986). Others note that it does not show how problem solving occurs in everyday contexts. Still others point out that it largely ignores the biological aspects of intelligence. Stephen Ceci (1990, 1996) has attempted to address these issues by building on Sternberg's theory while placing much more emphasis on context and its impact on problem solving. Ceci's bioecological theory proposes that there are 'multiple cognitive potentials', rather than a single underlying general intelligence or g. These multiple abilities, or intelligences, are biologically based and place limits on mental processes. Their emergence, however, is shaped by the challenges and opportunities in the individual's environment, or context. In Ceci's view, context is essential to the demonstration of cognitive abilities. By 'context', he means domains of knowledge as well as factors such as personality, motivation, and education. Contexts can be mental, social, or physical (Ceci & Roazzi, 1994). A particular individual   or population may appear to lack certain mental abilities, but if given a more interesting and motivating context, the same individual or population can demonstrate a higher level of performance. To take just one example, in a famous longitudinal study of high-IQ children studied by Lewis Terman (Terman & Oden, 1959), high IQ was thought to be correlated with high achievement. But a closer look at the results revealed that children from upperincome families went on to become more successful adults than children from lower-income families. In addition, those who became adults during the Great Depression ended up less successful than those who became adults later, when there were more job opportunities. In Ceci's words, 'The bottom line . . . is that the ecological niche one occupies, including individual and historical development, is a far more potent determinant of one's professional and economic success than is IQ' (1990, p. 62). Ceci also argues against the traditional view that intelligence is related to a capacity for abstract thinking, regardless of the subject area. He believes that the ability to engage in complex thought is tied to knowledge gained in particular contexts or domains. Rather than being endowed with a greater capacity for abstract reasoning, intelligent people have enough knowledge in a particular domain to enable them to think in a complex way about problems in that area of knowledge (Ceci, 1990). In the course of working in a particular domain – for example, computer programming – the individual's knowledge base grows and becomes better organized. Over time, this makes possible more intelligent performances – for example, more efficient programs. In sum, according to Ceci, everyday or real-world intellectual performance cannot be explained by IQ alone or by some biological notion of general intelligence. Instead, it depends on the interaction between multiple cognitive potentials with a rich, well-organized knowledge base. For example, a child could be born with strong cognitive potentials, but if she was raised in an extremely impoverished intellectual environment, she might never develop these potentials. One longitudinal study provided evidence of the impact of environment on IQ. Sameroff and colleagues (1993) examined the relationship between the environment children were exposed to in early childhood and their IQs at ages 4 and 13. The more environmental risk factors a child was exposed to – such as lack of education or mental illness in his or her mother, minority status (which is associated with low standard of living and inferior schools), and large family size – the lower the child's IQ was (see Figure 12.2). Comparing theories of intelligence The four theories of intelligence discussed in this section differ in several ways (see the Concept Review Table).

 Mean 4-year IQ score Mean 13-year IQ score 110 IQ 90 0 2 4 6 7–9 Multiple risk score Figure 12.2 The Impact of the Environment on IQ. Research indicates that the more risk factors children are exposed to, the lower their IQs tend to be. (After Sameroff) CONCEPT REVIEW TABLE Comparing theories of intelligence The four theories of intelligence reviewed conceptualize intelligence quite differently. Theory Description Gardner's theory Intelligence is an ability to solve problems or create products that are of value in a particular culture. Anderson's theory Intelligence is a basic processing mechanism, along with specific processors that deal with propositional thought and visual and spatial functioning. Sternberg's triarchic theory It consists of three subtheories: the componential theory, which looks at internal information-processing mechanisms; the experiential subtheory, which takes into account the individual's experience with a task or situation; and the contextual subtheory, which explores the relationship between the external environment and the individual's intelligence. Ceci's bioecological theory Intelligence involves multiple cognitive potentials that are biologically based, but their expression depends on the knowledge an individual has amassed in a particular domain. Gardner attempts to explain the wide variety of adult roles found in different cultures. He believes that this diversity cannot be explained by a single underlying intelligence and instead proposes that there are at least seven different intelligences, which are present in different combinations in each individual. To Gardner, an intelligence is an ability to solve problems or create products that are of value in a particular culture. In this view, the Polynesian mariner who is skilled at navigating by the stars, the figure skater who can successfully execute a triple axel, and the charismatic leader who can motivate throngs of followers are as 'intelligent' as a scientist, mathematician, or engineer. Anderson's theory attempts to explain several aspects of intelligence – not only individual differences but also the increase of cognitive abilities with development, the existence of specific abilities, and the existence of universal abilities that do not vary from one individual to another, such as the ability to see objects in three dimensions. To explain these aspects, he proposes the existence of a basic processing mechanism, equivalent to Spearman's general intelligence or g, along with specific processors that deal with propositional thought and visual and spatial functioning. The existence of universal abilities is explained by the notion of 'modules' whose functioning depends on maturation. Sternberg's triarchic theory stems from the belief that earlier theories are not wrong but merely incomplete. It consists of three subtheories: the componential subtheory, which looks at internal information-processing mechanisms; the experiential subtheory, which takes into account the individual's experience with a task or situation; and the contextual subtheory, which explores the relationship between the external environment and the individual's intelligence. Ceci's bioecological theory extends Sternberg's theory by examining the role of context in greater depth. Rejecting the idea of a single general capacity for abstract problem solving, Ceci proposes that intelligence rests on multiple cognitive potentials. These potentials are biologically based, but their expression depends on the knowledge an individual has amassed in a particular domain. Knowledge is crucial to intelligence, in Ceci's view. Despite their differences, these theories have some aspects in common. They all attempt to take into account the biological basis of intelligence, be it a basic processing mechanism or a set of multiple intelligences, modules, or cognitive potentials. In addition, three of the theories place a strong emphasis on the contexts within which individuals operate – environmental factors that influence intelligence. Thus, the study of intelligence continues to explore the complex interaction between biological and environmental factors that is a central focus of psychological research today.

CUTTING EDGE RESEARCH Cross-Cultural Conceptions of Intelligence and Testing Nations and cultures vary greatly in their conceptions of intelligence, and the means used to identify highly intelligent individuals. In the United States, the notion that intelligence is a general characteristic of the individual that is inborn still dominates laypeople's conceptions of intelligence (Kaufman & Sternberg, 2007). Sternberg's (2004) and Gardner's (2004a) arguments that there are multiple types of intelligence have had some impact on education, leading educators to be concerned about matching tasks to a child's learning style. But IQ tests and other standardized tests of general verbal and quantitative abilities are still widely used in the U.S. to determine access to any forms of education, even beginning at the preschool level! The reliance on standardized tests such as the SAT, GRE, MCAT, and GMAT for admissions decisions for U.S. colleges, graduate and professional schools, and even in job applications, is so great that whole industries have been developed to teach applicants how to maximize their scores on standardized tests. In contrast, the use of standardized tests to determine access to education and jobs varies much more across other nations, and in Australia, even across states (see Phillipson & McCann, 2007). This reflects, to a large degree, political and social philosophies that opportunities should be available to all individuals in the society. It also reflects deep-seated skepticism about the usefulness of intelligence tests. Differences in the use of standardized tests also reflect differences in conceptions of intelligence. Many cultures put emphasis on social intelligence (Sternberg, 2000). For example, several African cultures emphasize responsible participation in the family, cooperativeness, and obedience as important to intelligence. In Zimbabwe, the word for 'intelligence', ngware, actually means to be prudent and cautious, especially in social relationships (Sternberg, 2000). Similarly, some studies of China and Taiwan find that social competence and self-knowledge are important components of intelligence, according to citizens of these cultures (Sternberg, 2000). It is important to note that African and Asian cultures do not exclusively emphasize social intelligence but also recognize the importance of the cognitive skills. Over evolution, individuals who were able to adapt to the demands of their environments were more likely to survive and reproduce. Still today, the demands of the environment shape what skills cultures value. For example, in rural Kenya, knowledge of herbal medicines that are used to kill parasites is critical to survival, given the prevalence of hookworm, whipworm, and other diseases. Thus, people whose knowledge of herbal medicines is great are considered highly intelligent in that culture (Sternberg et al., 2001). Among Native American Yup'ik Eskimos, hunting, gathering and fishing skills are critical to survival, so individuals possessing these skills are considered intelligent (Grigorenko et al., 2004). Some theorists argue that intelligence is completely culturally bound, and that there are no overarching dimensions of intelligence that are applicable across cultures (see Phillipson,   2007). Others argue that many aspects of intelligence are culturally bound, but that there are some basic dimensions or skills that are universally valuable to survival and success, such as problem-solving skills (Sternberg, 2007). In all cultures, people need to be able to recognize when they have a problem, define what the problem is, allocate resources for solving the problems, mentally represent the problems, set up strategies for solving the problems, then evaluate the success of their solutions. The specific nature of the problem will vary greatly across environments and cultures. But these steps of problem-solving are applicable to a wide variety of problems. Identifying whether people of many cultures have basic skills such as problem-solving skills is no easy task, however. Attempts have been made to design culturally neutral intelligence tasks of basic cognitive skills, and most attempts have been disappointing. A classic example involves the interpretation of syllogisms, logical problems often used in intelligence tests. A typical syllogism runs like this: 'All bears in the North are white. My friend saw a bear in the North. What color was that bear?' According to intelligence tests, the 'right' answer is that the bear is white. A subject's ability to infer that the bear is white is taken as an indication of his or her deductive reasoning skills. When researchers asked farmers in Central Asia to solve these syllogisms, however, they discovered that this form of reasoning violated a social norm that you never state something you do not know from firsthand experience (Luria, 1976, pp. 108–109): Experimenter: In the Far North, where there is snow, all bears are white. Novaya Zemlya is in the Far North and there is always snow there. What color are the bears there? Respondent: . . . We always speak only of what we see; we don't talk about what we haven't seen. E: But what do my words imply? (The syllogism is repeated.) R: Well, it's like this: our tsar isn't like yours, and yours isn't like ours. Your words can be answered only by someone who was there and if a person wasn't there, he can't say anything on the basis of your words. E: . . . But on the basis of my words – in the North, where there is always snow, the bears are white, can you gather what kind of bears there are in Novaya Zemlya? R: If a man was 60 or 80 and had seen a white bear and had told about it, he could be believed, but I've never seen one and hence I can't say. That's my last word. This may have been interpreted as unintelligent by the rules of the test, but he was only following a social convention of his culture in his answer to the experimenter. Critics of

 intelligence tests argue that similar cultural clashes happen in subtler ways whenever persons not of the dominant, educated culture that created intelligence tests are asked to take these tests. A 'culture-fair' test would have to include items that are equally applicable to all groups or items that are different for each culture but are psychologically equivalent for the groups being tested. The fast-paced globalization of economies and communication is driving many more researchers to be concerned INTERIM SUMMARY l Gardner's theory of multiple intelligences suggests that there are seven distinct kinds of intelligence that are independent of one another, each operating as a separate system (or module) in the brain according to its own rules. These are (1) linguistic, (2) musical, (3) logical-mathematical, (4) spatial, (5) bodily-kinesthetic, (6) intrapersonal, and (7) interpersonal. l Anderson's theory of intelligence suggests that differences in intelligence result from differences in the 'basic processing mechanism' that implements thinking, which in turn yields knowledge. l Sternberg's triarchic theory has three parts or subtheories: the componential subtheory, which deals with thought processes; the experiential subtheory, which deals with the effects of experience on intelligence; and the contextual subtheory, which considers the effects of the individual's environment and culture. According to his componential subtheory, three components of thought are critical in intelligence: metacomponents or analytical abilities, performance components or creative abilities, and knowledgeacquisition components or practical abilities. l According to Ceci's bioecological theory of intelligence, everyday or real-world intellectual performance cannot be explained by IQ alone or by some biological notion of general intelligence. Instead, it depends on the interaction between multiple cognitive potentials with a rich, well-organized knowledge base. CRITICAL THINKING QUESTIONS 1 From your observations, what skills or abilities do you think are the most important components of intelligence? 2 What practical skills in your culture are considered key to intelligence? with differences across cultures in definitions and ways of measuring intelligence (Phillipson, 2007). This work has practical implications for how children and adults from cultures other than the dominant culture of a region will be treated in terms of access to education and jobs. There are also fundamental theoretical questions about whether or not there are universal components to intelligence, and whether different cultures think in fundamentally different ways. GENETICS AND INTELLIGENCE Some of the fiercest debates over intelligence have focused on the contribution of genetics to determining the level of intelligence in individuals or groups. Advocates of particular political positions and social policies frequently argue either for or against the idea that intelligence is inherited (for example, Herrnstein & Murray, 1994). Because these debates reveal widespread public misunderstanding about the empirical issues involved, we will describe in some detail the reasoning and methods that behavioral scientists use to assess how genetic and environmental factors contribute to individual differences, including differences in intelligence. We begin with Table 12.4, which lists (in descending order) the scores of a hypothetical examination taken by two groups of six students each. As shown in the last row, the average (mean) score of the students within each group is 82.0. But we can also see that the scores from Class A are much more spread out – that is, more variable – than the scores from Class B. In other words, the students in Class A are more different from one another than the students in Class B. As explained in the Appendix, the degree to which the scores in a set differ from one another Table 12.4 Hypothetical examination scores of two groups of students Group A Group B Alice Greta Bob Harold Carol Ilene Dan John Emily Karen Fred Leon Average 82.0 Average 82.0

can be expressed mathematically by a quantity called their variance. Now consider the scores for Class A. Why are they different from one another? Why do some students do better than others? What accounts for the variance we observe? One obvious possibility is that some students studied for the exam longer than other students did. To find out whether and to what extent this is true, we could conduct a hypothetical experiment in which we 'controlled for' the variable of study time by requiring all students to study exactly three hours for the exam, no more and no less. If study time really does affect students' scores, what would happen to the variance of those scores? First, some of the students who would have studied longer than three hours and done quite well will now do less well. For example, if Alice – who might have studied for six hours to achieve her perfect score of 100 – had been permitted to study for only three hours, her score might have been more like Greta's score of 89. Second, some of the students who would have studied less than three hours and not done very well will now do better. Fred – who had time to only skim the reading for the exam – might have obtained a score higher than 58 if he had studied for three hours. Like Leon, he might at least have obtained a score of 75. In other words, if we controlled the study time of Class A, the students' scores would bunch closer together, looking more like Class B's scores – the variance of their scores would decrease. If we actually did this experiment and observed that the variance in Class A's scores decreased by, say, 60 percent, we could claim that study time had accounted for 60 percent of the variance in the original scores for this class. In this hypothetical example, then, a major reason the exam scores differed so much from one another in Class A is that students differed in the amount of time they spent studying. Theoretically, we could test for other potential sources of variance in the same way. If we think that having a good breakfast might affect students' scores, we could feed all the students the same breakfast (or deny breakfast to all the students) and observe whether the variance of their scores is reduced as a result. In general, holding constant any variable that 'makes a difference' will reduce the variance of the scores. In the extreme case, if we held all the relevant variables constant, the variance would diminish to zero: Every student would obtain the same score. However, we cannot say what will happen to the mean of the scores when we hold a variable constant. For example, if the students in Class A had originally studied for the exam for only two hours on the average, by requiring them all to study for three hours we will raise the class average. If, however, the students had studied for four hours on the average, we will lower the class average by limiting everybody to only three hours of study time. GENETICS AND INTELLIGENCE Heritability We are now prepared to ask the 'genetics' question: To what extent do some students do better than others on the exam because they are genetically more capable? To put it another way, what percentage of the variance in exam scores is accounted for by genetic differences among the students? In general, the percentage of the variance in any trait that is accounted for by genetic differences among the individuals in a population is the trait's heritability. The more individual differences on a trait are due to genetic differences, the closer the heritability is to 100 percent. For example, height is heavily influenced by genetics: Its heritability ranges from about 85 to 95 percent across different studies. Now, however, we face a practical difficulty. We cannot experimentally determine how much of the variance in exam scores is accounted for by genetic differences the way we did for study time because that would require holding the genetic variable constant – that is, turning all the students into genetic clones. But we can take advantage of the fact that nature sometimes produces genetic clones in the form of identical twins. To the extent that identical twins are more alike on a trait than fraternal twins, we can infer that the trait has a genetic or heritable component (assuming that other factors, such as differential parental treatment, can be ruled out). Across many twin studies the heritability of intelligence (as measured by intelligence tests) has been estimated to be between 60 percent and 80 percent (Lubinski, 2000). One difficulty in interpreting the results of twin studies is that identical twin pairs may be treated more alike than fraternal twin pairs, which may account for the greater similarity of their personalities. This is one reason that researchers at the University of Minnesota decided to study sets of twins who had been reared apart (Bouchard, Lykken, et al., 1990). Several studies of twins suggest IQ is partly heritable.

The participants in the Minnesota Study of Twins Reared Apart were assessed on a number of ability and personality measures. In addition, they participated in lengthy interviews, during which they were asked questions about such topics as childhood experiences, fears, hobbies, musical tastes, social attitudes, and sexual interests. These studies reveal that twins reared apart are still quite similar to each other across a wide range of abilities although not as much as twins reared together (see Figure 12.3), permitting us to conclude that genetics are important in intelligence, but environment also plays a role (Bouchard, Lykken, McGue, Segal, & Tellegen, 1990; Lykken, 1982; Tellegen et al., 1988). Misunderstandings about heritability The recurring public debate over nature–nurture questions reveals widespread misunderstanding about the concept of heritability. Therefore, it is important to be clear about the following points: l Heritability refers to a population, not to individuals. The heritability of a trait refers to differences among individuals within a population, not to percentages of a trait within an individual. To say that height has a heritability of 90 percent does not mean that 90 percent of your height came from your genes and 10 percent came from the environment. It means that 90 percent of the differences in height among individuals observed in a particular population is due to genetic differences among those individuals. l The heritability of a trait is not a single, fixed number. Heritability refers to an attribute of a trait in a particular population at a particular point in time. If something happens to change the variance of a trait in a population, the heritability of the trait will also change. For example, if everyone in our society were suddenly given equal educational opportunities, the variance of intellectual performance in the society would decrease, and scores on standardized measures of intellectual ability would be more similar. (This is what happened in our hypothetical experiment in which everyone had to study the same length of time for the exam.) And because heritability is the percentage of variance that is due to inherited differences among individuals, the heritability would actually increase because the percentage of the variance due to an important environmental factor, education, would have decreased. l Heritability does not tell us about the source of mean differences between groups. One of the most contentious and recurring debates in American society is over the question of whether average differences in the intelligence test scores of different ethnic groups are due to genetic differences between the groups. In the early twentieth century the debate concerned the relatively low intelligence scores Siblings reared apart Unrelated children reared together Unrelated children reared apart +0.10 +0.20 +0.30 +0.40 +0.50 +0.60 +0.70 +0.80 +0.90 +1.00 Siblings reared together Nonidentical twins reared together Identical twins reared apart Identical twins reared together Correlation of IQ scores Figure 12.3 IQ Data From Twin Studies. Identical twins tend to have more similar IQs than nonidentical twins or other siblings, even when they were reared apart. (From “Familial Studies of Intelligence: A Review”, T. Bouchard, et al., Science, Vol. 212, #4498, p 1055–9, 29 May 1981. Copyright © 1981 American Association for the Advancement of Science. Used by permission of Thomas Bouchard.) CHAPTER 12 INTELLIGENCE For more Cengage Learning textbooks, visit www.cengagebrain.co.uk

obtained by Hungarian, Italian, and Jewish immigrants when they were tested upon arrival in the United States. The test scores of these immigrants led some researchers to conclude that the majority were ‘feebleminded’ (Kamin, 1974). Today the debate concerns the lower scores obtained by African Americans and Hispanic Americans compared with white Americans (Herrnstein & Murray, 1994). In these debates, the heritability of intelligence is often used to support the genetic argument. But this claim is based on a logical fallacy, as illustrated by the following ‘thought experiment': We fill a white sack and a black sack with a mixture of different genetic varieties of corn seed. We make certain that the proportions of each variety of seed are identical in each sack. We then plant the seed from the white sack in fertile Field A, while the seed from the black sack is planted in barren Field B. We will observe that within Field A, as within Field B, there is considerable variation in the height of individual corn plants. This variation will be due largely to genetic factors (differences in the seed). We will also observe, however, that the average height of plants in Field A is greater than that of plants in Field B. That difference will be entirely due to environmental factors (the soil). The same is true of IQs: Differences in the average IQ of various human populations could be entirely due to environmental differences, even if within each population all variation were due to genetic differences (Eysenck & Kamin, 1981, p. 97). l Heritability does not tell us about the effects of environmental changes on the average level of a trait. Another incorrect claim about heritability is that a trait with high heritability cannot be changed by a change in the environment. For example, it has been argued that it is futile to use preschool intervention programs to help disadvantaged children enhance their intellectual abilities because those abilities have high levels of heritability. But between 1946 and 1982 the height of young adult males in Japan increased by 3.3 inches, mainly owing to improved nutrition (Angoff, 1988). And yet height is one of the most heritable traits we possess. Then, as now, taller Japanese parents have taller children than do shorter Japanese parents. Similarly, IQ test scores have risen significantly over the past century in many cultures (Flynn, 1987). In sum, heritability is about variances, not average levels. EMOTIONAL INTELLIGENCE INTERIM SUMMARY l Behavioral scientists typically quantify the extent to which a group of people differ from one another on some measure of a trait or ability by computing the variance of the scores obtained. The more the individuals in the group differ from one another, the higher the variance. Researchers can then seek to determine how much of that variance is due to different causes. The proportion of variance in a trait that is accounted for (caused by) genetic differences among the individuals is called the heritability of the trait. l Heritabilities can be estimated by comparing correlations obtained on pairs of identical twins (who share all their genes) and correlations obtained on pairs of fraternal twins (who, on the average, share about half of their genes). If identical twin pairs are more alike on the trait than fraternal twin pairs, the trait probably has a genetic component. Heritabilities can also be estimated from the correlation between identical twin pairs who have been separated and raised in different environments. Any correlation between such pairs must be due to their genetic similarities. l Heritability refers to differences among individuals; it does not indicate how much of a trait in an individual is due to genetic factors. It is not a fixed attribute of a trait: If something happens to change the variability of a trait in a group, the heritability will also change. Heritability indicates the variance within a group, not the source of differences between groups. Heritability does, however, indicate how much possible environmental changes might change the mean level of a trait in a population. CRITICAL THINKING QUESTIONS 1 What are the political and social policy implications of claims that intelligence is largely due to genetic factors? 2 How might an individual's belief that his or her own level of intelligence is due to genetic factors influence his or her decisions about school or careers? EMOTIONAL INTELLIGENCE New York Times writer Daniel Goleman popularized the term emotional intelligence in his 1995 book on the subject. He argued that understanding and control of your emotions is one of the most important keys to health and

 success in life. Goleman's book was based on important empirical work by psychologists such as Peter Salovey, John Mayer, and Reuven Bar-On showing that, indeed, people who are emotionally astute have a leg up on those of us who are not. Mayer and Salovey (Mayer, Salovey, & Caruso, 2004) suggest there are four critical components to emotional intelligence. The first is accurate perception and expression of emotions. Being able to read the emotions of others enables you to anticipate possible threats they might pose. For example, imagine you are in an argument with a co-worker who is known to have a volatile temper. If you can accurately perceive that your co-worker is getting extremely agitated, you will know that it may be time to back off and live to fight another day. If you don’t accurately perceive your co-worker’s level of anger, you might end up with a bloody nose. Accurately perceiving and expressing others’ emotions also helps you empathize with their position. In turn, you can modify your responses to other people, either to be more persuasive in arguing your point or to make them feel that you understand them well. This can make you an effective negotiator and a trusted friend to others. Accurately perceiving and expressing your own emotions is the first step to responding appropriately to those emotions. People who don’t realize they are anxious can have chronic physiological arousal that costs them physical wear and tear and impairs their health (see Chapter 14). People who don’t realize they are sad may not take the necessary actions to change the sources of their sadness. People who don’t realize they are angry may suddenly and impulsively lash out at others, feeling out of control. The second component of emotional intelligence is the ability to access and generate emotions in the service of thinking and problem solving. We often ask ourselves, ‘How do I feel about this?’ in trying to make an important decision, such as what college to attend or what major to pursue. Being able to access our current feelings about an issue or to anticipate our future feelings, should we make a particular decision, gives us important information that should go into many decisions. The third component of emotional intelligence is understanding emotions and emotional meanings. We may accurately perceive we are anxious, but if we don’t understand why we are anxious, we can’t do much about it. We often make incorrect attributions for our emotions, which can lead us to take unwise steps. For example, imagine you have been staying up late each night for many weeks to complete your school assignments and then getting up for early morning classes. Eventually, you begin to feel sad, lethargic, and unmotivated. You might conclude that you are feeling sad and unmotivated because you are pursuing the wrong major, or even that college is not for you. The true reason for your sadness, however, may well be sleep deprivation, which can cause depression-like symptoms (see Chapter 6). Attributing Emotional intelligence is important in volatile situations. your sadness incorrectly to your college major rather than correctly to your lack of sleep could cause you to make some very bad decisions. The final component of emotional intelligence is emotional regulation – being able to manage and regulate your emotions appropriately. This does not mean completely controlling the emotions you feel or express. Indeed, such emotional overcontrol is unhealthy. But letting your emotions rage unabated can also be unhealthy. The most obvious example is with anger. We all feel angry at times, but most of us know we can’t express our anger at any time and in any way we wish (at least we can’t get away with it). How we channel our anger is critical to our relationships to others and to our own health. People who completely suppress their anger can be exploited by others, and people who chronically express their anger in a hostile manner lose friends quickly. In contrast, people who can express the reasons for their anger in ways that others can hear and accept are more likely to both maintain their friendships and avoid being exploited. In addition, research we will review in Chapter 14 clearly shows that people who do not channel their anger appropriately experience more heart disease, probably because their cardiovascular system is chronically overaroused and overreactive. Can you learn emotional intelligence? Many schools now have programs to teach young people how to recognize and better manage their anger, in hopes of reducing school violence, and some evaluations of these programs suggest they can be effective in teaching young people anger control (see Bar-On, Maree, & Elias, 2007). Many a crusty corporate executive has also undergone emotional schooling to learn how to better empathize with employees and manage with a bigger heart, and it appears these programs can be successful (Bar-On et al., 2007). Much of what psychotherapy focuses on is helping people recognize, accurately label, and manage their emotions better, and many studies show psychotherapy to be effective in relieving a variety of psychological

disorders (see Chapter 16). These same techniques are sometimes used to help cardiac patients better control anger and stress so as to improve their health (see Chapter 14). Thus, there is increasing evidence that emotional intelligence truly is important to success and well-being, and fortunately, those of us born emotionally challenged can become more intelligent. INTERIM SUMMARY l Emotional intelligence is thought to have four components: accurate perception and expression of emotions, the ability to access and generate emotions, understanding of emotions and emotional meanings, and good emotional regulation. l People with higher emotional intelligence tend to be healthier psychologically and physically. CRITICAL THINKING QUESTIONS 1 How might parents encourage high emotional intelligence in their children? 2 Why might emotional intelligence improve performance on the job or in school? GENERAL LEARNING DISABILITY Levels of intelligence fall along a continuum. Individuals whose intellectual and practical skills fall far below average are said to suffer from general learning disability. The World Health Organization has set criteria for a diagnosis of general learning disability. In order to be diagnosed as such, an individual must have both subaverage scores on an IQ test, and show significant problems in performing the tasks of daily life. For example, individuals must show significant delays or abnormalities in communication, inability to care for themselves, significant deficits in social or interpersonal skills, inability to use community resources (e.g., riding a bus), inability to be self-directed, very low academic or work skills, no leisure activities, or inability to care for their health or personal safety. The severity of general learning disability varies greatly. Individuals with mild general learning disability can feed and dress themselves with minimal help, may have average motor skills, and can learn to talk and write in simple terms. They can get around their own neighborhoods well, although they may not be able to go beyond their neighborhoods without help. If they are   placed in special education classes that address their specific deficits, they can achieve a high school education and become self-sufficient. As adults, they can shop for specific items and cook simple meals for themselves. They may be employed in unskilled or semiskilled jobs. Their scores on IQ tests tend to be between about 50 and 69. Individuals with moderate general learning disability typically have significant delays in language development, such as using only four to ten words by the age of 3. They may be physically clumsy and, thus, have some trouble dressing and feeding themselves. They typically do not achieve more than rudimentary academic skills but, with special education, can learn simple vocational skills. As adults, they may not be able to travel alone or shop or cook for themselves. Their scores on IQ tests tend to be between about 35 and 49. Individuals with severe general learning disability have very limited vocabularies and speak in two- or three-word sentences. They may have significant deficits in motor development and as children may play with toys inappropriately (e.g., banging two dolls together, rather than having them interact symbolically). As adults, they can feed themselves with spoons and dress themselves if the clothing is not complicated with many buttons or zippers. They cannot travel alone for any distance and cannot shop or cook for themselves. They may be able to learn some unskilled manual labor, but many do not. Their IQ scores tend to run between 20 and 34. Children and adults with profound general learning disability are severely impaired and require full-time custodial care. They cannot dress themselves completely. They may be able to use spoons, but not knives and forks. They tend not to interact with others socially, although they may respond to simple commands. They may achieve vocabularies of 300 to 400 words as adults. Many persons with profound general learning disability suffer from frequent illnesses, and their life expectancy is shorter than normal. Their IQ scores tend to be under 20. Causes of general learning disability A large number of biological factors can cause general learning disability, including chromosomal and gestational disorders, exposure to toxins prenatally and in early childhood, infections, physical trauma, metabolism and nutrition problems, and gross brain disease. In addition, sociocultural factors can influence general learning disability. As we have already discussed in this chapter, intellectual skills are at least partially inherited. The families of individuals with general learning disability tend to have high rates of intellectual problems, including the different levels of general learning disability and autism (Camp et al., 1998). Two metabolic disorders that are genetically transmitted and that cause general learning disability are

 ª ISTOCKPHOTO.COM/RICHARD ABPLANALP Children with Down syndrome typically have general learning disability. phenylketonuria (PKU) and Tay-Sachs disease. PKU is carried by a recessive gene and occurs in about 1 in 20,000 births. Children with PKU are unable to metabolize phenylalanine, an amino acid. As a result, phenylalanine and its derivative, phenyl pyruvic acid, build up in the body and cause permanent brain damage. Fortunately, an effective treatment is available, and children who receive this treatment from an early age can develop an average level of intelligence. If untreated, children with PKU typically have IQs below 50. Tay-Sachs disease also is carried by a recessive gene and occurs primarily in Jewish populations. Progressive degeneration of the nervous system begins, usually when a child is between three and six months old, leading to mental and physical deterioration. These children usually die before the age of 6 years, and there is no effective treatment. Several types of chromosomal disorders can lead to general learning disability. One of the best-known causes of general learning disability is Down syndrome, which is caused when chromosome 21 is present in triplicate rather than in duplicate. (For this reason, Down syndrome is also referred to as Trisomy 21). Down syndrome occurs in about 1 in every 800 children born in the United States. From childhood, almost all people with Down syndrome have general learning disability, although the level of their disability varies from mild to profound. People with Down syndrome have abnormalities in the neurons in their brains that resemble those found in Alzheimer’s disease. Fragile X syndrome, which is the second most common cause of general learning disability in males after Down syndrome, is caused when a tip of the X chromosome breaks off. This syndrome is characterized by severe to profound general learning disability, speech defects, and severe deficits in interpersonal interaction. The quality of the prenatal environment for a fetus can profoundly affect intellectual development. When a pregnant woman contracts the rubella (German measles) virus, the herpes virus, or syphilis, there is a risk of physical damage to the fetus that can cause general learning disability. Chronic maternal disorders, such as high blood pressure and diabetes, can interfere with fetal nutrition and brain development and, therefore, can affect the intellectual capacities of the fetus. Fortunately, effective treatment of these disorders during pregnancy can greatly reduce the risk of damage to the fetus. The drugs a woman takes while pregnant can pass through the placenta, affecting the development of the fetus. For example, any form of cocaine constricts the mother's blood vessels, reducing oxygen and blood flow to the fetus and possibly resulting in brain damage and disability. Babies whose mothers smoked crack during the pregnancy tend to be less alert than other babies and not as emotionally or cognitively responsive. They are more excitable and less able to regulate their sleep–wake patterns (Napiorkowski et al., 1996; Tronick et al., 1996). Women who take cocaine during pregnancy, compared to women who do not, tend to be more socially disadvantaged and more likely to use tobacco, alcohol, marijuana, and other illicit drugs (Tronick et al., 1996). These other risk factors, in addition to exposure to cocaine, may severely impair intellectual growth in the children of these mothers. Alcohol is another drug that, if taken during pregnancy, can affect the intellectual and physical development of a fetus. Children whose mothers ingested substantial amounts of alcohol during pregnancy are at increased risk for general learning disability and a syndrome known as fetal alcohol syndrome (FAS) (Fried & Watkinson, 1990). On average, children with fetal alcohol syndrome have an IQ of about 68, as well as poor judgment, distractibility, difficulty in perceiving social cues, and an inability to learn from experience. Their academic functioning tends to be low throughout their lives. Abel Dorris was a child with fetal alcohol syndrome (adapted from Dorris, 1989; Lyman, 1997): Abel Dorris was adopted when he was 3 years old by Michael Dorris. Abel's mother had been a heavy drinker throughout the pregnancy and after Abel was born, and later died at age 35 of alcohol poisoning. Abel had been born almost seven weeks premature, with low birth weight. He had been abused and malnourished before being removed to a foster home. At age 3, Abel was small for his age, not yet toilet-trained, and could speak only about 20 words. He had been diagnosed as mildly retarded. His adoptive father hoped that, in a positive environment, Abel could catch up. Yet, at age 4, Abel was still in diapers and weighed only 27 pounds. He had trouble remembering the names of other children and his activity level was unusually high. When alone, he would rock back and forth rhythmically. At age 4, he suffered the first

of several severe seizures, which caused him to lose consciousness for days. No drug treatments seemed to help. When he entered school, Abel had trouble learning to count, to identify colors, and to tie his shoes. He had a short attention span and difficulty following simple instructions. Despite devoted teachers, when he finished elementary school, Abel still could not add, subtract, or identify his place of residence. His IQ was measured in the mid-60s. Eventually, at age 20, Abel entered a vocational training program and moved into a supervised home. His main preoccupations were his collections of stuffed animals, paper dolls, newspaper cartoons, family photographs, and old birthday cards. At age 23, he was hit by a car and killed. It may not be safe for women to drink any amount of alcohol during pregnancy. Studies suggest that even low to moderate levels of drinking during pregnancy are associated with subtle alcohol-related birth defects (Jacobson & Jacobson, 2000; Kelly, Day, & Streissguth, 2000; Olson et al., 1998). For example, longitudinal studies of children exposed prenatally to alcohol show negative effects on growth at 6 years of age and on learning and memory skills at 10 years of age, even if they do not evidence the full syndrome of FAS (Cornelius, Goldschmidt, Day, & Larkby, 2002). Children with general learning disability are more likely to come from low socioeconomic groups (BrooksGunn, Klebanov, & Duncan, 1996; Camp et al., 1998). This may be because their parents also have general learning disability and have not been able to acquire wellpaying jobs. The social disadvantages of being poor may also contribute to lower than average intellectual development. Poor mothers are less likely to receive good prenatal care, increasing the risk of damage to the fetus and of their children being born prematurely. Children living in poverty are at increased risk for exposure to lead, because many old, run-down buildings have lead paint, which chips off and is ingested by the children. Ingestion of lead can cause brain damage and impede intellectual development. Poor children are concentrated in the inner city in poorly funded schools, and this is especially true for poor minority children. Thus, they do not receive the kind of education that could improve their intellectual functioning. Poor children who have lower IQs receive even less favorable attention from teachers and fewer learning opportunities, especially if they are also members of minorities (Alexander, Entwisle, & Thompson, 1987). Poor children are less likely to have parents who read to them, who encourage academic success, and who are involved in their schooling. These factors may directly affect a child's intellectual development and may exacerbate the biological conditions that interfere with a child's cognitive development (Camp et al., 1998). For more Cengage Learning textbooks, visit www.cengagebrain.co.uk GENERAL LEARNING DISABILITY ª JOSE MANUEL GELPI DIAZ j DREAMSTIME.COM When women drink during pregnancy, their children are at risk of intellectual disabilities. Treatments for general learning disability Ideally, children at risk of general learning disability receive comprehensive interventions from the first days of life. Intensive individualized interventions can enhance individuals' development of basic skills. Drug therapies reduce aggressive and self-destructive behaviors. And social programs ensure that the environment is optimal for the child's development. Behavioral interventions can help children and adults learn new skills, from identifying colors correctly to using vocational skills. Other adults may model the desired behavior, starting with the simplest steps, then rewarding the child or adult as he or she comes closer and closer to mastering the skill. Behavioral strategies can also help to reduce self-injurious and other maladaptive behaviors, such as head-banging. Medications are used to reduce seizures, which are common among people with general learning disability. Medications can also reduce aggressive, self-destructive, and antisocial behavior. Finally, antidepressant medications can reduce depressive symptoms, improve sleep patterns,

454 CHAPTER 12 INTELLIGENCE SEEING BOTH SIDES HOW IMPORTANT IS EMOTIONAL INTELLIGENCE? In support of Emotional Intelligence Marc A. Brackett & Peter Salovey, Yale University Nearly 20 years ago, Salovey and Mayer (1990) proposed that some individuals possess greater ability than others to reason about and use emotion-laden information to enhance both cognitive activity and social functioning. Their ability model of emotional intelligence evolved as the concept of general intelligence was expanding to include an array of mental abilities, including social, practical, and creative intelligence, rather than merely a monolithic 'g'. The 'four branch model' of emotional intelligence is the framework in broader use (Mayer & Salovey, 1997), and it includes the ability to perceive, use, understand, and manage emotions. These four emotion abilities are arranged such that the more basic psychological processes (i.e., perceiving emotions) are at the foundation, and more advanced processes (i.e., regulation of emotion) are at the top of a hierarchy and are thought, to some extent, to be dependent upon the lower level abilities. Within each dimension there is a developmental progression of skills from the more basic to the more sophisticated. Perceiving emotion pertains to the ability to identify emotions in oneself and others, as well as in other stimuli including voices, gesture, music, and works of art. Using emotion involves the ability to harness feelings that assist in certain cognitive activities such as reasoning, decision-making, creativity, and interpersonal communication. Understanding emotion involves language and propositional thought to reflect the capacity to analyze emotions. This skill includes an understanding of the emotional lexicon and both the antecedent events and outcomes of emotional experiences. Managing emotion pertains to the ability to reduce, enhance, or modify an emotional response in oneself and others, as well as the ability to make decisions about the

usefulness of emotions in given situations. According to the ability model of emotional intelligence, there are individual differences in each of the four branches, and such differences can be measured by performance tests. Performance tests, as opposed to self-report indices, address the limitations that individuals are often inaccurate when making judgments about their abilities, and emotional abilities in particular (Brackett et al., 2006). One measure that was developed to assess all four branches of emotional intelligence is the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT, V. 2.0; Mayer, Salovey, & Caruso, For more Cengage Learning textbooks, visit www.cengagebrain.co.uk 2002). The MSCEIT is a 141-item test comprised of eight tasks; there are two tasks measuring each of the four abilities. An emotional intelligence for adolescents, the MSCEIT-Youth Version, is under development. The MSCEIT is considered an objective, performance test because responses are evaluated by comparing participants' responses to those made by either emotion experts or a normative sample. For example, the ability to manage emotions is measured with vignettes describing particular emotional problems. After reading the vignettes, participants rate a number of possible actions for managing emotions on a scale ranging from 'very ineffective' to 'very effective', which are then compared to the responses made by experts or those in the normative sample. MSCEIT scores are related to but distinct from general and verbal intelligence (correlations range in the .3 to .4 range); they also are associated with a wide range of criteria. Individuals with higher MSCEIT scores report better quality friendships and are more likely to be nominated by peers as being social skilled. Dating and married couples with higher MSCEIT scores report more satisfaction and happiness and less conflict in their relationships. College students with higher MSCEIT scores report lower levels of drug and alcohol consumption and fewer deviant acts, including stealing, gambling, and fighting. Higher MSCEIT scores also are associated with decreased levels of anxiety and depression. Finally, emotional intelligence is associated with a number of important outcomes in the workplace. MSCEIT scores are correlated positively with objective performance indicators including company rank and percent merit pay increases, and business professionals with high MSCEIT scores are rated by their supervisors as effective at handling stress and skilled at creating an enjoyable work environment (summarized by Mayer. Roberts, & Barsade, 2008). What we know thus far about the emotional intelligence demonstrates its important applications at home, school, and the workplace (see Mayer, Salovey, & Caruso, 2008). Nevertheless, there is much to be learned about the construct and its measurement. The MSCEIT does not include direct assessment of all emotion abilities captured by the EI framework, especially more fluid skills such as processing speed for identifying facial expressions. Research on emotional intelligence is only in the beginning stages: the theory was published just 17 years ago and performance measures like the MSCEIT have been used in scientific investigations for only about 5 years. A better understanding of the validity of emotional intelligence is in the hands of future researchers who will investigate the construct in greater detail.

A critique of EI Chockalingam Viswesvaran, Florida International University Emotional intelligence is an exciting new concept. Nevertheless, scientists and researchers need to critically evaluate it before enthusiastically endorsing its use in high-stakes testing. Let us consider some issues where the current literature is deficient. Consider the definition of emotional intelligence. At the beginning of this chapter, you learned how different definitions have been proposed for intelligence, but nevertheless, a common core (information processing) is discernible. At present, there is a controversy in defining emotional intelligence (EI). It is not merely the presence of definitional variation that is the issue. In fact, in any concept in the social sciences, scientists emphasize different aspects of the concept – with the specific definition of that concept varying accordingly.

The problem with the EI literature is that there are at least two distinct models of EI. One model defines EI as a specific intelligence and is called the ability model of EI (Mayer & Salovey, 1997). The second can be referred to as the mixed or trait model of EI and defines EI as a set of personality dispositions (Bar-On, 1997). The average correlation between the measures of these two models across several studies is only .12 (Van Rooy, Viswesvaran, & Pluta, 2005). This is a low correlation. Some researchers have tried to address this low correlation by asserting that EI should be defined only as a specific ability. They dismiss the other conceptualization as being an eclectic hodgepodge mix of variables (i.e., the mixed model). However, the average correlation among measures of the mixed models is .61, a value that suggests a common core across these 'hodge-podge' measures. More importantly, EI measures using either model have been found to be predictive of important outcomes (refer to the discussion of criterion-related validity in the text). Van Rooy and Viswesvaran (2004) report a correlation of .17 for MEIS (an ability measure of EI) and .18 for EQ-I (a mixed model measure). There are other explanations for the low correlation of .12. It is possible that we have two conceptualizations of EI that assess distinct domains of the EI construct. After all, it is likely that to be emotionally intelligent one needs certain skills and also certain dispositions! What we need are factor analytic studies (see definition of factor analysis in the text) that analyze multiple measures from the two models to test for alternate conceptualizations. It took decades for intelligence researchers to delineate the boundaries of intelligence – EI research is nowhere near achieving that clarity. You have read in this chapter about how test scores should be correlated with important outcomes (i.e., criterion related For more Cengage Learning textbooks, visit www.cengagebrain.co.uk GENERAL LEARNING DISABILITY SEEING BOTH SIDES HOW IMPORTANT IS EMOTIONAL INTELLIGENCE? validity). There are hundreds of studies in the literature that document a relationship between general intelligence and job performance measured as supervisory ratings, production counts, co-worker assessments, and so on. We know unambiguously that general intelligence is related to performance. The literature on EI is in its infancy in attempting to reach this level of certainty. Much more needs to be done here. Further, under construct validity, you read why it is important to test not only relationships between test scores and important outcomes but also why this relationship holds. For example, we know that general intelligence results in higher job knowledge acquisition, which in turn improves performance. There are many empirical studies investigating such processes with general intelligence. We need such explicit articulation of why EI will relate to important outcomes and empirical tests of such propositions. The current EI literature needs to be substantially improved. Despite these shortcomings, EI is being touted as an important variable on which individuals should be assessed in high-stakes selection situations (e.g., applying for a job). EI is presented as an alternative to general intelligence because (1) there is adverse impact when general intelligence scores are used for selection decisions and, (2) EI helps in explaining performance beyond general intelligence. Adverse impact is where a much larger percentage of one group (e.g., Whites) gets selected compared to another group (e.g., Blacks). However, there are no systematic evaluations of group differences in EI in applicant settings. Most studies are using student samples in non-selection settings and it is not sure whether these results will generalize to selection settings. Similarly, there is scarce literature on predictive bias of EI or cross-cultural equivalence. Two plus two is four in all cultures but emotion regulation will differ across cultures. In this age of globalization, much more needs to be done before EI is accepted as an important trait on which individuals are to be evaluated and screened. Consider the claim that EI explains variance in performance beyond that explained by general intelligence (or personality factors). To substantiate this claim the incremental validity of EI over performance beyond general intelligence and personality variables for different criteria needs to be established. That is, general intelligence and Big Five factors of personality have some validity in predicting different criteria. For EI to be a distinct and useful construct, we need to show that EI improves the validity of predictions beyond that of general intelligence and factors of personality. This improvement is referred to as incremental validity. Very few studies have reported the incremental validity of EI over personality and general intelligence which raises the legitimate concern that EI is old wine in a new bottle.

456 CHAPTER 12 INTELLIGENCE and help control self-injurious behavior in mentally impaired individuals. Comprehensive interventions for children at risk of general learning disability combine all these strategies and more into one package. One such program was the Infant Health and Development Program (Gross, Brooks-Gunn, & Spiker, 1992). The 985 children enrolled in this program had a birth weight of 2,500 grams or less and a gestational age of 37 completed weeks or less. Low birthweight, premature infants were chosen for this program because these are risk factors for general learning disability. Two-thirds of these infants were randomly assigned to receive high-quality pediatric care for high-risk infants. The other third received the same pediatric care plus a comprehensive psychological intervention The intervention had three components. First, specially trained counselors visited the homes of these children during the first three years of the child's life. The children's mothers were taught good parenting practices and strategies for improving their children's cognitive development. For example, counselors gave mothers strategies to calm their babies (who tended to be irritable). The mothers were shown how to provide appropriate levels of stimulation for their child and how to encourage their children to be self-motivated and to explore their environments. The counselors helped the mothers reduce stress in their environments and in their babies' environments. In addition, each day the children in the intervention program attended a child development center with specially trained teachers, who worked to overcome the children's intellectual and physical deficits. Finally, parent support groups were started to help the parents cope with the stresses of parenting. At 36 months of age, the children in the intervention group were significantly less likely to have IQ scores in the low range than were those in the control group, who received only medical care (The Infant Health and Development Program, 1990). Among the infants with ª TOM STEWART/CORBIS Early intervention can reduce the risk of intellectual difficulties in low birth weight babies. For more Cengage Learning textbooks, visit www.cengagebrain.co.uk birth weights between 2,001 and 2,500 grams, the effects of the program were especially strong: At age 36 months, they had IQ scores an average of 13 points higher than the infants in the control group with similar birth weights. The infants with birth weights under 2,000 grams also benefited from the program, but to a lesser degree: Their 36-month IQ scores were an average of 6.6 points higher than the control-group infants with similar birth weights. Both the 'heavier' and 'lighter' birth weight groups who received the intervention condition also showed fewer behavioral and emotional problems at 36 months than did the children in the control groups. The 'heavier' birth weight children continued to show benefits in cognitive development from the intervention at 60 months and 96 months of age, compared with the control groups (Brooks-Gunn, Klebanov, & Liaw, 1995). Differences between the intervention groups and the control groups in behavior and emotional problems had disappeared by this age, however. Thus, as has been the case with many early intervention programs, benefits are seen in the short term, but without continuation of the intervention, these benefits often diminish with time. INTERIM SUMMARY l General learning disability is defined as subaverage intellectual functioning, indexed by an IQ score of under 70 and deficits in adaptive behavioral functioning. There are four levels of general learning disability, ranging from mild to profound. l A number of biological factors are

implicated in general learning disability, including metabolic disorders (PKU, Tay-Sachs disease); chromosomal disorders (Down syndrome, Fragile X, Trisomy 13, and Trisomy 18); prenatal exposure to rubella, herpes, syphilis, or drugs (especially alcohol). l There is some evidence that intensive and comprehensive educational interventions, administered very early in life, can help to decrease the level of general learning disability. CRITICAL THINKING QUESTIONS 1 Do you think the cost of comprehensive interventions for individuals with general learning disability does or does not outweigh the benefits? Why? 2 What kinds of interventions might be important for parents of children with general learning disability to reduce their stress and improve their parenting to their child?

CHAPTER SUMMARY There are many different definitions of intelligence. Some theorists view it as simply what intelligence tests measure. Others view it as a set of general abilities, including the ability to learn from experience, think in abstract terms, and deal effectively with one's environment. A good test of intelligence must be reliable – it must yield reproducible and consistent results. Alternate form reliability is shown when two forms of a test correlate highly with each other. A test has good internal consistency when various items on the test are correlated highly with each other. When more subjective assessments are used, judges rate the answers of respondents, and the researcher hopes to see interjudge reliability or interrater reliability. A test has good validity if it measures what it is intended to measure. Criterion or empirical validity is shown when the test is highly correlated with another test of the same construct. Construct validity is shown when the scores on the test predict outcomes that the researcher's theory suggests it should predict. The first successful intelligence tests were developed by the French psychologist Alfred Binet, who proposed the concept of mental age. A bright child's mental age is above his or her chronological age; a slow child's mental age is below his or her chronological age. The concept of the intelligence quotient (IQ), the ratio of mental age to chronological age (multiplied by 100), was introduced when the Binet scales were revised to create the Stanford-Binet. Many intelligence test scores are still expressed as IQ scores, but they are no longer actually calculated according to this formula. Both Binet and Wechsler, the developer of the Wechsler Adult Intelligence Scale (WAIS), assumed that intelligence is a general capacity for reasoning. Similarly, Spearman proposed that a general factor (g) underlies performance on different kinds of test items. Factor analysis is a method for determining the kinds of abilities that underlie performance on intelligence tests. Gardner's theory of multiple intelligences suggests that there are seven distinct kinds of intelligence that are independent of one another, each operating as a separate system (or module) in the brain according to its own rules. These are (1) linguistic,   (2) musical, (3) logical-mathematical, (4) spatial, (5) bodily-kinesthetic, (6) intrapersonal, and (7) interpersonal. Anderson's theory of intelligence suggests that differences in intelligence result from differences in the 'basic processing mechanism' that implements thinking, which in turn yields knowledge. Sternberg's triarchic theory has three parts or subtheories: the componential subtheory, which deals with thought processes; the experiential subtheory, which deals with the effects of experience on intelligence; and the contextual subtheory, which considers the effects of the individual's environment and culture. According to his componential subtheory, three components of thought are critical in intelligence: metacomponents or analytical abilities, performance components or creative abilities, and knowledge-acquisition components or practical abilities. According to Ceci's bioecological theory of intelligence, everyday or real-world intellectual performance cannot be explained by IQ alone or by some biological notion of general intelligence. Instead, it depends on the interaction between multiple cognitive potentials with a rich, wellorganized knowledge base. Other cultures tend to emphasize social intelligence more than Europe and North America do. Behavioral scientists typically quantify the extent to which a group of people differ from one another on some measure of a trait or ability by computing the variance of the scores obtained. The more the individuals in the group differ, the higher the variance. Researchers can then seek to determine how much of that variance is due to different causes. The proportion of variance in a trait that is accounted for (caused by) genetic differences among the individuals is called the heritability of the trait. Heritabilities can be estimated by comparing correlations obtained on pairs of identical twins (who share all their genes) and correlations obtained on pairs of fraternal twins (who, on the average, share about half of their genes). If identical twin pairs are more alike on the trait than fraternal twin pairs, the trait probably has a genetic component. Heritabilities can also be estimated from the correlation between identical

 twin pairs who have been separated and raised in different environments. Any correlation between such pairs must be due to their genetic similarities. Heritability refers to differences among individuals; it does not indicate how much of a trait in an individual is due to genetic factors. It is not a fixed attribute of a trait: If something happens to change the variability of a trait in a group, the heritability will also change. Heritability indicates the variance within a group, not the source of differences between groups. Heritability does, however, indicate how much possible environmental changes might change the mean level of a trait in a population. Emotional intelligence is thought to have four components: accurate perception and expression of emotions, the ability to access and generate CORE CONCEPTS construct validity Stanford-Binet Intelligence Scale intelligence quotient (IQ) Wechsler Adult Intelligence Scale factor analysis g Gardner’s theory of multiple intelligences intelligence reliability alternative form reliability internal consistency interrater agreement interjudge reliability validity criterion or empirical validity criterion problem in assessment emotions, understanding of emotions and emotional meanings, and good emotional regulation. People with higher emotional intelligence tend to be healthier psychologically and physically. General learning disability is defined as subaverage intellectual functioning, indexed by an IQ score of under 70 and deficits in adaptive behavioral functioning. A number of biological factors are implicated in this, including metabolic disorders (PKU, Tay-Sachs disease); chromosomal disorders (Down syndrome, Fragile X, Trisomy 13, and Trisomy 18); prenatal exposure to rubella, herpes, syphilis, or drugs (especially alcohol) and premature delivery. Intensive and comprehensive educational interventions, administered very early in life, can help to decrease the level of general learning disability. Anderson’s theory of intelligence Sternberg’s triarchic theory Ceci’s bioecological theory heritability emotional intelligence general learning disability fetal alcohol syndrome

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