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 potential 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**

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

**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, 1986). 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.
Is Intelligence One General Ability or Several Specific Abilities?

**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 (1887–1950). 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 those 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 factor.

We might, then, liken mental abilities to physical abilities. Athleticism 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 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 own tribe on the other side of a flooded river. More common problems—such as how to make 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 bundles.

**Theories of Multiple Intelligences**

**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 memory no larger than a candy box, 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 **one** 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, 1996a).

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, says Gardner’s critics, the world is not just

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**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-earned 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.
Gardner’s eight intelligences

Try This

For more on how self-disciplined grit leads to achievement, see Module 62.

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.

K. Anders Ericsson (2002, 2007; Ericsson et al., 2007) reports a 20-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, 2003). As with humans, animal performance therefore tends to peak near midlife.

STERNBERG’S THREE INTELLIGENCES

Robert Sternberg (1985, 1999, 2003) argues 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.

Spatial intelligence genius in 1999, World Chessmen’s Champion for “Blitz” 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 (1989)

"You’re smart, but you lack street smarts.”

"The street-smart kids will make it in any circumstances. They have the sense to get out of the street and into the white-collar jobs." - Frank Sinatra (1959)

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 marvelled that high-empathy 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, 1985; Weiss & Sahl, 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 outgrowth of this automatic process becomes 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; Zeldner 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 slotting situations where academically smarter (but emotionally less intelligent) people fail (Cherniss, 2011a,b; Carrochio 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 (1999a) welcomes our stretching the concept into such realms as music and information about 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.

Is Intelligence Neurologically Measurable?

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, 2003). Do people with big brains have big smarts?

Also, 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 (Casey, 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).

Sandia Witelesek would not have been surprised. With the brains of 91 Canadians as a comparison base, Witelesek 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 seem effortless. Agile minds move 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 stink and skulk are different words and that A and a share the same name, tend to score high in verbal ability. Extremely precious 12- to 14-year-old college students are especially quick in responding to such tasks (Jensen, 1989). To try to define quick-thinking, researchers are taking a close look at speed of perception and speed of neural processing.
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 can perceive the stimulus very quickly and score somewhat higher on intelligence tests. (Adapted from Deary & Stough, 1994)

Stimulus
Mask
Question: Long side on left or right?

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 & Verhaeg, 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, 1984; Deary & Caryl, 1995; 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., 2015).

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Table 60.1 Comparing Theories of Intelligence

<table>
<thead>
<tr>
<th>Theory</th>
<th>Summary</th>
<th>Strengths</th>
<th>Other Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman’s general intelligence</td>
<td>A basic intelligence predicts our abilities in varied academic areas.</td>
<td>Different abilities, such as verbal and spatial, do have some tendency to correlate.</td>
<td>Human abilities are too diverse to be encapsulated by a single general intelligence factor.</td>
</tr>
<tr>
<td>Thurstone’s primary mental abilities</td>
<td>Our intelligence may be broken down into seven factors: word fluency, verbal comprehension, spatial ability, perceptual speed, numerical ability, inductive reasoning, and memory.</td>
<td>A single g score is not as informative as scores for seven primary mental abilities.</td>
<td>Even Thurstone’s seven mental abilities show a tendency to cluster, suggesting an underlying g factor.</td>
</tr>
<tr>
<td>Gardner’s multiple intelligences</td>
<td>Our abilities are best classified into eight independent intelligences, which include a broad range of skills beyond traditional school smarts.</td>
<td>Intelligence is more than just verbal and mathematical skills. Other abilities are equally important to our human adaptability.</td>
<td>Should all of our abilities be considered intelligence? Shouldn’t some be called talents?</td>
</tr>
</tbody>
</table>
| Sternberg’s triarchic theory     | Our intelligence is best classified into three areas that predict real-world success: analytical, creative, and practical. | Those three facets can be reliably measured.                                | 1. These three facets may be less independent than Sternberg thought and may actually share an underlying g factor.  
2. Additional testing is needed to determine whether these facets can reliably predict success. |

For a summary of Spearman’s, Thurstone’s, Gardner’s, and Sternberg’s theories, see Table 60.1.

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-kinaesthetic, intrapersonal, interpersonal, and naturalist.
- Robert Sternberg’s triarchic theory proposes three intelligence areas that predict real-world skills: analytical 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.
Module 61
Assessing Intelligence

Module Learning Objectives

61-1 Discuss the history of intelligence testing.
61-2 Distinguish between aptitude and achievement tests.
61-3 Explain the meaning of standardization, and describe the normal curve.
61-4 Explain the meanings of reliability and validity.

How do we assess intelligence? And what makes a test credible? Answering these questions begins with a look at why psychologists created tests of mental abilities and how they have used these tests.

The Origins of Intelligence Testing

61-1 When and why were intelligence tests created?

Some societies concern themselves with promoting the collective welfare of the family, community, and society. Other societies emphasize individual opportunity. Plato, a pioneer of the individualist tradition, wrote more than 2000 years ago in The Republic that “no two persons are born exactly alike; but each differs from the other in natural endowments, one being suited for one occupation and the other for another.” As heirs to Plato’s individualism, people in Western societies have pondered how and why individuals differ in mental ability. Western attempts to assess such differences began in earnest over a century ago. The English scientist Francis Galton (1822–1911) had a fascination with measuring human traits. When his cousin Charles Darwin proposed that nature selects successful traits through the survival of the fittest, Galton wondered if it might be possible to measure “natural ability” and to encourage those of high ability to mate with one another. At the 1884 London Exposition, more than 10,000 visitors received his assessment of their “intellectual strengths” based on such things as reaction time, sensory acuity, muscular power, and body proportions. But alas, on these measures, well-regarded adults and students did not outscore others. Nor did the measures correlate with one another.

Although Galton’s quest for a simple intelligence measure failed, he gave us some statistical techniques that we still use (as well as the phrase “nature and nurture”). And his persistent belief in the inheritance of genius—reflected in his book, Hereditary Genius—illustrates an important lesson from both the history of intelligence research and the history of science: Although science itself strives for objectivity, individual scientists are affected by their own assumptions and attitudes.