

Unit XI

Testing and Individual Differences

Modules

- 60 Introduction to Intelligence
- 61 Assessing Intelligence
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Three huge controversies have sparked recent debate in and beyond psychology. First is the “memory war,” over whether traumatic experiences are repressed and can later be recovered, with therapeutic benefit. The second great controversy is the “gender war,” over the extent to which nature and nurture shape our behaviors as men and women. In this unit, we meet the “intelligence war”: Does each of us have an inborn general mental capacity (intelligence), and can we quantify this capacity as a meaningful number?

School boards, courts, and scientists debate the use and fairness of tests that assess people’s mental abilities and assign them a score. Is intelligence testing a constructive way to guide people toward suitable opportunities? Or is it a potent, discriminatory weapon camouflaged as science? First, some basic questions:

- What is intelligence?
- How can we best assess it?
- To what extent does it result from heredity and from environmental influence?

- What do test score differences among individuals and groups really mean? Should we use such differences to track the abilities of public school students? To admit them to colleges or universities? To hire them?

This unit offers answers. It identifies a variety of mental gifts. And it concludes that the recipe for high achievement blends talent and grit.

Module 60

Introduction to Intelligence

Module Learning Objectives

- 60-1 Discuss the difficulty of defining *intelligence*.
- 60-2 Present arguments for and against considering intelligence as one general mental ability.
- 60-3 Compare Gardner’s and Sternberg’s theories of intelligence.
- 60-4 Describe the four components of emotional intelligence.
- 60-5 Describe the relationship between intelligence and brain anatomy.
- 60-6 Describe the relationship between intelligence and neural processing speed.

60-1 How is *intelligence* defined?

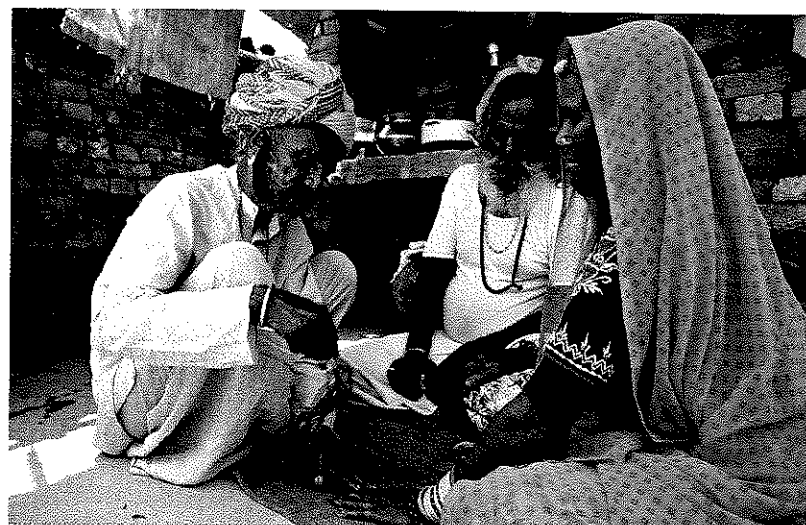
Psychologists debate: Should we consider intelligence as one aptitude or many? As linked to cognitive speed? As neurologically measurable? On this much, intelligence experts agree: Intelligence is a concept and not a “thing.”

In many research studies, *intelligence* has been operationally defined as whatever intelligence tests measure, which has tended to be school smarts. But intelligence is not a quality like height or weight, which has the same meaning to everyone around the globe. People assign the term *intelligence* to the qualities that enable success in their own time and in their own culture (Sternberg & Kaufman, 1998). In the Amazon rain forest, *intelligence* may be understanding the medicinal qualities of local plants. In a North American high school, it may be mastering difficult concepts in tough courses. In both locations, **intelligence** is the ability to learn from experience, solve problems, and use knowledge to adapt to new situations. An **intelligence test** assesses people’s mental abilities and compares them with others, using numerical scores.

intelligence mental quality consisting of the ability to learn from experience, solve problems, and use knowledge to adapt to new situations.

intelligence test a method for assessing an individual’s mental aptitudes and comparing them with those of others, using numerical scores.

Hands-on healing The socially constructed concept of intelligence varies from culture to culture. This natural healer in India displays his intelligence in his knowledge about his medicinal plants and understanding of the needs of the people he is helping.



Is Intelligence One General Ability or Several Specific Abilities?

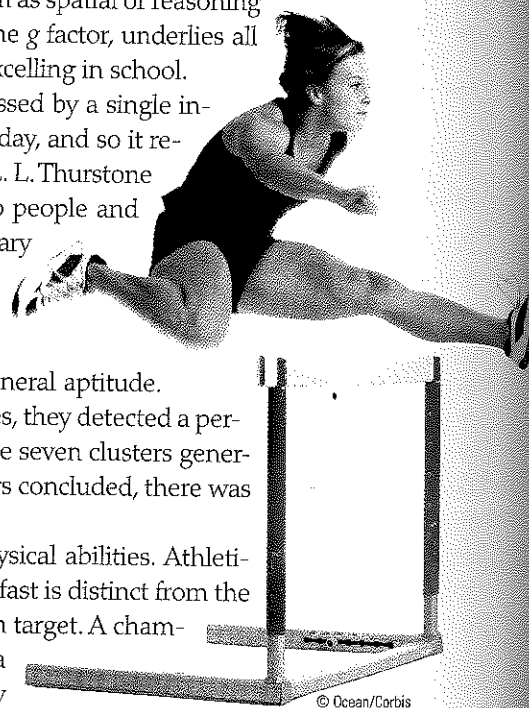
60-2 What are the arguments for and against considering intelligence as one general mental ability?

You probably know some people with talents in science, others who excel in social studies, and still others gifted in athletics, art, music, or dance. You may also know a talented artist who is stumped by the simplest math problem, or a brilliant math student with little aptitude for literary discussion. Are all these people intelligent? Could you rate their intelligence on a single scale? Or would you need several different scales?

Charles Spearman (1863–1945) believed we have one **general intelligence** (often shortened to **g**). He granted that people often have special abilities that stand out and he helped develop **factor analysis**, a statistical procedure that identifies clusters of related items. But Spearman also found that those who score high in one area, such as verbal intelligence, typically score higher than average in other areas, such as spatial or reasoning ability. Spearman believed a common skill set, the **g** factor, underlies all intelligent behavior, from navigating the sea to excelling in school.

This idea of a general mental capacity expressed by a single intelligence score was controversial in Spearman's day, and so it remains. One of Spearman's early opponents was L. L. Thurstone (1887–1955). Thurstone gave 56 different tests to people and mathematically identified seven clusters of primary mental abilities (word fluency, verbal comprehension, spatial ability, perceptual speed, numerical ability, inductive reasoning, and memory). Thurstone did not rank people on a single scale of general aptitude. But when other investigators studied these profiles, they detected a persistent tendency: Those who excelled in one of the seven clusters generally scored well on the others. So, the investigators concluded, there was still some evidence of a **g** factor.

We might, then, liken mental abilities to physical abilities. Athletics is not one thing but many. The ability to run fast is distinct from the eye-hand coordination required to throw a ball on target. A champion weightlifter rarely has the potential to be a skilled ice skater. Yet there remains some tendency



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AP® Exam Tip

David Myers identified three "huge controversies" in the unit opener. All three are covered extensively in this book, and all three will probably show up on the AP® exam.

general intelligence (**g**)

a general intelligence factor that, according to Spearman and others, underlies specific mental abilities and is therefore measured by every task on an intelligence test.

factor analysis a statistical procedure that identifies clusters of related items (called *factors*) on a test; used to identify different dimensions of performance that underlie a person's total score.

for good things to come packaged together—for running speed and throwing accuracy to correlate, thanks to general athletic ability. So, too, with intelligence. Several distinct abilities tend to cluster together and to correlate enough to define a general intelligence factor.

Satoshi Kanazawa (2004, 2010) argues that general intelligence evolved as a form of intelligence that helps people solve *novel* problems—how to stop a fire from spreading, how to find food during a drought, how to reunite with one's tribe on the other side of a flooded river. More common problems—such as how to mate or how to read a stranger's face or how to find your way back to camp—require a different sort of intelligence. Kanazawa asserts that general intelligence scores *do* correlate with the ability to solve various novel problems (like those found in academic and many vocational situations) but do *not* much correlate with individuals' skills in *evolutionarily familiar* situations—such as marrying and parenting, forming close friendships, and navigating without maps. No wonder academic and social skills may come in different bodies.

Theories of Multiple Intelligences

60-3 How do Gardner's and Sternberg's theories of multiple intelligences differ?

Since the mid-1980s, some psychologists have sought to extend the definition of *intelligence* beyond Spearman's and Thurstone's academic smarts.

GARDNER'S EIGHT INTELLIGENCES

Howard Gardner (1983, 2006) views intelligence as multiple abilities that come in different packages. Brain damage, for example, may destroy one ability but leave others intact. And consider people with **savant syndrome**, who often score low on intelligence tests but have an island of brilliance (Treffert & Wallace, 2002). Some have virtually no language ability, yet are able to compute numbers as quickly and accurately as an electronic calculator, or identify the day of the week corresponding to any given historical date, or render incredible works of art or musical performance (Miller, 1999). About 4 in 5 people with savant syndrome are males, and many also have autism spectrum disorder (ASD; see Module 47).

The late memory whiz Kim Peek, a savant who did not have ASD, was the inspiration for the movie *Rain Man*. In 8 to 10 seconds, he could read and remember a page. During his lifetime, he memorized 9000 books, including Shakespeare and the Bible. He learned maps from the front of phone books and could provide GPS-like travel directions within any major U.S. city. Yet he could not button his clothes. And he had little capacity for abstract concepts. Asked by his father at a restaurant to "lower your voice," he slid lower in his chair to lower his voice box. Asked for Lincoln's Gettysburg Address, he responded, "227 North West Front Street. But he only stayed there one night—he gave the speech the next day" (Treffert & Christensen, 2005).

Using such evidence, Gardner argues that we do not have *an* intelligence, but rather *multiple intelligences* (FIGURE 60.1 on the next page), including the verbal and mathematical aptitudes assessed by standard tests. Thus, the computer programmer, the poet, the street-smart adolescent who becomes a crafty executive, and the basketball team's point guard exhibit different kinds of intelligence (Gardner, 1998a).

Wouldn't it be nice if the world were so just that being weak in one area would be compensated by genius in another? Alas, say Gardner's critics, the world is not just (Ferguson, 2009; Scarr, 1989). Recent research, using factor analysis, has confirmed that there *is* a general intelligence factor (Johnson et al., 2008): **g** matters. It predicts performance on various complex tasks and in various jobs (Gottfredson,

"**g** is one of the most reliable and valid measures in the behavioral domain . . . and it predicts important social outcomes such as educational and occupational levels far better than any other trait." —BEHAVIOR GENETICIST ROBERT PLOMIN (1999)

savant syndrome a condition in which a person otherwise limited in mental ability has an exceptional specific skill, such as in computation or drawing.

Islands of genius: Savant syndrome Matt Savage, an award-winning jazz musician, is a Berklee College of Music graduate who has released many albums. His success has been hard-won given his early childhood diagnosis of what is now called autism spectrum disorder, which came with struggles to communicate and an initial inability to tolerate sounds of any kind.



Joanne Rahe/The Boston Globe via Getty Images

Figure 60.1
Gardner's eight intelligences



grit in psychology, grit is passion and perseverance in the pursuit of long-term goals.

Try This

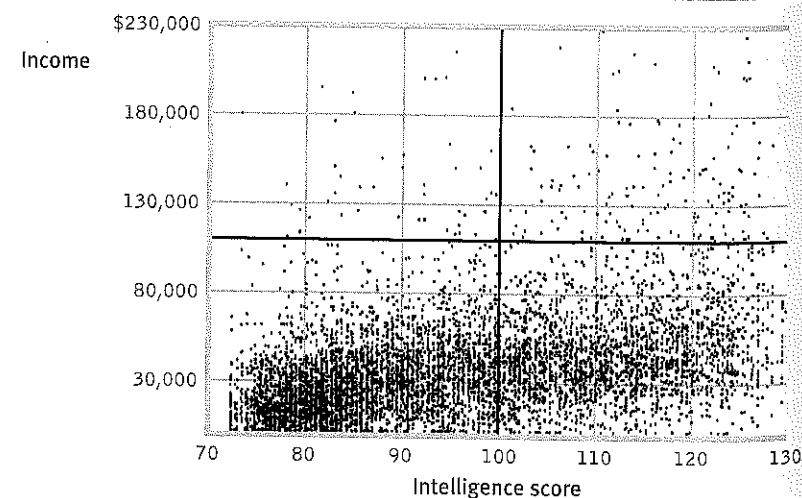
For more on how self-disciplined grit feeds achievement, see Module 82.

2002a,b, 2003a,b; see also **FIGURE 60.2**). Much as jumping ability is not a predictor of jumping performance when the bar is set a foot off the ground—but becomes a predictor when the bar is set higher—so extremely high cognitive ability scores predict exceptional attainments, such as doctoral degrees and publications (Kuncel & Hezlett, 2010).

Even so, “success” is not a one-ingredient recipe. High intelligence may help you get into a good college and ultimately a desired profession, but it won’t make you successful once there. The recipe for success combines talent with **grit**: Those who become highly successful tend also to be conscientious, well-connected, and doggedly energetic.

Figure 60.2

Smart and rich? Jay Zagorsky (2007) tracked 7403 participants in the U.S. National Longitudinal Survey of Youth across 25 years. As shown in this scatterplot, their intelligence scores shared a small but significant correlation (+.30) with their later income. Each dot indicates a given youth's intelligence score and later adult income.



K. Anders Ericsson (2002, 2007; Ericsson et al., 2007) reports a *10-year rule*: A common ingredient of expert performance in chess, dancing, sports, computer programming, music, and medicine is “about 10 years of intense, daily practice.” Various animal species, including bees, birds, and chimps, likewise require time and experience to acquire peak expertise in skills such as foraging (Helton, 2008). As with humans, animal performance therefore tends to peak near midlife.



Spatial intelligence genius In 1998, World Checkers Champion Ron “Suki” King of Barbados set a new record by simultaneously playing 385 players in 3 hours and 44 minutes. Thus, while his opponents often had hours to plot their game moves, King could only devote about 35 seconds to each game. Yet he still managed to win all 385 games!

“You have to be careful, if you’re good at something, to make sure you don’t think you’re good at other things that you aren’t necessarily so good at. . . . Because I’ve been very successful at [software development] people come in and expect that I have wisdom about topics that I don’t.”
—BILL GATES (1998)

STERNBERG'S THREE INTELLIGENCES

Robert Sternberg (1985, 1999, 2003) agrees that there is more to success than traditional intelligence and also agrees with Gardner’s idea of multiple intelligences. But he proposes a *triarchic theory* of three, not eight, intelligences:

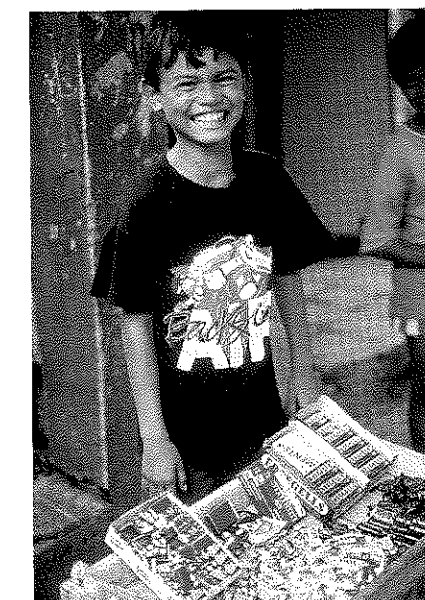
- **Analytical (academic problem-solving) intelligence** is assessed by traditional intelligence tests, which present well-defined problems having a single right answer. Such tests predict school grades reasonably well and vocational success more modestly.
- **Creative intelligence** is demonstrated in reacting adaptively to novel situations and generating novel ideas. Many inventions result from such creative problem solving.
- **Practical intelligence** is required for everyday tasks, which may be ill-defined, with multiple solutions. Managerial success, for example, depends less on academic problem-solving skills than on a shrewd ability to manage oneself, one’s tasks, and other people. Sternberg and Richard Wagner (1993, 1995) offer a test of practical managerial intelligence that measures skill at writing effective memos, motivating people, delegating tasks and responsibilities, reading people, and promoting one’s own career. Business executives who score relatively high on this test tend to earn high salaries and receive high performance ratings.

With support from the U.S. College Board® (which administers the Advanced Placement® Program as well as the widely used SAT Reasoning Test™ to U.S. college and university applicants), Sternberg (2006, 2007, 2010) and a team of collaborators have developed new measures of creativity (such as thinking up a caption for an untitled cartoon) and practical thinking (such as figuring out how to move a large bed up a winding staircase). Their initial data indicate that these more comprehensive assessments improve prediction of American students’ first-year college grades, and they do so with reduced ethnic-group differences.

Although Gardner and Sternberg differ on specific points, they agree that multiple abilities can contribute to life success. They also agree that the differing varieties of giftedness add spice to life and challenges for education. Under their influence, many teachers have been trained to appreciate such variety and to apply multiple intelligence theory in their classrooms.



“You’re wise, but you lack tree smarts.”



Street smarts This child selling candy on the streets of Manaus, Brazil, is developing practical intelligence at a very young age.

Emotional Intelligence

60-4 What are the four components of emotional intelligence?

Also distinct from academic intelligence is *social intelligence*—the know-how involved in successfully comprehending social situations. People with high social intelligence can read social situations the way a skilled football player reads the defense or a seafarer reads the weather. The concept was first proposed in 1920 by psychologist Edward Thorndike, who noted, “The best mechanic in a factory may fail as a foreman for lack of social intelligence” (Goleman, 2006, p. 83). Later psychologists have marveled that high-aptitude people are “not, by a wide margin, more effective . . . in achieving better marriages, in successfully raising their children, and in achieving better mental and physical well-being” (Epstein & Meier, 1989). Others have explored the difficulty that some smart people have processing and managing social information (Cantor & Kihlstrom, 1987; Weis & Süß, 2007). This idea is especially significant for an aspect of social intelligence that John Mayer, Peter Salovey, and David Caruso (2002, 2008) have called **emotional intelligence**. They have developed a test that assesses four emotional intelligence components:

- *Perceiving* emotions (to recognize them in faces, music, and stories)
- *Understanding* emotions (to predict them and how they change and blend)
- *Managing* emotions (to know how to express them in varied situations)
- *Using* emotions to enable adaptive or creative thinking

Mayer, Salovey, and Caruso caution against stretching “emotional intelligence” to include varied traits such as self-esteem and optimism. Rather, emotionally intelligent people are both socially and self-aware. And in both the United States and Germany, those scoring high on managing emotions enjoy higher-quality interactions with friends (Lopes et al., 2004). They avoid being hijacked by overwhelming depression, anxiety, or anger. Being sensitive to emotional cues, they know what to say to soothe a grieving friend, encourage a colleague, and manage a conflict.

Emotional intelligence is less a matter of conscious effort than of one’s unconscious processing of emotional information (Fiori, 2009). Yet the outgrowths of this automatic processing become visible. Across dozens of studies in many countries, those scoring high in emotional intelligence exhibit somewhat better job performance (Joseph & Newman, 2010; Van Rooy & Viswesvaran, 2004; Zeidner et al., 2008). They also can delay gratification in pursuit of long-range rewards, rather than being overtaken by immediate impulses. They are emotionally in tune with others, and thus often succeed in career, marriage, and parenting situations where academically smarter (but emotionally less intelligent) people fail (Cherniss, 2010a,b; Ciarrochi et al., 2006).

Brain damage reports have provided extreme examples of the results of diminished emotional intelligence in people with high general intelligence. Neuroscientist Antonio Damasio (1994) tells of Elliot, who had a brain tumor removed: “I never saw a tinge of emotion in my many hours of conversation with him, no sadness, no impatience, no frustration.” Shown disturbing pictures of injured people, destroyed communities, and natural disasters, Elliot showed—and realized he felt—no emotion. He knew but he could not feel. Unable to intuitively adjust his behavior in response to others’ feelings, Elliot lost his job. He went bankrupt. His marriage collapsed. He remarried and divorced again. At last report, he was dependent on a disability check and custodial care from a sibling.

Some scholars, however, are concerned that emotional intelligence stretches the concept of intelligence too far. Multiple-intelligence man Howard Gardner (1999b) welcomes our stretching the concept into such realms as music and information about ourselves and others. But let us also, he says, respect emotional sensitivity, creativity, and motivation as important but different. Stretch “intelligence” to include everything we prize and it will lose its meaning.

emotional intelligence the ability to perceive, understand, manage, and use emotions.

“I worry about [intelligence] definitions that collapse assessments of our cognitive powers with statements about the kind of human beings we favor.”
—HOWARD GARDNER, “RETHINKING THE CONCEPT OF INTELLIGENCE,” 2000

Is Intelligence Neurologically Measurable?

You know it: You are smarter than some people and not as smart as others. Question: What in that heart of smarts—your brain—creates this difference? Is it your brain’s relative *size*? The amount of certain brain *tissue*? Your brain networks’ *efficiency*?

Brain Size and Complexity

60-5 To what extent is intelligence related to brain anatomy?

After the brilliant English poet Lord Byron died in 1824, doctors discovered that his brain was a massive 5 pounds, not the normal 3 pounds. Three years later, Beethoven died and his brain was found to have exceptionally numerous and deep convolutions. Such observations set brain scientists off studying the brains of other geniuses (Burrell, 2005). Do people with big brains have big smarts?

Alas, some geniuses had small brains, and some dim-witted criminals had brains like Byron’s. More recent studies that directly measure brain volume using MRI scans do reveal correlations of about +.33 between brain size (adjusted for body size) and intelligence score (Carey, 2007; McDaniel, 2005). Bigger is better.

One review of 37 brain-imaging studies revealed associations between intelligence and brain size and activity in specific areas, especially within the frontal and parietal lobes (Jung & Haier, 2007; Tang et al., 2010). Intelligence is having ample gray matter (mostly neural cell bodies) plus ample white matter (axons) that make for efficient communication between brain centers (Deary et al., 2009; Haier et al., 2009).

Sandra Witelson would not have been surprised. With the brains of 91 Canadians as a comparison base, Witelson and her colleagues (1999) seized an opportunity to study Einstein’s brain. Although not notably heavier or larger in total size than the typical Canadian’s brain, Einstein’s brain was 15 percent larger in the parietal lobe’s lower region—which just happens to be a center for processing mathematical and spatial information.

Brain Function

60-6 To what extent is intelligence related to neural processing speed?

The correlations between brain anatomy and intelligence only begin to explain intelligence differences. Searching for other explanations, neuroscientists are studying the brain’s functioning.

As people contemplate a variety of questions like those found on intelligence tests, a frontal lobe area just above the outer edge of the eyebrows becomes especially active—in the left brain for verbal questions, and on both sides for spatial questions (Duncan et al., 2000). Information from various brain areas seems to converge here, suggesting to researcher John Duncan (2000) that it may be a “global workspace for organizing and coordinating information” and that some people may be “blessed with a workspace that functions very, very well.”

Functioning well means functioning efficiently. Brain scans reveal that smart people use less energy to solve problems (Haier, 2009). They are like skilled athletes, for whom agile moves can seem effortless. Agile minds come with agile brains.

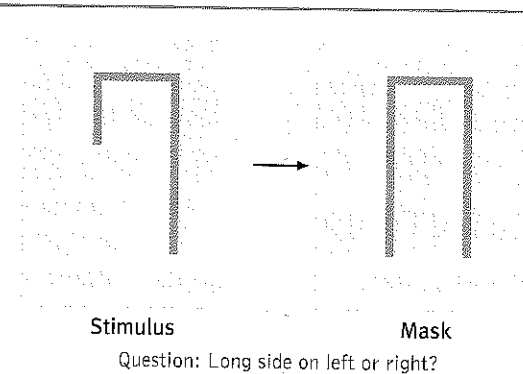
So, are more intelligent people literally more quick-witted, much as today’s speedier computer chips enable ever more powerful computing? On some tasks they seem to be. Verbal intelligence scores are predictable from the speed with which people retrieve information from memory (Hunt, 1983). Those who recognize quickly that *sink* and *wink* are different words, or that *A* and *a* share the same name, tend to score high in verbal ability. Extremely precocious 12- to 14-year-old college students are especially quick in responding to such tasks (Jensen, 1989). To try to define *quick-wittedness*, researchers are taking a close look at speed of perception and speed of neural processing.

AP® Exam Tip

Do not continue on if you can’t remember what terms like *MRI*, *parietal lobe*, and *axon* mean. Now is the time to head back to Unit III for a review. If you do this sort of review frequently, you’ll have much better command of the material on the day of the AP® exam.

Figure 60.3

An inspection time task
A stimulus is flashed before being overridden by a masking image. How long would you need to glimpse the stimulus at the left to answer the question? People who can perceive the stimulus very quickly tend to score somewhat higher on intelligence tests. (Adapted from Deary & Stough, 1996.)



Across many studies, the correlation between intelligence score and the speed of taking in perceptual information tends to be about +.3 to +.5 (Deary & Der, 2005; Sheppard & Vernon, 2008). A typical experiment flashes an incomplete stimulus, as in **FIGURE 60.3**, then a *masking image*—another image that overrides the lingering afterimage of the incomplete stimulus. The researcher then asks participants whether the long side appeared on the right or left. Those whose brains require the least inspection time to register a simple stimulus tend to score somewhat higher on intelligence tests (Caryl, 1994; Deary & Caryl, 1993; Reed & Jensen, 1992).

Perhaps people who process more quickly accumulate more information. Or perhaps, as one Australian-Dutch research team has found, processing speed and intelligence correlate not because one causes the other but because they share an underlying genetic influence (Luciano et al., 2005).

For a summary of Spearman's, Thurstone's, Gardner's, and Sternberg's theories, see **TABLE 60.1**.

Table 60.1 Comparing Theories of Intelligence

| Theory | Summary | Strengths | Other Considerations |
|---|--|---|---|
| <i>Spearman's general intelligence (g)</i> | A basic intelligence predicts our abilities in varied academic areas. | Different abilities, such as verbal and spatial, do have some tendency to correlate. | Human abilities are too diverse to be encapsulated by a single general intelligence factor. |
| <i>Thurstone's primary mental abilities</i> | Our intelligence may be broken down into seven factors: word fluency, verbal comprehension, spatial ability, perceptual speed, numerical ability, inductive reasoning, and memory. | A single <i>g</i> score is not as informative as scores for seven primary mental abilities. | Even Thurstone's seven mental abilities show a tendency to cluster, suggesting an underlying <i>g</i> factor. |
| <i>Gardner's multiple intelligences</i> | Our abilities are best classified into eight independent intelligences, which include a broad range of skills beyond traditional school smarts. | Intelligence is more than just verbal and mathematical skills. Other abilities are equally important to our human adaptability. | Should all of our abilities be considered <i>intelligences</i> ? Shouldn't some be called talents? |
| <i>Sternberg's triarchic theory</i> | Our intelligence is best classified into three areas that predict real-world success: analytical, creative, and practical. | These three facets can be reliably measured. | <ol style="list-style-type: none"> 1. These three facets may be less independent than Sternberg thought and may actually share an underlying <i>g</i> factor. 2. Additional testing is needed to determine whether these facets can reliably predict success. |

Before You Move On

▶ ASK YOURSELF

The modern concept of multiple intelligences (as proposed by Gardner and Sternberg) assumes that the analytical school smarts measured by traditional intelligence tests are important abilities but that other abilities are also important. Different people have different gifts. What are yours?

▶ TEST YOURSELF

Joseph, a Harvard Law School student, has a straight-A average, writes for the *Harvard Law Review*, and will clerk for a Supreme Court justice next year. His grandmother, Judith, is very proud of him, saying he is way more intelligent than she ever was. But Joseph is also very proud of Judith: As a young woman, she was imprisoned by the Nazis. When the war ended, she walked out of Germany, contacted an agency helping refugees, and began a new life in the United States as an assistant chef in her cousin's restaurant. According to the definition of intelligence in this unit, is Joseph the only intelligent person in this story? Why or why not?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 60 Review

60-1 How is *intelligence* defined?

- *Intelligence* is a mental quality consisting of the ability to learn from experience, solve problems, and use knowledge to adapt to new situations.
- An *intelligence test* aims to assess these qualities and compare them with those of others, using a numerical score.

60-2 What are the arguments for and against considering intelligence as one general mental ability?

- Charles Spearman proposed that we have one *general intelligence (g)*. He helped develop *factor analysis*, a statistical procedure that identifies clusters of related mental abilities.
- L. L. Thurstone disagreed and identified seven different clusters of mental abilities. Yet a tendency remained for high scorers in one cluster to score high in other clusters.
- Studies indicate that *g* scores are most predictive in novel situations and do not much correlate with skills in evolutionarily familiar situations.

60-3 How do Gardner's and Sternberg's theories of multiple intelligences differ?

- *Savant syndrome* seems to support Howard Gardner's view that we have multiple intelligences. He proposed eight independent intelligences: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, intrapersonal, interpersonal, and naturalist.
- Robert Sternberg's triarchic theory proposes three intelligence areas that predict real-world skills: analytical (academic problem solving), creative, and practical.

60-4 What are the four components of emotional intelligence?

- *Emotional intelligence*, which is an aspect of social intelligence, is the ability to perceive, understand, manage, and use emotions.
- Emotionally intelligent people achieve greater personal and professional success.
- Some critics question whether calling these abilities "intelligence" stretches that concept too far.