

Chapter Eight ~ //

Language, Thinking, and Intelligence



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Psychological Applications: How Can You "Create" a Creative Environment?

magine an alternative reality where people are absolutely obsessed with Great Literature and where children swap author cards with the zeal that children in our world have for sports cards. Instead of seeking religious converts, missionaries show up at your door trying to convince you that Francis Bacon is the true author of Shakespeare's plays. In pubs and other social venues, "Will-Speak" machines that quote Shakespeare on command

stand in place of the flashy video games of our world. However, this literature-enriched world is

not without its share of problems. The Crimean War between Great Britain and czarist Russia—which ended in 1856 in our reality—is still being waged, and Wales has

The world we have created is a product of our thinking; it cannot be changed without changing our thinking.

> —Albert Einstein, German physicist, 1879–1955

a communist government. An evil, multinational conglomerate, the Goliath Corporation, controls much of the world's economy and resources. And, oh yes, the Third Most Wanted criminal on the planet has somehow entered the original manuscript of Charlotte Brontë's Jane Eyre and kidnapped its namesake. Big problem. Suddenly, everyone reading Jane Eyre discovers the book's narrative is in serious disarray as the remaining characters are at a loss on how to proceed with the disrupted storyline.

Welcome to the hilariously off-kilter world of author Jasper Fforde, where fictional characters from famous and not-so-famous (and even unpub-

or been: it is lying as in the pages of books.

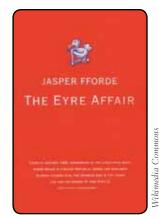
> —Thomas Carlyle, British author and social critic, 1795-1881

Literature is the one place the secrecy of our own heads, we can hear voices in every possible way.

-Salmon Rushdie, Indian-born British author, b. 1947 lished) novels have lives beyond the stories they inhabit and occasionally cross over to the "real" world. The heroine of Fforde's novels is a smart, gun-toting literary detective named Thursday Next, who has the job of setting right that which has gone so wrong. Does this story sound like the basis for a commercially successful book? Not according to almost all the major

Fforde's globe. first manuscript, The Eyre Affair, received 76 rejections before finally being published in 2001. Today he is a best-selling author and touted by literary critics as the "adult's J. K. Rowling" (the Harry Potter author).

What do Jasper Fforde and the content of his books have to do with the content of this chapter? Fforde's work represents an excellent example of the creative



Language is a complex means of communicating, involving the use of symbols and rules for combining them. In writing books, authors rely upon creative literary skills to convey their ideas to readers.

expression of language and the ability to envision alternative realities. This chapter examines the psychology of language and cognition, including the range of mental abilities that identify intelligence. In this regard, Fforde's work is an illustration of our chapter topics. At the outset, let us explore how our world is transformed by the ability to share the meaning of these markings on the page and the vocal utterances we emit. We will begin this journey by stepping into the past and examining the evolution of language.

publishing houses around

into being?

Communication is the sending and receiving of information. Every day of our lives, we communicate hundreds, if not thousands, of bits of information to others. Some of these messages are intended, while others are not. **Language**, the primary mode of communication among humans, is a systematic way of communicating information using symbols and rules for combining them. It is a complex and sophisticated skill, and the principal tool for building human culture. Speech is the oral expression of language; approximately 6,500 spoken languages exist today. How did they come

8.1a Human Language Evolution Had Social and Cognitive Advantages.

The search for the origins of language begins in the brain. As noted in Chapter 2, Section 2.3e, PET scan studies indicate that the major neural mechanisms for language are located in the left hemisphere, even in most left-handed people (see Figure 8-1). A small clump of neurons near the front of the brain, known as *Broca's area*, influences brain areas that control the muscles of the lips, jaw, tongue, soft palate, and vocal cords

Communication The sending and receiving of information

Language A systematic way of communicating information using symbols and rules for combining them

Speech The oral expression of language

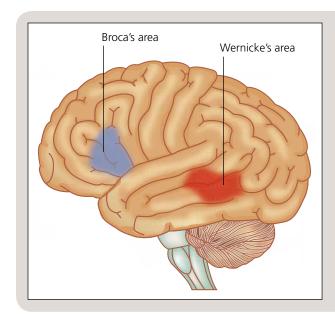


FIGURE 8-1

Broca's and Wernicke's Areas of the Cerebral Cortex

Traditionally, two brain areas have been associated with language function—namely, Broca's area and Wernicke's area. These brain areas are usually located in the left cerebral hemisphere.

during speech. Thus, Broca's area is important in *language production*. Connected by a nerve bundle to Broca's area is *Wernicke's area*, a part of the brain important for *language comprehension*, which is the ability to understand the message conveyed by words, phrases, and sentences (Hale, 2007; Hickok et al., 2011).

Even though Broca's area is primarily responsible for speech production and Wernicke's area is more involved in speech comprehension, brain scans indicate that Broca's area is also activated when a person is trying to comprehend a sentence with a complex *syntax*, which is the area of grammar dealing with the language rules for combining words into sentences. Thus, Broca's area appears to be involved when we use the grammatical rules of a language in both producing and comprehending sentences (Newman et al., 2003).



The two areas in the left temporal lobes of the brain associated with language function are named after two nineteenth-century scientists. *Broca's area* is named after a French neuroanatomist who first described how damage to this area disrupted language production. *Wernicke's area* is named after the German neurologist Carl Wernicke, who first reported how damage to this area disrupted language comprehension.

Although we can identify the major brain areas associated with language production and comprehension, answering the "when" and "why" questions of language evolution has proven to be a bigger problem (Botha, 1997). The *gradual increase theory* contends that human language is the product of a very long period of biological evolution, spanning millions of years. In contrast, the *threshold theory* asserts that human language is more a product of sudden cultural evolution. Proponents of the threshold theory believe that language is no older than 50,000 years and is closely tied to the development of tools, imagery, and art (Isaac, 1983). Genetic testing of different animal species provides evidence bolstering the threshold theory (Enard, 2011; Enard et al., 2002). This research suggests that roughly 200,000 years ago, mutations in the FOXP2 gene may have caused changes in the brains of archaic *Homo sapiens*, providing them with much finer control over their mouth and throat muscles. Within 1,000 generations,

Asking an archeologist to discuss language is rather like a mole being asked to describe life in the treetons

—Glynn Isaac, American archeologist, 1937–1985

or about 20,000 years, these mutations may have played a central role in enabling modern humans to speak and, therefore, develop language about 50,000 years ago. The human and chimpanzee FOXP2 genes differ by only 2 out of their 715 amino acids, but this small difference may partly explain why chimps cannot speak.

Beyond the "when" question, one possible reason why language evolved is that it had social significance to humans (Bejarano, 2011; Oda, 2001). That is, it provided a way for our ancestors to more efficiently communicate in such cooperative ventures as hunting and gathering food. Support for this view comes from cross-cultural studies indicating that language is mostly used today for establishing, maintaining, and refining social relationships (Burling, 1986; Dunbar, 1993). It is also possible that language evolved because of its cognitive significance to humans. Throughout evolutionary history, brains have been shaped to construct a representation of the world appropriate to a species' daily life. Human brains have been shaped to facilitate reflective thought and imagery, abilities essential for complex decision making and problem solving. From this perspective, language use evolved as a means of facilitating the construction of an inner reality that we call consciousness. Thus, consistent with the Chapter 5 discussion (see Section 5.1b) of the evolution of consciousness, language may have evolved because it facilitated the construction of consciousness at the same time it facilitated the cooperative efforts of individuals living in groups. By sharing a common language, our ancestors could communicate about events not currently present, such as food in a distant valley, or they could conjure up ideas in the minds of fellow tribal members about alternative realities, which became the foundation for their mythologies. This ability to create pictures and thoughts in another's mind through language is the art of the writer and orator. As Jasper Fforde, author of the Thursday Next novels, explains the marvel of written language:

If books and reading were invented tomorrow they would be hailed as the greatest technological advance known to mankind. No batteries, simple, portable, durable. Why bother building sets or creating convincing computer effects when the images are already there in the reader's mind? ... When a reader praises an author, they should reserve 75% of that praise for themselves. (White, 2002, p. 10)

Some linguists believe that remnants of the earliest language spoken by our ancestors—referred to as *protolanguage*—are preserved in the distinctive clicking sounds still spoken by some southern and eastern African tribes. Linguists once assumed that these click languages—each with a set of four or five click sounds—were derived relatively recently from a common language. However, genetic testing of people from different click-speaking tribes who live thousands of miles apart (the Hadzabe and the !Kung) has found no evidence of any interbreeding over tens of thousands of years (Knight et al., 2003). This means that these two cultures have had no apparent contact with one another for thousands of generations. Although it is possible that the two cultures independently invented similar-sounding clicks, some linguists believe it is far more likely that these two tribes are very distant descendants of the world's earliest language users. If this is so, then these unusual click sounds may represent the remaining distinctive elements of this ancient vocabulary.



Anatomically, the evolutionary descent of the larynx in the human vocal tract increased the range of sounds that we could make. The "cost" of this anatomical change is that we now have an increased risk of choking when we eat or drink (J. M. Smith & Szathmáry, 1995).

8.1b Language Capabilities May Not Be Unique to Humans.

Beyond searching for the reasons why we became language users, scientists have also wondered whether language and speech are uniquely human abilities. Since the 1930s, a number of attempts have been made to teach language to a few select species, such as chimpanzees, bonobos, gorillas, dolphins, and parrots (Hayes, 1951; Kellogg & Kellogg, 1933; Oelschlager, 2008).

Perhaps the most famous case is that of Washoe, a young female chimpanzee who was raised at home by Allen and Beatrix Gardner (1969) and taught sign language as though she were a deaf human child. Within four years, Washoe was using more than 100 signs, ranging from *baby*, *banana*, and *airplane* to *window*, *woman*, and *you*. She could also combine words to produce sentencelike phrases such as *gimme banana* and *open food drink*. Some of these phrases appeared to be novel constructions by Washoe, as in her combination of *water bird* to refer to a swan. Even more impressive was Washoe's apparent ability to engage in simple conversations, prompting a visiting reporter for *The New York Times* to declare, "Suddenly I realized I was conversing with a member of another species in my native tongue."

During the 1970s and 1980s, research with other chimps and gorillas using sign language or plastic shapes representing words provided further evidence of ape language ability (Premack & Premack, 1983). One female gorilla named Koko learned more than 600 words and demonstrated even more spontaneous and productive use of language than Washoe (Patterson, 1978). In one memorable incident, Koko created a new word for an object she had previously never encountered, calling a ring a *finger bracelet*.

Additional research with bonobos (or "pigmy chimps"), which are close genetic relatives of both chimpanzees and humans, provided further evidence that apes could use language. In particular, one young male bonobo, Kanzi, began using symbols at age 2 1/2 years to communicate with humans without any special training (Rumbaugh, 1990). Like human children, Kanzi learned to use symbols early in life by observing his adoptive mother use language (while she was in a training study). Eighty percent of the time, this communication occurred spontaneously, without prompting by the researchers. Kanzi learned not only how to "talk" by using hand signals and typing geometric symbols on a keyboard, but also how to comprehend the semantic nuances of spoken English. Although dogs, cats, horses, and many other species can sometimes guess what we mean when we talk to them by attending to various situational cues (for example, our tone of voice and gaze direction), Kanzi's understanding of spoken English was much more complex. For instance, when listening through earphones to a list of words spoken by a person in another room—thus eliminating situational cues—Kanzi was able to select the correct picture from among a pile of pictures. In another testing situation, when he was told to "Give the dog a shot," Kanzi picked up a toy hypodermic syringe from among a host of objects and "injected" his stuffed toy dog.

Over the years, scientists have observed Kanzi (a bonobo), Washoe (a chimp), Koko (a gorilla), and other apes not only sign spontaneously but also use their signing to let others know their likes and dislikes, just as humans do. Although these apes have not mastered human language, these animals are able to communicate with humans and even with others of their own species using a form of human language (Jensvold & Gardner, 2000). In contrast to humans, their vocabulary is small and their sentences are simple, similar to those of a 2-year-old child. Further, it takes substantially longer and requires more effort for them to learn a language than it does for human children. This suggests that the human brain must have something present at birth that is more ready to acquire language that the ape brain lacks.

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Bonobos and other apes have been taught by humans to communicate with sign language. Once taught, they have been observed teaching their offspring sign language. Does this mean that these animals possess the ability to learn language, an ability once thought unique to humans?

8.1c Infants Appear to Be Born Prepared to Learn Language.

As in other areas of psychological inquiry, researchers have debated the degree to which language acquisition is simply due to experience and learning, and the degree to which it naturally unfolds due to inborn capacities (Sealey, 2000; Snow, 1999).

The Behaviorist Perspective

Until about 1960 most psychologists assumed that children's development of language ability was simply a learned response. Championing this behaviorist perspective, B. F. Skinner (1957) asserted that people speak as they do because they have been reinforced for doing so. Children, according to Skinner, begin life with a blank "language blackboard," which is then slowly filled by the experiences provided by people in their social environment. Throughout this learning process, Skinner and other behaviorists assumed that children were relatively passive; parents and other speakers were given credit for shaping their younger charges' utterances into intelligible words by selectively reinforcing correct responses.

The problem with this explanation is that it does not fit the evidence. Behaviorism cannot explain how children often produce sentences they have never heard before (Brown, 1973). Instead of saying, "Mommy went to work" or "That is my cookie"—which would be correct imitations of adult speech—children typically say "Mommy goed to work" and "That mine cookie." Perhaps more importantly, children's imitation of adult speech drops dramatically after age 2, despite the fact that language development continues. How could children continue to learn language if imitation is at the core of their learning?

Selective reinforcement and punishment also cannot explain language development. Parents rarely provide negative feedback when their young children make grammatical errors, and children's speech usually is not significantly influenced by such corrections when they do occur (Gordon, 1990). This does not mean that operant conditioning principles do not play a role in learning language; for example, anyone who remembers learning when to use "who" and when to use "whom" can attest to the influence that learning principles can have in language acquisition. Yet, contrary to earlier behaviorist assumptions, operant conditioning principles do not play the primary role in language development.

The Nativist Perspective

Standing in sharp contrast to the behaviorist view of language development is the nativist perspective, which contends that normal development proceeds according to an inborn program that is not significantly influenced by environmental factors. Nativist theories of language acquisition suggest that we learn language for the same reason that we learn to walk—because we're biologically equipped for it (Perani et al., 2011). In this vein, linguist Noam Chomsky (1957) proposed that humans are born with specialized brain structures or neural prewiring, called the **language acquisition device**, which facilitates the learning of language. According to Chomsky, thanks to this inborn capacity to acquire language, if children are exposed to it, they will learn to talk even if they are not reinforced for doing so.

Although the existence of a language acquisition device remains an unconfirmed hypothesis, studies suggest that we may indeed be biologically predisposed to acquire language. For example, by studying videotapes of infants while they were engaged in babbling and nonbabbling mouth movements, Siobhan Holowka and Laura-Ann Petitto (2002) discovered that the right sides of the babies' mouths opened wider than the left sides when they babbled, but not when they nonbabbled. As you recall from Chapter 2, Section 2.3e, the right side of the body is controlled by the left side of the brain, which is where the major neural mechanisms for language are located. Holowka and Petitto contend from their findings that certain brain areas are specialized for language very early in life, and perhaps even prior to birth. These studies suggest that we have an inborn capacity for language.

The Interactionist Perspective

In the debate on language acquisition, while behaviorists emphasize environmental factors and nativists champion inborn predispositions, it appears that the most complete explanation is one that takes an interactionist perspective (Nelson et al., 2003). As the name implies, *interactionists* assume that environmental and biological factors interact to affect the course of language development.

Although children appear to be born with the capacity for language, a good deal of research suggests that their experiences during early childhood are critical in their acquiring this ability. As previously discussed in Chapter 3, Section 3.1c, there are sensitive periods during development after which it becomes more difficult to acquire certain abilities. For language acquisition, if children are not exposed to any human language before a certain age, their language abilities never fully develop. This sensitivity period for language begins during the first year of life and ends at about age 12 when children reach or are near puberty. Around the onset of puberty, the brain's pruning of underused neurons and overall neural wiring is at its peak; thereafter, the brain's ability to make new neural connections—its plasticity—decreases (see Chapter 2, Section 2.3h). Consistent with this notion of a language sensitivity period is the finding that when adults learn a language, they speak with a more native-like accent if they overheard the language regularly during childhood than if they did not (Au et al.,



Noam Chomsky, b. 1928

Language acquisition device According to Chomsky's linguistic theory, an innate mechanism that facilitates the learning of language



Verbal interaction with competent language users is essential in order for children to develop language skills. Which perspective on language development does this evidence support?

2002). Apparently, early exposure to a language establishes a long-lasting mental representation of it in memory.

One environmental factor that is critical in children's language development is adult interaction. Studies of abused and neglected children who received little adult attention found that they had impaired speech comprehension and verbal expression when compared with children who received normal adult attention (Allen & Oliver, 1982; Culp et al., 1991). Unlike these language deficits, no differences were found in the children's cognitive development, leading to the conclusion that language development is particularly vulnerable in an environment lacking normal parent-child verbal interaction. Numerous studies indicate that when children are isolated from normal language interaction beyond their

middle childhood, they develop irreversible language deficits (Ouellet et al., 2001). Taken together, these studies suggest that a critical component in the development of language is supportive social interaction with competent language users.

8.1d Language Development Occurs in Distinct Stages.

Regardless of the exact process by which language acquisition occurs, it begins shortly after birth and involves a number of distinct stages that move from simple to complex (Taylor, 2012). All human languages are composed of **phonemes**, which are the smallest significant sound units in speech. For example, to say *men*, you use three phonemes: m, e, and n. Linguists estimate that humans have the capacity at birth to produce about 100 phonemes, but because no language uses all these phonemes, this number is reduced to a much smaller set as children learn to speak (Maye et al., 2008). The Hindi language uses the most phonemes (over 60), and the Polynesian language uses the least (only 11). Most languages consist of between 30 and 40 phonemes; the English language uses about 40.

One step above phonemes in the language hierarchy are **morphemes**, which are the smallest units of language that carry meaning. Morphemes include prefixes and suffixes, such as the *re* in *replay* or the *s* in *plans*. The word *tourists* contains three morphemes—*tour*, *ist* (meaning "person who does something"), and *s* (indicating plural)—each of which adds to the meaning of the morpheme it follows. The average English speaker uses the available 40 phonemes to build between 50,000 and 80,000 morphemes.

In every culture throughout the world, language development begins with children using primitive-sounding phonemes. By 3 to 5 weeks of age, newborns begin a vocalization pattern known as *cooing*, in which they produce phoneme sounds such as *ooooh* and *aaaah*. Between the fourth and sixth month, infants can read lips and distinguish between the phonemes that comprise their language (Cohen et al., 1992). They also begin *babbling*, in which they spontaneously repeat phoneme combinations like *ahh-goo* and *baa-baa* (Plaut & Kello, 1999). This sequence of cooing, then babbling, occurs even among babies born deaf (Oller & Eilers, 1988).

Up until about 10 months of age, children from different cultures appear capable of discriminating between the phonemes in all existing languages. However, by about 10 months of age, many of the phonemes not in children's native language drop out, resulting in their babbling taking on a more culture-specific sound (De Boysson-Bardies et al., 1989). Because one language might not include all the phonemes found in another language, people who learn to speak another language

Phonemes The smallest significant sound units in speech

Morphemes The smallest units of language that carry meaning

often have difficulty pronouncing the novel phonemes in their second language. This is why Japanese who learn to speak English often fail to distinguish between r sounds and l sounds. Similarly, native English speakers have difficulty vocalizing the guttural Arabic ch or rolling the r sound of German.

At about age 1, most children begin uttering morpheme sounds that can be identified as words, like *mama*, *papa*, and the ever-popular *no*. This period in language acquisition is typically called the *one-word stage* because children can use only one-word phrases (Akhtar & Tomasello, 1996). These words usually relate to specific objects or concepts that children regularly encounter or use in their world. Because they still possess a fairly small vocabulary, young children often don't have words for many of the objects they want to talk about.



Throughout the world, children progress through distinct stages in developing language. During the early stages of language development, what sort of speech feedback do adults provide that facilitates children's language learning?

Consequently, they *overextend* their words to these yet unnamed objects. Thus, an 18-month-old child might use the word wawa not only for water but also for milk, juice, and any other liquid. Similarly, anything sweet might be called a *cookie*. Overextension is an application of the process of *assimilation* of children's words. As you recall from Chapter 3, Section 3.3a, assimilation is the process of using existing schemas to deal with information encountered in the world. When children call all liquids *wawa*, they are assimilating these objects into their *wawa* schema. However, when they begin calling liquids by their specific names—for example, milk is no longer wawa, but *milk*—this is an application of the process of *accommodation*, which involves the creation of new schemas.

By age 2, children enter the *two-word stage*, in which they begin using two separate words in the same sentence. During this two-word stage, a phase of **telegraphic speech** begins, in which children use multiple-word sentences that leave out all but the essential words, like in a telegrammed message (*BABY BORN. MOTHER FINE*). Thus, instead of saying "I want to go outside," children will say, "Want outside." Even when using this basic telegraphic speech, youngsters demonstrate an elementary knowledge of syntax: Words are almost always spoken in their proper order ("Want outside" instead of "Outside want").

Telegraphic speech An early speech phase in which children use short, multiple-word sentences that leave out all but the essential words, as in a telegrammed message



Journey of Discovery

Research indicates that infants have an inborn ability to detect phoneme sounds that are not a part of their culture's language repertoire. Given that you cannot ask infants questions, how do you think psychologists tested this ability in newborns? That is, how did they design an experiment to test children's inborn ability to detect phoneme sounds?

Once children move beyond using two-word sentences, they quickly produce longer phrases, and telegraphic speech is used less frequently by age 3 (Riley, 1987; Waxman, 2003). By the time children reach age 4, they are using plurals, as well as the present and past tense in sentences; however, they often *over generalize* grammatical rules. For example, in using the past tense, they will incorrectly say things like "I goed outside" or "I rided my bike." Because "goed" and "rided" are words children would not have heard from adults, their use suggests that children are naturally predisposed

to pick up grammatical rules and then apply them generally (Marcus, 1996). Children also don't seem to be especially attentive to adult corrections, as illustrated in the following dialogue (quoted in Cazden, 1972):

Child: "My teacher holded the baby rabbits and we patted them."

Mother: "Did you say your teacher held the baby rabbits?"

Child: "She holded the baby rabbits and we patted them."

Mother: "Did you say she held them tightly?"

Child: "No, she holded them loosely."

Of course, children's seeming inattentiveness to adult corrections does not mean that adults are irrelevant to children's language acquisition. As noted earlier, especially during the early stages of language development, the day-to-day verbal feedback that infants receive from their caregivers plays an important role in the learning process. This **child-directed speech**—also called *motherese*—is characterized by exaggerated intonations, high pitch, clear enunciation, short sentences, repetition, and slow speech (Stumper et al., 2011). Child-directed speech may help infants recognize specific language forms and understand where utterances begin and end, skills necessary for future language learning. Adults who communicate with deaf children exhibit a similar pattern by making signs more slowly, repeating the signs, and making exaggerated gestures when signing (Sandler, 2003). Deaf infants pay more attention to this *child-directed signing* than to the more rapid, fluid signing typically used between adults.

Child-directed speech Speech to babies that is characterized by exaggerated intonations, high pitch, clear enunciation, short sentences, repetition, and slow speech; also called motherese



During childhood, we learn almost 5,000 words per year, which amounts to about 13 new words per day. The vocabulary of high school graduates includes about 80,000 words, while adults with excellent vocabularies retain upward of 200,000 words (G. A. Miller & Gildea, 1987)!

8.1e Language Can Influence Thought.

In this chapter, in addition to examining our language system, we analyze how we think. Yet, how strong is the connection between cognition and language? Anthropologists Benjamin Lee Whorf and Edward Sapir developed the *Whorf-Sapir hypothesis*, which proposed that the structure of language *determines* the structure of thought (Whorf, 1956). The implications of this hypothesis are profound. First, if language shapes your conception of reality, without a word or phrase to describe an experience, you literally cannot think about it. Second, if language shapes reality, then no two cultures share the same understanding of the world; their thinking and their perceptions of the world differ because of differences in their languages (Pilling & Davies, 2004).

The idea that language determines thinking has been the subject of considerable debate and research over the years. In a critical test of the Whorf-Sapir hypothesis, Eleanor Rosch (1973) compared the color perceptions of the Dani people of New Guinea—who use only two words for color (*bright* and *dark*)—with those of English-speaking people—who use many different color terms. Despite these large language differences, Rosch found no differences in the way the two groups perceived color: Dani speakers made discriminations among colors as fine as the discriminations of English speakers. Other cross-cultural studies using different languages have also failed to support the hypothesis that language determines thinking (Regier et al.,

Every country has its own language, yet the subjects of which the untutored soul speaks are the same everywhere

—Tertullian, Roman theologian, 160–240 A.D.

2010). Thus, counter to the Whorf-Sapir hypothesis, even though a language lacks terms for certain stimuli, the users of the language may still be able to perceive the various features of those stimuli. In fact, when we encounter something novel, we change our language to accommodate the need to refer to it. We manipulate our language much more than our language manipulates us.

Although the hypothesis that language determines thought in some sort of lockstep fashion has no empirical support, most psychologists do believe in a weaker version of the Whorf-Sapir hypothesis—that language can *influence* thinking (Zhang & Xiumei, 2007). This position, known as **linguistic relativism**, may not seem that unusual to you if you speak two dissimilar languages, like English and Japanese or English and Chinese (Brown, 1986). English, rooted in an individualist cultural context, has many self-focused words, while the collectivist-based Japanese and Chinese languages have many interpersonally focused words. Bilingual people report that the way they think about themselves and others is influenced by which language they happen to be using. For instance, when speaking English, bilingualists are more likely to attend to their own personal needs and desires, while social obligations are more salient in their thoughts when they speak Japanese or Chinese (Boucher & O'Dowd, 2011; Matsumoto, 1994). Beyond these particular culturally-based language influences on thought, Exploring Culture & Diversity 8-1 discusses how gender-related pronouns in language can shape people's thinking.

Linguistic relativism The idea that language can influence thinking



How Is Thinking Influenced by Generic Masculine Pronouns?

In English, you cannot avoid specifying gender when using pronouns like his or her. Yet, traditionally in the English language, masculine pronouns and nouns have been used to refer to all people, regardless of gender. Although the **generic masculine** is meant to include women as well as men, it does not do so in reality. For example, a number of studies indicate that people learn to associate men and women with certain activities and occupations by listening to the gendered pronouns used to describe these activities and occupations (McConnell & Fazio, 1996; Miller & Swift, 1991). When telling children what a physician does on the job, for instance, using the generic masculine ("He takes care of sick people") conveys to the child that this is an occupation for men, not women. Similarly, after reading a paragraph that describes psychologists with the generic masculine he, both women and men rated psychology as a less attractive profession for women than students who read a gender-neutral (they) description (Briere & Lanktree, 1983). Based on this research, the American Psychological Association recommends that genderneutral language be used to reduce gender bias in people's thinking. Reading-time studies indicate that using gender-neutral terms instead of gendered terms is cognitively efficient and does not reduce reading comprehension (Foertsch & Gernsbacher, 1997). Table 8-1 lists some suggestions for avoiding gendered terms in your own language.

Generic masculine The use of masculine nouns and pronouns to refer to all people, instead of just males

In summary, then, although research does not support the original strong version of the linguistic relativity hypothesis—that language determines what we can (and cannot) think about—it does appear that language can make certain ways of thinking more or less likely. This weaker version of the original hypothesis tells us that although language is not the sole determinant of thought, it does influence thought in some meaningful ways.

TABLE 8-1 Suggestions for Reducing Gendered Terms in Language					
Gendered Terms to Avoid	Alternative Gender-Neutral Terms				
He, his, him	He or she, she or he, her or his, his or her, him or her, her or him, or switch to the plural they, their, them				
Man, mankind	Humanity, people, human beings, humankind, the human species				
Man-made	Handmade, synthetic, fabricated, constructed				
Coed	Student				
Freshman	First-year student, frosh				
Manpower	Workers, human resources, personnel, workforce				
Businessman	Businessperson				
Chairman, chairwoman	Chairperson, head, chair				
Saleswoman, salesgirl	Sales clerk				
Foreman	Supervisor				
Policeman, policewoman	Police officer				
Waitress	Server Person-to-person				
Man-to-man					
Forefathers	Ancestors				
Housewife, househusband	Homemaker				
Mothering	Parenting, caregiving, nurturing				
Gunman	Shooter				
Fireman	Firefighter				
Mailman	Mail carrier				
Caveman	Prehistoric person				
Fisherman	Fisher				
First baseman	First base player				
Actress	Actor				
Brotherhood	Kinship				
Weatherman	Meteorologist				





- According to the evolutionary perspective, language may have evolved because it facilitated the construction of consciousness and the cooperative efforts of group living.
- Certain nonhuman species can be taught languagelike communication.
- Three theories of how language develops in humans maintain the following: Behaviorists stress the role played by operant conditioning; nativists contend that humans are born with a capacity to acquire language; and interactionists assert that environmental and biological factors interact.
- The smallest significant sound units in speech are phonemes; morphemes are the smallest language units that carry meaning.
- Children progress through distinct stages in language development.
- Although the linguistic relativity hypothesis proposes that the structure of language determines the structure of thought, research suggests that this is not the case; however, language can make certain ways of thinking more or less likely.

8.2 Thinking

Thinking, or **cognition**, is the mental activity of knowing and the processes through which knowledge is acquired and problems are solved. While Chapter 3 examined how cognition develops in children, in this chapter section we begin by examining the building blocks of cognition, namely, *concepts*.

Cognition The mental activity of knowing and the processes through which knowledge is acquired and problems are solved

8.2a Concept Formation Is a Basic Element of Cognition.

A **concept** is a mental grouping of objects, ideas, or events that share common properties (Markman, 1999). For example, the concept *insect* stands for a class of animals that have three body divisions (head, thorax, abdomen), six legs, an external skeleton, and a rapid reproductive system. As you recall from our discussion of the semantic network model in Chapter 7, Section 7.2b, concepts enable us to store our memories in an organized fashion. When one concept in our long-term memory is activated, other closely related concepts are also activated, or *primed*.

The primary means of coding experience by forming concepts is called **categorization** (Rakison & Oakes, 2003). As a species, we spontaneously categorize things we experience. Categorization is adaptive because it saves time and helps in making predictions about the future. I know, for example, that if I eat an object from the concept cheese, I am likely to enjoy the experience. I also know that if I need medical attention, I will likely receive it by seeking out people from either of the concepts *physician* or *nurse*. Like the heart that pumps life-giving blood throughout the body or the lungs that replenish the oxygen in this blood, humans could not survive without engaging in categorization.

We form some concepts by identifying *defining features*. For instance, if an animal has three body divisions, six legs, an external skeleton, and a rapid reproductive system, I would say it was an insect; if it lacks one or more of these features, I would not think of it as an insect (Medin, 1989). The problem with forming concepts by

Concept A mental grouping of objects, ideas, or events that share common properties

Categorization The primary means of coding experience through the process of forming concepts

FIGURE 8-2

When Is This Object a "Cup," and When Is It a "Bowl"?



definition is that many familiar concepts have uncertain or *fuzzy boundaries*. This fact makes categorizing some members of familiar concepts more difficult than others. To see an illustration of this point, consider the objects included within the fuzzy boundaries of the concept *cup* in Figure 8-2. In one experiment, when people were individually shown objects like this and asked to name them, they were more likely to abandon the "cup" label and identify the object as a "bowl" as its width increased relative to its depth (Labov, 1973). However, the point at which this shift occurred was gradual, not fixed.

Findings such as these suggest that categorizing has less to do with the features that define all members of a concept and more to do with the features that characterize the typical member of a concept. This is the reason some members of familiar concepts are easier to categorize than others; they are better representatives of the concept (Olson et al., 2004; Rosch, 1978). The most representative members of a concept are known as **prototypes**. For example, most people consider a German shepherd more doglike than a Chihuahua, a robin more birdlike than a penguin, and an undergraduate more "studentlike" when she is 20 years of age versus 65. For most of us, German shepherds are "doggier," robins are "birdier," and 20-year-olds are "studentier" because they more closely resemble our prototypes for their respective concepts than the alternative choices. In fact, the Chihuahua might be mistakenly categorized as a rat because it looks more "ratty" than "doggy," and the elderly student might be mistaken for a college professor.

Our failure to correctly categorize things because they don't match our prototype for that concept can lead to errors in decision making. For instance, if certain physical symptoms don't fit our flu prototype, we may continue our normal activities, thus worsening our condition and also infecting others (Bishop, 1991). Similarly, we may turn our life savings over to a dishonest investment adviser because he looks like "Honest Abe."

8.2b We Employ a Number of Problem-Solving Strategies.

One important way we use concepts is in **problem solving**, which is the thought process you use to overcome obstacles to reach your goals (Pretz, 2008). There are a number of ways to problem-solve. A very simple strategy is **trial and error**, which involves trying one possible solution after another until one works. Do you remember Edward Thorndike's puzzle box experiments with hungry cats described in Chapter 6, Section 6.2a? Through trial and error, Thorndike's cats eventually learned how to escape from the puzzle box to reach a bowl of food. In many species, trial and error often provides responses that are important to survival. Whether you are a lion cub discovering how best to attack your prey or a teenager finding the right tone of voice to use when asking someone for a date, haphazardly trying various solutions until you stumble on one that works may be time-consuming, but it is often effective.

Unlike trial and error, which does not guarantee success, an **algorithm** is a problem-solving strategy that involves following a specific rule or step-by-step procedure that inevitably produces the correct solution. For example, recently, I needed to contact a student named John Smith. I knew he lived in Milwaukee, but I

Prototype The most representative member of a concept

Problem solving The thought process used to overcome the obstacles to reaching a goal

Trial and error A problemsolving strategy that involves trying one possible solution after another until one works

Algorithm A problem-solving strategy that involves following a specific rule or step-by-step procedure until you inevitably produce the correct solution





Which of these birds is more birdlike to you—the robin in (a) or the penguin in (b)? That is, which of these birds is closer to your bird prototype?

didn't know his phone number. There are 40 John Smiths in the Milwaukee telephone directory. One available strategy was to use an algorithm; that is, simply phone all the John Smiths until I found the right one. Assuming that my John Smith had a phone and that his number was listed, this strategy was guaranteed to work. The drawback to algorithms, however, is that they are inflexible. Further, like trial and error, they are time-consuming. Computers are based on algorithms, and that is the reason they are inflexible in their functioning.

Instead of trying to solve my problem of contacting John Smith by calling all the John Smiths in the phone book, I used a **heuristic**, which involves following a general rule of thumb to reduce the number of possible solutions (Gigerenzer et al., 2011). The general rule I used was that college students usually live on or near campus. Now, the number of phone numbers to call was reduced to five. Heuristics have a reasonably good chance of working, and true to form, I found my John Smith on the third call. However, unlike algorithms, they do not guarantee success. What if my John Smith had lived at home with his parents? The chief advantage of heuristics is that they usually save time. Learning to use these short-cut cognitive strategies is an important skill that helps college students efficiently solve many problems in English, math, and science courses (Sharps et al., 2008).

Sometimes, we are unaware of using any problem-solving strategy at all; solutions simply pop into our heads (MacGregor & Cunningham, 2008; Ollinger et al., 2008). The sudden realization of how a problem can be solved is called **insight**. Consider the following problem that is often solved by insight:

A man walks into a tavern and asks for a glass of water. The bartender pulls a shotgun from behind the bar and points it at the man. The man says "Thank you" and walks out.

Can you explain the behavior of these two people? This story was presented to people in an insight problem-solving study, with participants being allowed to ask yes/no questions for up to two hours (Durso et al., 1994). At several points during this problem-solving period, participants were asked to rate the degree to which different

Heuristic A problem-solving strategy that involves following a general rule of thumb to reduce the number of possible solutions

Insight A problem-solving strategy that involves a sudden realization of how a problem can be solved

pairings of 14 words were related to the problem. Some of these word pairs were explicitly stated in the story (*man*, *bartender*), others were implicit in the correct solution (*surprise*, *remedy*), and still others had no relation at all to the story (*clock*, *grass*). Results indicated that at first, the implicitly related words were thought by participants to be highly unrelated to the story. However, before insight was achieved, participants slowly perceived an increased association between the story and these implicitly related words. No such increase in relatedness occurred for explicitly related words or unrelated words. These results suggest that in solving problems through insight, people gradually increase their focus on those concepts important to the solution, even though they are yet unaware of the solution itself. Thus, although insight seems to happen unexpectedly, the cognitive organization necessary for this type of problem solving is built beforehand, like the slowly gathering clouds that eventually lead to the sudden lightning flash. (The solution to the problem preceding this paragraph is that the man had the hiccups.)

Brain-imaging studies find that insight involves increased activity in the right temporal lobe, specifically in the area known as the anterior cingulate cortex, and also more balanced brain activity between the right and left cerebral hemispheres (Takeuchi et al., 2010). Additional research suggests that we solve more problems with insight when we are in a good mood rather than a bad mood because good moods are more likely to increase neural activity in the anterior cingulate cortex (Subramaniam et al., 2009). Overall, brain-imaging research informs us that the analogy of insight being like a lightning bolt or a light bulb turning on are accurate depictions of this flash of right-temporal lobe activity in the brain (Jung-Beeman et al., 2004).



Culture plays an important role in preserving useful problemsolving techniques across generations, even among nonhuman primates. For example, for more than a century, certain bands of chimpanzees in western Africa have used a variety of crude stone hammers to crack open calorie-rich panda nuts. Using an elaborate set of procedures, the chimps establish nut-cracking stations on battered tree roots, which they employ as anvils.

It takes up to seven years for the animals to learn the precise technique for successfully extracting the nutrients from the nut's outer husk, and this technique has not been observed among chimps in central Africa, where similar nuts are available.

8.2c Internal Obstacles Can Impede Problem Solving.

Despite having various strategies to solve problems, psychologists have identified a number of cognitive tendencies that act as barriers to problem solving (Stein & Burchartz, 2006). Three of the more common internal obstacles are *confirmation bias*, *mental set*, and *functional fixedness*.

Confirmation Bias

When you think you have a solution to a problem, you may fall victim to **confirmation bias**, which is the tendency to seek only information that verifies your beliefs (K. Edwards & Smith, 1996). Unfortunately, such selective attention prevents you from realizing that your solution is incorrect. In one confirmation-bias study, college students were given the three-number sequence 2-4-6 and told to discover the rule used to generate it (Wason, 1960). Before announcing their beliefs

Confirmation bias The tendency to seek information that supports our beliefs while ignoring disconfirming information

about the rule (which is simply any three increasing numbers), students could make up their own number sequences, and the experimenter told them whether these sequences fit the rule. The students were instructed to announce the correct rule only after receiving feedback from enough self-generated number sequences to feel certain that they knew the solution. True to the confirmation bias, 80 percent of the students convinced themselves of an incorrect rule. Typically, they would begin with a wrong hypothesis (for example, adding by 2s) and then search only for confirming evidence (testing 8-10-12, 20-22-24, 19-21-23, and so on). Had they tried to disconfirm this hypothesis by testing other number sequences that simply increased in value (for example, 1-2-3 or 10-19-39), they would have realized their error. Experiments like this indicate that an important barrier to problem solving is our tendency to search more energetically for information that will confirm our beliefs than for information that might refute them (Klayman & Ha, 1987).

How might this tendency to seek confirming information lead to incorrect social beliefs? In one experiment, Mark Snyder and William Swann (1978) asked some participants to find out whether the person they were about to interact with was an introvert, while other participants were asked to find out whether the person was an extravert. Consistent with the confirmation bias, the questions that people asked their interaction partners were biased in the direction of the original question. If they had been asked to find out whether the person was an introvert, they asked questions such as "What do you dislike about loud parties?" In contrast, in the extravert condition, they asked questions such as "How do you liven things up at a party?" Because most people can recall both introverted and extraverted incidents from their past, the interaction partners' answers provided confirmatory evidence for either personality trait. As you can see, such confirmation seeking can easily lead to mistakes when forming impressions about individuals. Similarly, incorrect stereotypes of social groups can also be perpetuated by seeking confirmation of preexisting beliefs (Yzerbyt et al., 1996).

Mental Set

Another common obstacle to problem solving is **mental set**—the tendency to persist in using solutions that have worked in the past, even though better alternatives may exist (Luchins & Luchins, 1994). In 1942, in his "water-jar" problems study, Abraham Luchins first demonstrated the influence that a mental set can have on problem solving. Participants were asked to solve problems involving the filling of water jars. In the first task, using a 21-cup jar, a 127-cup jar, and a 3-cup jar, they were asked to measure out exactly 100 cups of water. With minimal effort, participants discovered that the solution was to fill the largest jar (B), and from it fill the second-largest jar (A) once and the smallest jar (C) twice. Try solving the remaining problems in Figure 8-3 yourself before reading further.

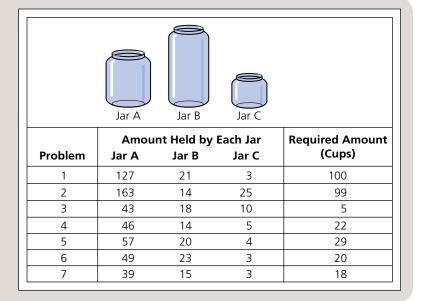
Like Luchins's participants, you probably ran into a mental set. That is, you probably discovered that you could use the basic algorithm B-A-2C to solve all the remaining problems; but this caused you to miss the much simpler solutions for problem $6\ (B-C)$ and for problem $7\ (B+C)$. Although mental sets can lead to solutions, they can also lead to "mental ruts" when the situation changes and old methods are no longer efficient or are completely ineffective (Pashler et al., 2000). Now that you understand something about mental sets, complete Closer Look 8-1 before continuing with your reading.

Mental set The tendency to continue using solutions that have worked in the past, even though a better alternative may exist

FIGURE 8-3

The Water-Jar Problems

In each problem, what is the most efficient way of measuring out the correct amount of water using jars A, B, and/or C?

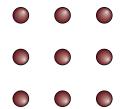




8-1

Can You Solve the Nine-Dot Problem?

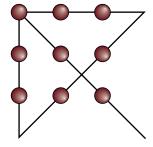
Connect all nine dots with four straight lines without lifting your pencil from the paper. A line must pass through each point. Can you solve this problem?



Solution: To solve the nine-dot problem, you need to step out of the mental set in which you think that the four lines must remain within or on the edge of the square of dots. When you realize that the lines can extend beyond the "boundaries" of the square, you solve the problem.

If the only tool you have is a hammer, you tend to see every problem as a nail.

—Abraham Maslow, founder of humanistic psychology, 1908–1970



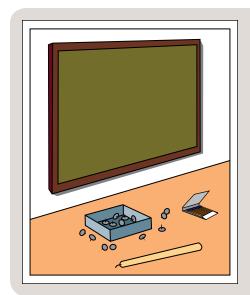


FIGURE 8-4a

The Candle Problem

How would you mount a candle on a bulletin board so that it does not drip when lit? All you have to work with is a candle, a book of matches, and a box of tacks. (See the solution on page 384.)

Functional Fixedness

Finally, related to mental set is **functional fixedness**, which identifies our tendency to think of objects as functioning in fixed and unchanging ways (Furio et al., 2000). In problem solving, when you are unable to consider using familiar objects in unusual ways—for example, using a dime as a screwdriver—you are experiencing this cognitive obstacle. In one study of functional fixedness, participants were given a small cardboard box of tacks, some matches, and a candle (see Figure 8-4). Their task was to mount the candle on a bulletin board in such a way that it would burn without dripping wax on the floor (Duncker, 1945). Before reading further, try solving "The Candle Problem" in Figure 8-4.

Many participants could not solve the problem because they thought of the box as simply a container for tacks, not as a support for a candle. Later research found that when the experimenter used the term *box of tacks* rather than just *tacks* when describing the task, more solutions were obtained (Glucksberg & Danks, 1968; Glucksberg & Weisberg, 1966). This suggests that when a person hears the word *box*, numerous possible encodings of *box* may be activated from memory, thus making a solution more likely. In general, the more experience a person has with an object, the greater the likelihood that he or she will experience functional fixedness with this object.

8.2d Decision-Making Heuristics Often Sidetrack Everyday Cognition.

As discussed in the "Psychological Applications" section of Chapter 1, *critical thinking* is the process of deciding what to believe and how to act based on a careful evaluation of the evidence. Although we often may engage in systematic and rational decision making, we may also often take cognitive shortcuts. When we do engage in lazy decision making, what kind of time-saving mental shortcuts do we use? Heuristics, of course! To understand how we use specific types of heuristics, and how they can sometimes lead us astray, let us examine two heuristics identified by Amos Tversky and Daniel Kahneman (1974): *representativeness* and *availability*.

Functional fixedness The tendency to think of objects as functioning in fixed and unchanging ways and ignoring other less obvious ways in which they might be used

Representativeness heuristic

The tendency to make decisions based on how closely an alternative matches (or represents) a particular prototype

Availability heuristic The tendency to judge the frequency or probability of an event in terms of how easy it is to think of examples of that event



Following wide media coverage of an airline crash, some people decide to drive long distances instead of flying to their destinations because they believe it is safer. Which heuristic are these people using in deciding to drive rather than fly?

The Representativeness Heuristic

Remember my example of being cheated out of your life savings because your investment adviser happened to look like an honest person? To judge the likelihood of things based on how closely they represent particular prototypes is to use a cognitive shortcut known as the **representativeness heuristic** (Gilovich & Savitsky, 2002; Tversky & Kahneman, 1974). The problem with this cognitive shortcut is that, being a rapid method of decision making, it doesn't take into account other important qualifying information. The most important information of this type relates to *base rates*—the frequency with which some event or pattern occurs in the general population.

The tendency to overlook base-rate information was demonstrated in a well-known study by Tversky and Kahneman (1973). Research participants were told that an imaginary person named Jack had been selected from a group of 100 men. Some participants were told that 30 of the men were engineers (a base rate for engineers of 30 percent), and others were told that 70 were engineers (a base rate of 70 percent). Half the participants were given no other information, but the other half were given a description of Jack that either fit the common stereotype of engineers (for example, practical, likes to work with numbers) or did not. They were then asked to guess the probability that Jack was an engineer. Results indicated that when participants received only information related to base rates, they were more likely to guess that Jack was an engineer when the base rate was 70 percent than when it was 30 percent. However, when they received information about Jack's personality and behavior, they tended to ignore the base-rate information and focus, instead, on whether lack fit their prototype of an engineer. The tendency to ignore or underuse useful base-rate information and overuse personal descriptors of the individual being judged has been called the base-rate fallacy.

The Availability Heuristic

Following the terrorist attacks on September 11, 2001, many Americans were afraid to fly on commercial airlines. Instead of flying, people began driving in their cars cross-country. In nixing plane travel for car travel, they based their judgments on the **availability heuristic**, which is the tendency to judge the frequency or probability

of an event in terms of how easy it is to think of examples of that event. In using the availability heuristic, the most important factor for people is not the content of their memory but the ease with which this content comes to mind (Gana et al., 2011; Vaughn & Weary, 2002). Because people could easily recall the horrible images of September 11, they decided that car travel was safer than plane travel. These judgments were made despite the fact that National Safety Council data reveal that, mile for mile, Americans are 37 times more likely to die in a vehicle crash than on a commercial flight. Indeed, if terrorists destroyed more than 50 planes per year, each containing 60 passengers, we would still be safer traveling by plane than by car. In this instance, it appears that reliance on the availability heuristic caused many Americans to actually increase their safety risks when traveling.



Journey of Discovery

In Olympic competition, athletes who win an event receive the gold medal, those who finish in second place receive a silver medal, and third-place finishers get a bronze medal. Fourth-place finishers receive nothing. During the 1992 Olympics, bronze medalists (third-place finishers) exhibited more joy than silver medalists (second-place finishers) after their events (Medvec et al., 1995). How can this finding be explained by the availability heuristic?

The ease with which we generally recall our own characteristics and opinions from memory helps explain why we tend to believe that other people share our views and preferences to a greater extent than is actually true. This *false consensus effect* has been observed in numerous contexts: We exaggerate how common our own personalities are in the general population; we overestimate how many people smoke or do not smoke, based on our own smoking habits; we assume that most people agree with our political beliefs (Aksoy & Weesie, 2011). The ease with which we generally recall important aspects of ourselves from memory may well explain our tendency to exaggerate how common our own characteristics and opinions are in the general population. That is, perhaps we often assume others share our characteristics, habits, and opinions because these self-aspects are readily available in memory. As you can see, this type of thinking, brought about by the availability heuristic, can cause us to make misguided decisions. To gain further insight into your own tendencies to engage in effortless versus effortful thinking, examine Self-Discovery Questionnaire 8-1.

When Do We Use Heuristics?

With what frequency do we take mental shortcuts in decision making? As you have learned, frequency is partly determined by our need for cognition. Beyond this individual difference, Anthony Pratkanis (1989) has identified at least five conditions most likely to lead to the use of heuristics rather than rational decision making. The first condition in which these mental shortcuts will likely be used is when we simply don't have time to engage in systematic analysis. The second and third conditions are when we are overloaded with information, so it is impossible to process all that is meaningful and relevant, and/or when we consider the issues in question to be not very important. Finally, heuristics will often be relied on when we have little other knowledge or information to use in making a decision or when something about the situation in question calls to mind a given heuristic, making it cognitively available.

One final note: Although basing decisions on heuristics may lead to errors, relying on them may actually be adaptive under conditions where we don't have the luxury of carefully analyzing all our options (Johnston et al., 1997; Klein, 1996). For example, reacting quickly in an emergency based only on information most accessible from memory (the availability heuristic) may often be the difference between life and death. Thus, although heuristics can lead to sloppy decision making, their time-saving quality may sometimes be a lifesaver. In this regard, heuristics can be very helpful because they provide a reasonably accurate basis for making decisions under many conditions (Haselton & Nettle, 2006).

To most people, nothing is more troublesome than the effort of thinking.

—James Bryce, British statesman, 1838–1922



Do We Differ in Our Need for Cognition?

An important ingredient in competent decision making is to critically analyze your options and hazards, an approach not everyone takes. John Cacioppo and Richard Petty (1982) have designed a self-report scale measuring

Need for cognition A person's preference for and tendency to engage in effortful cognitive activities individual differences in the motivation to think, which they call the **need for cognition**. People high in the need for cognition (high NFC) like to work on difficult cognitive tasks, analyze situations, and

make subtle cognitive distinctions. In contrast, individuals with a low need for cognition (low NFC) are more likely to take mental shortcuts and avoid effortful thinking unless they are required to do so (Nair & Ramnarayan, 2000; Sommers & Kassin, 2001). Spend a few minutes answering the need for cognition items in Table 8-2 before reading further.

Researchers have studied how the need for cognition affects people's attention to political campaigns and their voting decisions. During the 1984 presidential and vice-presidential debates, for instance, voters high in the need for cognition were more likely to watch these events than were their low-NFC counterparts (Ahlering, 1987). The high-NFC voters also developed more beliefs

about the candidates than did those low in the need for cognition, and their attitudes toward the candidates eight weeks before the November election were better predictors of their actual voting behavior (Cacioppo et al., 1986). This latter finding probably occurred because attitudes and beliefs formed due to critical analysis are more resistant to change than attitudes shaped by lazy thinking (Priluck & Till, 2004; Shestowsky et al., 1998).

Although high-NFC persons are more disposed to critically analyze information when making decisions than low-NFC persons, this is no guarantee that they will actually do so. Even people who enjoy intellectual stimulation will often engage in lazy thinking when the decisions have little relevance to their lives (Leippe & Elkin, 1987). Yet it is also true that people who are typically lazy thinkers can become critical thinkers if the decision is personally compelling and relevant. Thus, while our need for cognition will generally affect how much we critically analyze our options before making a decision, when we believe that a decision is important, we all tend to take greater care in weighing our options. Yet, because we sometimes are not aware that a decision is "important" until after the fact, the greater overall care taken by high-NFC individuals should lead to better results than the lazier decisionmaking style of low-NFC persons (Cacioppo et al., 1996).

TABLE 8-2 Need for Cognition Scale: Sample Items

Directions: These are sample items taken from the Need-for-Cognition Scale. If you agree with items 1, 3, 5, and 7 and disagree with items 2, 4, 6, and 8, you exhibit behaviors indicative of a person high in the need for cognition. If your responses to these items are exactly the opposite you may be low in the need for cognition. Based on your responses, which route to decision making do you think you tend to take?

- 1. I really enjoy a task that involves coming up with new solutions to problems.
- 2. Thinking is not my idea of fun.
- 3. The notion of thinking abstractly is appealing to me.
- 4. I like tasks that require little thought once I've learned them.
- 5. I usually end up deliberating about issues even when they do not affect me personally.
- 6. It's enough for me that something gets the job done; I don't care how or why it works.
- 7. I prefer my life to be filled with puzzles that I must solve.
- 8. I only think as hard as I have to.

Source: From "The Need for Cognition" by J. T. Cacioppo and R. E. Petty in *Journal of Personality and Social Psychology,* 1982, 42, 116–131 (table 1, pp. 120–121). Copyright © 1982 by the American Psychological Association. Adapted with permission.





- Concept formation is a basic element of cognition, and the process of forming concepts is called categorization.
- Failing to correctly categorize things because they don't match our prototype can lead to errors in decision making.
- Typical problem-solving strategies include trial and error, algorithms, heuristics, and insight.
- Three common internal obstacles to problem solving are confirmation bias, mental set, and functional fixedness.
- An important ingredient in competent decision making is critical analysis, but we often rely on time-saving heuristics.
- People with a high need for cognition are likely to engage in critical thinking.

8.3 Intelligence and Intelligence Testing

Thus far, we have examined how we communicate and think. However, do we individually differ in our capacity to think in a useful, efficient, and creative manner? Let us continue our discovery journey by analyzing the nature of intelligence. **Intelligence** consists of the mental abilities necessary to adapt to and shape the environment (van Heck & Den Oudsten, 2008). This means that intelligence involves not only reacting to one's surroundings but also *actively forming* them. It also means that intelligent behavior in New York City, for example, may not be intelligent or adaptive in the jungles of South America (Detterman, 2005). These mental abilities are the keys to lifelong learning.

Intelligence The mental abilities necessary to adapt to and shape the environment

8.3a Early Intelligence Testing Was Shaped by Racial and Cultural Stereotypes.

Psychometrics—which literally means "to measure the mind"—is the measurement of intelligence, personality, and other mental processes. Although the psychometric approach has been extensively employed in the study of intelligence, the results have sometimes given psychology a black eye. For example, in the nineteenth century, British mathematician and naturalist Sir Francis Galton (1822–1911) believed that the wealthy families in society—like his own—were also the more intelligent because intelligence was assumed to result in success and wealth (Galton, 1869). He was so confident that families ended up either wealthy or poor because of their inherited traits that he founded the **eugenics** (the Greek word for "well-born") movement to improve the hereditary characteristics of society. Eugenics proposed not only that men and women of high mental ability—meaning upper-middle-class White individuals—should be encouraged to marry and have children, but also that those of lesser intelligence—meaning lower-class Whites and members of other races—should be discouraged (or prevented) from reproducing.

How did Galton measure intelligence? Believing that intelligence is a product of how quickly and accurately people respond to stimuli, Galton's assessment battery included measurements of sensory abilities and reaction times, as well as

Psychometrics The measurement of intelligence, personality, and other mental processes

Eugenics The practice of encouraging supposedly superior people to reproduce, while discouraging or even preventing those judged to be inferior from doing so



Sir Francis Galton: "If everybody were to agree on the improvement of the race of man being a matter of the very utmost importance, and if the theory of the hereditary transmission of qualities in men was as thoroughly understood as it is in the case of our domestic animals, I see no absurdity in supposing that, in some way or other, the improvement would be carried into effect."

measurements of head size and muscular strength. Unfortunately for Galton, his tests not only did not correlate with each other but also had almost no relation to accepted criteria of intellectual functioning (Sharp, 1898; Wissler, 1901).

While Galton's attempts to measure intelligence failed, across the English Channel, French psychologist Alfred Binet and physician Theodore Simon developed an inexpensive, easily administered, objective measure of intelligence that could identify lower-performing children in need of special education (Binet & Simon, 1905). In contrast to Galton's work, the resulting Binet-Simon test measured general mental ability and emphasized abstract reasoning rather than sensory skills. Today, Alfred Binet is considered to be the "father" of modern intelligence testing. He contended that cognitive development follows the same course in all children, but some learn faster and more easily than others. In intelligence testing, this means that "average" children will perform similarly to those their own chronological age, "dull" children will perform similarly to children younger than themselves, and "bright" children will perform like older children. Binet reasoned that general mental ability could be calculated by comparing children's mental age with their chronological age. Thus, a 12-year-old child who performs equally to the average child her chronological age would have the mental age of 12 years. Armed with this method of intellectual comparison, testers could place children into appropriate grades in school and identify those who would benefit from additional tutoring. Unlike Galton's intelligence test, the Binet-Simon test proved to be the first valid intelligence measuring instrument: That is, it accurately identified lower-performing students (Huteau, 2007).

In designing the Binet-Simon test, Binet, unlike Galton, made no assumptions about why intelligence differences exist. However, he did insist that his test did not measure inborn intelligence, and he believed that intellectual ability could be increased through education. He also realized that his test merely *sampled* intelligence and did not measure all intellectual aspects. Finally, he warned that because the test was developed in France using children with similar cultural backgrounds, it might not accurately measure intelligence in other countries. Two of his fears were that his test would be used not to help slow learners receive special help but would be used, instead, to (1) limit their educational opportunities and (2) plant the idea in their own minds that they are incapable of learning. Unfortunately, both fears were realized when his test was redesigned for use in the United States by psychologist Henry Goddard (Mayrhauser, 2002).

Despite Binet's insistence that his test did not measure inherited intelligence, Goddard, a strong advocate of Galton's eugenics movement, used Binet's test to identify the feebleminded so they could be segregated and prevented from having children (Thalassis, 2004). To describe these low-intelligence people, he coined the term *moron*, which is derived from a Greek word meaning "foolish." Goddard (1913, 1919) used the Binet-Simon test to assess newly arrived immigrants at Ellis Island in New York Harbor. Because these tests were biased toward native-born English speakers, many immigrants scored very low. These test results were later used by politicians to pass the Immigration Act of 1924, which dramatically restricted admittance of certain "undesirable" ethnic groups, especially those from eastern and southern Europe (Sedgwick, 1995). Although Goddard and most other psychologists involved in the eugenics movement later reversed their positions and argued against such discriminatory measures, this aspect of their research not only harmed the reputation of psychology as a science but also justified racist societal practices here and abroad (Leahey, 1991).

8.3b Modern Tests of Mental Abilities Measure Either Aptitude or Achievement.

When describing mental abilities tests, psychologists generally place them into the two categories of aptitude and achievement (Reynolds & Livingston, 2012; Russo, 2011). Intelligence tests are **aptitude tests**; they predict your capacity to learn a new skill if you are given an adequate education. In contrast to predicting what you can learn, achievement tests measure what you have already learned. Whenever you are given an exam in a course to determine what you have learned, you are taking an achievement test.

Although the distinctions between aptitude and achievement tests seem clear-cut, they are not. For instance, suppose two college students who have an equal capacity for learning math are given a test of mathematical aptitude. One student, however, attended a high school where he had four years of college-level math instruction, while the other student's school offered no college-level courses. Despite their equal capacity for learning math, it's likely that the student with the greater math experience will obtain a higher math aptitude score. The implication of this example is that your score on an aptitude test can be affected by your prior experience in the area being tested.

The Stanford-Binet Intelligence Test

Although Goddard introduced the Binet-Simon test to America, Lewis Terman (1877-1956), a psychology professor at Stanford University, was responsible for revising it so it could be used on American children (Terman, 1916). The resulting Stanford-Binet Intelligence Test employed a new scoring system known as the intelligence quotient (IQ). Based on an idea of German psychologist William Stern (1914), IQ was represented as a ratio of mental age divided by chronological age, multiplied by 100:

$$IQ = \frac{Mental~age}{Chronological~age} \times 100$$

With this formula, a child whose mental and chronological ages were the same had an IQ of 100. However, a 10-year-old who answered questions at the level of a typical 8-year-old had an IQ of 80, and an 8-year-old who answered questions like a typical 10-year-old had an IQ of 125. The advantage of this ratio formula over the Binet-Simon scoring system was that it was more useful when comparing mental ages within a group of children who differed in their chronological ages.

Although the IQ ratio was adequate in representing children's intelligence, it proved problematic when the Stanford-Binet was redesigned to also measure adult intelligence. Because the rate of growth does not occur as rapidly in adulthood as in childhood, using the IQ ratio led to the mistaken representation that intelligence declines with age. For example, if Raymond had the mental age of 20 at age 15, he would have an IQ of 133, which is considered mentally gifted. However, at the age of 40, if Raymond's mental age had increased to 28, his IQ would now be only 70, which is the beginning of the intellectually disabled range. Raymond might have a successful career in a profession requiring above-average intelligence, but the ratio IQ would not accurately reflect this fact. Today, most intelligence tests, including the Stanford-Binet, no longer compute a ratio IQ. Instead, it has been replaced with a deviation IQ, which compares how a person's intelligence test score deviates from the average score of her or his same-age peers, which is 100 (Alfonso & Flanagan, 2007).

Aptitude test Test designed to predict a person's capacity for

Achievement test A test designed to assess what a person has learned

Stanford-Binet Intelligence

Test The widely used American revision of the original French Binet-Simon intelligence test

Intelligence quotient

(IQ) Originally, the ratio of mental age to chronological age multiplied by 100 (MA/CA × 100) that today is calculated by comparing how a person's performance deviates from the average score of her or his same-age peers, which is 100



Lewis Terman: "The children of successful and cultured parents test higher than children from wretched and ignorant homes for the simple reason that their heredity is better ... The whole question of racial differences in mental traits will have to be taken up anew and by experimental methods. The writer predicts that when this is done, there will be discovered enormously significant racial differences in general intelligence, differences which cannot be wiped out by any scheme of mental culture." (1916, pp. 91-92, 115)

The Wechsler Intelligence Scales

The person responsible for developing the deviation IQ score was David Wechsler, one of those supposedly feebleminded eastern Europeans who immigrated to this country in the early 1900s. Today's most widely used set of intelligence tests in the United States is the **Wechsler Intelligence Scales**, named after their creator. Three separate intelligence tests have been designed—for adults (*Wechsler Adult Intelligence Scale*), for preschoolers (*Wechsler Preschool and Primary Scale of Intelligence*), and for school-age children (*Wechsler Intelligence Scale for Children*).

For all the Wechsler tests, intelligence is measured by 11 subtests—6 verbal and 5 performance—that yield a verbal IQ score, a performance IQ score, and an overall IQ score. Figure 8-5 provides sample items from the adult test for the verbal and performance subscales. As you can see, the verbal items consist of vocabulary, general information, analogies, math, comprehension, and the recall of number strings. In contrast, the performance subscales require you to locate missing picture parts, reproduce block designs, assemble jigsaw puzzles, arrange cartoons in a logical sequence, and copy symbols on paper. Because the performance subtests rely less on familiarity with words and language than do the verbal subtests, the performance subtests are less likely to be affected by the test takers' education or cultural experiences. Significant differences between the verbal and performance scores alert test administrators to

Wechsler Intelligence Scales The most widely used set of intelligence tests, containing both verbal and performance (nonverbal) subscales

FIGURE 8-5 Sample Items from the Wechsler Adult Intelligence Scale (WAIS)

Source: From Robert M. Thorndike. Measurement and Evaluation in Psychology and Education, 7/e. Published by Allyn and Bacon/Merrill Education, Boston, MA. Copyright © 2005 by Pearson Education. Adapted by permission of the publisher. Upper Saddle River, NJ.

VERBAL

General Information

What day of the year is independence Day?

Similarities

In what way are wool and cotton alike?

Arithmetic Reasoning

If eggs cost 60 cents a dozen, what does 1 egg cost?

Vocabulary

Tell me the meaning of corrupt.

Comprehension

Why do people buy fire insurance?

Digit Span

Listen carefully, and when I am through, say the numbers right after me.

7 3 4 1 8 6

Now I am going to say some more numbers, but I want you to say them backward.

3 8 4 1 6

PERFORMANCE

Picture Completion

I am going to show you a picture with an important part missing. Tell me what is missing.

		'85				
SUN	MON	TUE	WED	THU	FRI	SAT
	2					
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Picture Arrangement

The pictures below tell a story. Put them in the right order to tell the story.



Block Design

Using the four blocks, make one just like this.



Object Assembly

If these pieces are put together correctly, they will make something. Go ahead and put them together as quickly as you can.



Digit-Symbol Substitution

Code	Δ	0		X	8	
	1	2	3	4	5	

lest								
Δ	8	X	0	Δ	8	X	Δ	8

possible learning problems (Edwards & Paulin, 2007; Weiss et al., 2005). For instance, a verbal score considerably lower than a performance score might indicate a reading or language disability. However, as just mentioned, it could also mean that the test taker is not very familiar with the language or customs of the larger society.

Group-Administered Tests

While the Stanford-Binet and the Wechsler tests are administered to people individually, group-administered tests can assess hundreds or thousands of people simultaneously. Group aptitude and achievement tests are widely used today, including the familiar college entrance *Scholastic Assessment Test (SAT)*, which was previously known as the Scholastic Aptitude Test. The reason for this name change is because the old name's use of the term *aptitude* implied that the SAT measures a person's capacity for learning. In reality, it measures learned verbal and mathematical skills; thus, it is more accurately considered an achievement test. As such, SAT scores are significantly influenced by the quality of the schools test takers attend. Overemphasizing SAT scores in evaluating students for college admission, therefore, can disadvantage students who attended inferior schools and also those whose main academic strengths lie in such areas as music and art. Both the verbal and math sections of the SAT have an average score of 500 and a range from 200 to 800, resulting in a total score range from 400 to 1600.

Similar tests are also used to assess students' potential for postgraduate training. For graduate school in the arts and sciences, there is the Graduate Record Exam (GRE); for graduate school in business, there is the Graduate Management Admission Test (GMAT); medical schools use the Medical College Admission Test (MCAT); and law schools use the Law School Aptitude Test (LSAT). There is sufficient evidence that, like the SAT, these exams measure not only the potential for performing well on scholastic tasks but also achievement. The practical importance of this fact for students is that studying can improve test performance. Extensive training or coaching on how to take the SAT can increase one's total score by as many as 30 to 50 points (Coyle et al., 2011; Kulik et al., 1984).



Journey of Discovery

Women who go to college after their mid-20s receive better grades than would be predicted by their scores on SAT tests taken just before entering college. Why might this be the case?

8.3c Psychological Tests Must Be Standardized, Reliable, and Valid.

All psychological tests, including the mental ability tests discussed in this chapter, are measurement instruments that must have three basic characteristics: *standardization*, *reliability*, and *validity*. The Stanford-Binet, Wechsler, and scholastic tests we have reviewed thus far all possess these characteristics.

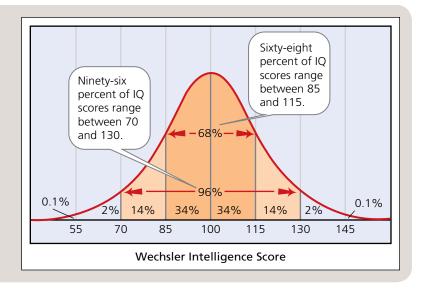
Standardization

If you have taken the SAT or any other achievement or aptitude tests, you may recall that the testing procedures are extremely rigid. Regardless of where or when the

FIGURE 8-6

The Normal Distribution

Scores on standardized aptitude tests, such as the Wechsler Adult Intelligence Scale, tend to form a normal distribution (also known as a "bell-shaped curve"). The Wechsler scale, like other IQ tests, calls the average score 100.



Standardization The process of establishing uniform procedures for administering a test and for interpreting its scores

Normal distribution The bell-shaped appearance of a distribution that results when the mean, median, and mode are identical in value

Flynn effect The tendency for people's performance on IQ tests to improve from one generation to the next test is administered, everyone receives the same instructions, the same questions, and the same time limits. You may also remember that when you received your test results, your individual score was compared against those of a previously tested group of people who had followed the same testing procedures that you followed. This comparison process allowed you to convert your "raw score" into a *percentile*, which indicates the percentage of people in the standard group who scored at or below your score. This entire process of establishing uniform procedures for administering a test and interpreting its scores is known as **standardization**.

Standardized test results often show a roughly **normal distribution**, which has a bell-shaped appearance when the individual scores are placed in a graph. As you can see in Figure 8-6, in a normal distribution, most test scores cluster around the *median*, or middle score, which has a value similar to both the *mean* (the average test score) and the *mode* (the most frequent test score). As previously mentioned, the mean score on an intelligence test is 100. As we move away—in either direction—from this mean score, we find fewer test scores. Also as depicted in Figure 8-6, in a normal distribution of IQ scores, 68 percent of the scores will range between 85 and 115, and 96 percent of the scores will fall between 70 and 130. Only 2 percent of the population has IQ scores above 130, and only 2 percent has scores below 70.

Periodically, the Stanford-Binet and the Wechsler IQ tests must be restandardized to maintain the mean score of 100. This is necessary because in every single one of the 20 countries studied worldwide, each succeeding generation intellectually outperforms the previous generation (Flynn, 1987, 2007; Woodley, 2012). For restandardization purposes, this means that test items must be made more difficult to keep the average intelligence score at 100. This tendency for people's performance on IQ tests to improve from one generation to the next is known as the **Flynn effect**, after the psychologist who first noticed it.

What accounts for this rapid increase in IQ? Evolution—which occurs slowly—cannot provide an answer; and the increase certainly appears inconsistent with Galton's prediction that higher birthrates observed among those with lower IQ scores would move IQ scores lower. A likely explanation is that it is the combined effects of improvements in health, education and nutrition, greater experience with testing, and increased exposure to a broader range of information via television and the computer (Colom et al., 2005; Eppig et al., 2010).

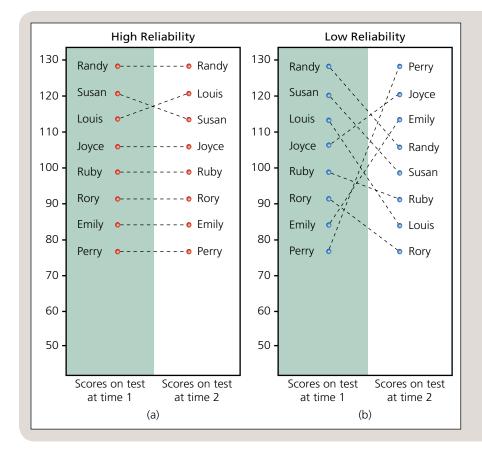


FIGURE 8-7

Determining Both Test-Retest and Alternate-Forms Reliabilities

In test-retest reliability, people take a test at time 1 and again at time 2. In alternateforms reliability, they take one version of the test at time 1 and a slightly different version at time 2. For both of these reliability techniques, people's scores at time 1 are depicted on the left, and their scores at time 2 are depicted on the right. (a) When people obtain similar scores on both occasions, the test has high reliability. (b) If they get very different scores, the test has low reliability.

Reliability

The **reliability** of a test indicates the degree to which it yields consistent results. The most common technique for estimating this type of consistency is through *test-retest reliability*, which is checking to see how people score on the same test on two separate occasions. The drawback to this reliability technique, however, is that people tend to remember the test items when they take the test again—and this influences their performance. A solution is to use *alternate-forms reliability*, in which slightly different versions of the test are given to people on the two separate occasions. The items on the two test versions are similar in format but different enough in content that test takers' performance will not be influenced by familiarity.

Reliability estimates for both techniques are based on correlation coefficients. As you recall from Chapter 1, Section 1.3d, a *correlation coefficient* (also known by the symbol r) is a statistical measure of the direction and strength of the linear relationship between two variables, ranging from -1.00 to +1.00. In estimating both test-retest and alternate-forms reliability, the two variables are the two test scores obtained on two different occasions. If people's test scores at time 1 have a strong correspondence with their scores at time 2 (Figure 8-7a), the correlation coefficient will be near +1.00, meaning that the test's reliability is high, which is good news for the test developer. However, if people's scores at time 1 and time 2 do not correspond (Figure 8-7b), then the correlation coefficient will be closer to 0.00, meaning that the test's reliability is low. The contemporary intelligence tests described thus far have correlation coefficients of about +.90, which indicate high reliability (Hunt, 2011).

Reliability The degree to which a test yields consistent results

Validity The degree to which a test measures what it is designed to measure

Content validity The degree to which the items on a test are related to the characteristic the test supposedly measures

Predictive validity The degree to which a test predicts other observable behavior related to the characteristic the test supposedly measures; also known as *criterion validity*

Validity

Knowing that a test is reliable does not tell you anything about its validity. **Validity** refers to the degree to which a test measures what it is designed to measure. In our household, we have a weighing scale that is highly reliable: Everyone who steps on it consistently weighs 32 pounds. Although it is reliable, none of us believe it is a *valid* weight measure. While the invalidity of our household scale is a source of amusement for us, invalid intelligence tests are no joking matter.

How do researchers determine whether an intelligence test is valid? Typically, they analyze different aspects of the test. **Content validity** refers to the degree to which the items on a test are related to the characteristic the test supposedly measures. For example, if an intelligence test consisted of measuring a person's weight and height, we would probably conclude that it was low in content validity because these measurements seem completely unrelated to our conception of intelligence. However, if it contained items that measured abstract reasoning, we would be more inclined to believe that it had reasonable content validity.

Besides content validity, tests are analyzed in terms of **predictive validity** (also known as *criterion validity*), which is the degree to which the test results predict other observable behavior related to the characteristic the test supposedly measures. How well do contemporary intelligence tests predict behavior that is thought to be related to intelligence? It depends. The correlation between IQ scores and scholastic achievement (usually measured by students' school grades) is about +.60 to +.70 during elementary school, which is quite high. However, during the college years, this correlation drops to about +.40 to +.50.

Why does predictive validity decline from elementary school to college? More important than the greater number of social distractions in college is the fact that there is a more *restricted range* of intelligence among college students than among students in elementary school. That is, regardless of whether they are low or high in intelligence, almost all children attend elementary school. In such an environment where virtually all intelligence levels are represented, it isn't surprising that IQ scores do a pretty good job predicting school grades: The cream rises to the top. However, following high school, students with above-average intelligence—the "cream" of elementary school—are the ones most likely to attend college. In this "creamy" environment, IQ scores cannot possibly predict academic performance as well as in the "milky" elementary school environment.

Do SAT scores significantly predict whether students will actually succeed or fail in college? Yes, but similar to IQ scores, they are not strong predictors—the correlation with college grades is less than +.50 (Aiken, 1996; Coyle et al., 2011). The SAT is a better predictor of college performance for those who score at the two extremes. Very low scorers are quite likely to fail in college, while very high scorers are quite likely to succeed. A probable reason for the greater predictive power of the SAT at these two extremes has to do with the fact that college success is due to both intellectual ability and a desire to achieve. Most high SAT scorers have both of these personal qualities, while many of the low scorers have neither.

In summary, an intelligence test, like any other psychological test, is useful only to the extent that it is both reliable and valid. Does the test yield consistent scores, and does it actually predict what it supposedly measures? In general, the reliability of intelligence tests is higher than their validity.

What About Possible Cultural Bias in Testing?

Intelligence tests measure people's developed abilities at a particular point in time. As such, they detect not only innate differences in intellectual abilities but

also differences due to cultural learning and experiences. Because of this fact, two people with the same innate intellectual ability will probably score differently on an intelligence test when one of them has considerably less experience with the culture in which the test was developed.

In the United States, critics of intelligence tests claim that Whites and middleand upper-class individuals have had greater exposure than ethnic minority and lowerclass individuals to the topics contained within some of the test items in the country's most commonly used IQ tests. Consider again the sample item on the Wechsler Adult Intelligence Scale in Figure 8-5, which asks why people buy fire insurance. Is it possible that this item is biased against a person who has never had enough possessions to make the cost of fire insurance relevant? Consider, also, this question on a children's IQ test: "Which is most similar to a xylophone? (violin, tuba, marimba, piano)." Are White children of well-to-do parents more likely to have attended orchestra concerts or learned about these instruments than minority children of poor parents? Could such questions explain the racial group differences in IQ test scores discussed later in this chapter (see Section 8.4c)?

It is true that some of the test items on the most frequently used IQ tests in the United States are still based on the vocabulary and experiences of the dominant middle-class culture. As such, these tests are measuring a person's achievement in acquiring knowledge valued by mainstream culture, in addition to measuring innate abilities (Coyle et al., 2011; Suzuki et al., 2008). Supporters of IQ tests respond to these charges of culture bias by pointing out that although these tests do not provide an unbiased measure of cognitive abilities in general, they do provide a fairly accurate measure of whether people are likely to succeed in school and in certain occupations. Thus, in statistically predicting academic and career success, standard intelligence tests and achievement tests are not biased. Their predictive ability is roughly the same for Blacks and Whites and for rich and poor (Neisser et al., 1996; te Nijenhuis et al., 2004).

The question of cultural bias in intelligence testing is also an issue when attempting to assess and compare the intellectual abilities of people in different cultures around the world. Intelligence researchers have attempted to construct "culture-free" tests to solve this problem, but it is now clear that no current test is completely free of cultural bias. For example, the Raven Progressive Matrices Test, which was initially touted as "culture-free," is now known to be "culturally loaded." In this test, people are presented with a number of increasingly difficult nonverbal matrix problems to solve, such as the exercise in Figure 8-8. The problem with using this test to measure intelligence cross-culturally is that, whereas matrices are repeatedly encountered in most cultures that have formal schooling, they are virtually nonexistent in cultures that lack formal schooling. Because of this difference, test takers in cultures with formal schooling perform at a higher level than test takers where formal schooling is rare (Benson, 2003). Yet, even with this culturally based problem, the Raven Progressive Matrices Test has been found to have adequate validity across a number of cultures (Rushton et al., 2004).

The problem of cultural bias does not mean that administering valid intelligence tests in other cultures is impossible. However, it does mean that simply translating a test developed in the United States into the local language of another culture is not sufficient. Instead, researchers must become very familiar with the cultures they study and design tests consistent with the needs and values of the people who will be tested (Greenfield et al., 2003; Holding et al., 2004). For example, when Ashley Maynard (2002) studied intellectual development among children in a Zinacantec Mayan village in Chiapas, Mexico, she used toy looms, spools of thread, and other common objects from the local culture. Her results indicated that the progression of children's intellectual development was comparable to that found among children

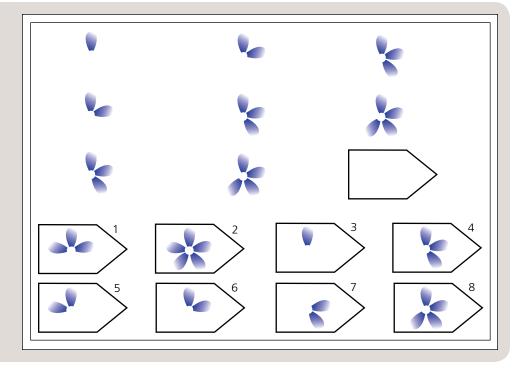
BVTLab

Visit www.BVTLab.com to explore the student resources available for this chapter.

FIGURE 8-8

Raven Progressive Matrices Test

This example of an item like those on the Raven Progressive Matrices Test relies on visual-spatial ability. Which of the eight figures presented at the bottom best completes the logic of the matrix at the top?



in the United States. Maynard's research demonstrates that when psychologists use testing materials and measurement techniques associated with test takers' cultural experiences, the psychologists can be more confident in making cross-cultural comparisons of intellectual abilities.



Imagine that you wanted to develop your own intelligence test. What are some of the pitfalls in early intelligence testing you would want to avoid?

Intelligence Encompasses Either a General Ability or Several Distinct Abilities.

As researchers began to more carefully study the nature of intelligence, one primary question concerned whether intelligence was best conceptualized as a general, unifying capacity along which people vary, or whether it should be thought of as composed of many separate and relatively independent abilities (Brody, 2000). One researcher who explored this question in the 1920s was British psychologist Charles Spearman (1863–1945). To aid him in his dissection of intelligence, Spearman helped develop a statistical technique called factor analysis, which allows researchers to identify clusters of test items that correlate with one another. By analyzing these correlations, researchers are in a better position to judge whether people's test performance can be accounted for by a single underlying ability (known as a factor) or whether multiple abilities (or factors) are needed. In essence, factor analysis helps researchers reduce the number of variables they are studying to a more manageable level by grouping together those that seem to be measuring the same thing. For example, if people who do well on reading tests also do well on writing and vocabulary tests, this suggests

Factor analysis A statistical technique that allows researchers to identify clusters of variables or test items that correlate with one another

that there might be an underlying "verbal ability" factor that is tapped by each of the individual performance measures. Moreover, if all the different intelligence abilities are highly correlated with one another, this might suggest that intelligence can be thought of as "one thing" rather than "many things."

Based on his factor-analytic research, Spearman (1927) concluded there was a **general intelligence factor**, or **g-factor**, underlying all mental abilities and a set of specific factors (s-factors) underlying certain individual mental abilities. However, because the g-factor could predict performance on a variety of intelligence tests measuring math ability, vocabulary, and general knowledge, Spearman asserted that the g-factor was much more important than the specific factors. He and other researchers believed that this general factor, which involves the more complex, higher-level mental functions, provided the key to understanding intelligence.

Although the g-factor's relative simplicity was appealing to many researchers, others argued that a person's intellect could not be captured by a general factor. Leading this dissenting group was Louis Thurstone (1887–1955). In the 1930s, Thurstone's (1938) own factor-analytic studies led him to conclude that there were seven clusters of *primary mental abilities*: reasoning, verbal fluency, verbal comprehension, perceptual speed, spatial skills, numerical computation, and memory (see Table 8-3). For Thurstone, just as we have games called football, baseball, soccer, basketball, hockey, tennis, and track but no game called athletics, we also have seven primary mental abilities but no general ability called intelligence.

How could the same statistical technique—namely, factor analysis—lead researchers to different conclusions? The answer is that despite its reliance on sophisticated and objective mathematical formulas, factor analysis requires researchers to make a number of highly subjective decisions concerning how their data will be organized and interpreted. As a result, researchers with different assumptions about how intelligence is organized sometimes interpret the findings of factor analysis differently.

Which of these perspectives on intelligence prevails today? The current scientific reality is that there is solid evidence for both perspectives: We have distinct mental abilities, but there is also evidence of a general intelligence factor (Johnson et al., 2004). A number of PET-scan studies find that when people perform different cognitive tasks associated with spatial reasoning, verbal abilities, or perceptual-motor skills, the same brain area, the lateral frontal cortex, is activated (Anderson, 2005; Duncan et al., 2000). The fact that these different mental abilities rely on some of

TABLE 8-3 Thurstone's Primary Mental Abilities **Primary Mental Ability** Description Reasoning Ability to find a rule or principle from a few examples Verbal fluency Ability to use words in special contexts, such as in solving anagrams and making rhymes Verbal comprehension Ability to understand words and sentences Perceptual speed Ability to detect visual details quickly Spatial skills Ability to visualize complex shapes in different orientations Numerical computation Ability to make mental and other mathematical computations Ability to recall verbal material, learn pairs of related words, etc. Memory

General intelligence factor (g-factor) The intelligence factor that Spearman and other researchers believed underlies all mental abilities

Multiple intelligences

Gardner's theory contends that there are at least eight distinct and relatively independent intelligences (linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, naturalist, interpersonal, and intrapersonal)—all of which are differently developed in each of us

the same underlying neurological processes is consistent with the g-factor hypothesis. However, it is possible that the brain scans performed using current PET technology are not sensitive enough to detect activation of different subregions of the lateral frontal cortex when people are performing different cognitive tasks. In the future, a more sensitive brain-scanning device may find this different subregion activation. Such a discovery would be inconsistent with the hypothesis that the g-factor is associated with a single general cognitive process. Thus, until we can determine what different neural networks in this region of the brain are doing, the issue of the existence of a general intelligence factor remains open to debate.

In the twenty-first century, Howard Gardner (1999) is an advocate of the view that there are different kinds of intelligence. His theory of **multiple intelligences** contends that the human brain has evolved separate systems for different adaptive abilities, and what we call "intelligence" in our culture is simply a small cluster of these abilities (Gardner, 2011). Gardner proposes that intelligence consists of at least eight distinct and relatively independent intelligences, all of which are differently developed in each of us: linguistic or verbal, logical-mathematical, spatial, musical, bodily-kinesthetic, naturalist, interpersonal, and intrapersonal. The degree to which particular individuals develop these intellectual abilities largely depends on which ones are most highly valued in their culture (Furnham et al., 2002).

Table 8-4 summarizes the multiple intellectual abilities described by Gardner. The first three on this list are most highly valued in Western culture; thus, they are the ones measured by conventional intelligence tests. A person with high *linguistic intelligence*, such as an author or public speaker, would be good at communicating

TABLE 8-4 Gardner's Multiple Intelligences					
Type of Intelligence	Description				
Linguistic intelligence	Ability to communicate through written and spoken language: author, poet, public speaker, native storyteller				
Logical-mathematical intelligence	Ability to solve math problems and analyze arguments: engineer, scientist, mathematician, navigator				
Spatial intelligence	Ability to perceive and arrange objects in the environment: carpenter, air traffic controller, sculptor, architect				
Musical intelligence	Ability to analyze, compose, or perform music: musician, singer, composer				
Bodily-kinesthetic intelligence	Ability to control body motions to handle objects skillfully: athlete, dancer, surgeon, craftsperson				
Naturalist intelligence	Ability to see patterns in nature: forest ranger, ecologist, zoologist, botanist				
Interpersonal intelligence	Ability to interact well socially and to reliably predict others' motives and behavior: mental health therapist, salesperson, politician, fund-raiser				
Intrapersonal intelligence	Ability to gain insight into one's own motives and behavior: meditator, essayist, stand-up comic				
A Possible Ninth Intelligence					
Existential intelligence	Ability to pose and ponder large philosophical questions: philosopher, clergy				

through written and spoken language. A person with high logical-mathematical intelligence, such as an engineer or scientist, would be good at solving math problems and analyzing arguments; and a person with high spatial intelligence, such as a carpenter or air traffic controller, would be skilled at perceiving and arranging objects in the environment. Regarding the five less conventional forms of intelligence, musical intelligence entails the ability to analyze, compose, or perform music. Our gifted athletes, dancers, and surgeons display bodily-kinesthetic intelligence; bodily-kinesthetic intelligence is also necessary, however, in ordinary activities, such as driving a car or hammering a nail. Naturalist intelligence, which relates to seeing patterns in nature, is an ability that forest rangers, ecologists, and zoologists must possess. Finally, interpersonal intelligence identifies the ability to interact well socially and to reliably predict others' motives and behavior, while intrapersonal intelligence is associated with insight into one's own motives and behavior. Besides these eight basic intelligences, Gardner has also suggested a possible ninth intelligence, existential intelligence, which deals with the posing and pondering of large philosophical questions, such as the meaning of life (Davis et al., 2011).

Although Gardner considers these different intelligences to be separate systems located in distinct brain areas, he does believe that they often interact to produce intelligent behavior. For example, skilled politicians rely heavily on linguistic intelligence when debating issues, but they also use logical-mathematical intelligence to critically analyze these issues and

interpersonal intelligence to understand what motivates voters (Bass, 2002). By combining skills in different intellectual domains, people can become competent in certain tasks or occupations, even though they may not be particularly gifted in any specific intelligence.

Support for Gardner's theory comes from the fact that brain damage may severely diminish one kind of mental ability but not others. Further, among healthy individuals, it is extremely rare to find the so-called Renaissance person who excels in all or several forms of intelligence. More frequently, a person with an extraordinary ability in one area will have normal abilities in the others. The existence of **prodigies**, people who easily master skills in one intellectual area, supports Gardner's hypothesis that various types of intelligence exist and are relatively independent of one another. Besides prodigies, an even greater intellectual variance can be found among savants, who demonstrate exceptional ability in one specific area, such as music or drawing, while having very limited mental abilities in all other areas (D. H. Feldman & Morelock, 2011). In one such case, Harriet, an autistic child who did not speak until the age of 9, could hum a classic operatic piece in perfect pitch at the age of 7 months. By age 4, she had taught herself to read music; and she had also learned to play the piano, violin, clarinet, trumpet, and French horn. As an adult, although Harriet's IQ was only 73, her proficiency in music increased dramatically. She not only could identify and provide key details about any major symphony but also could play a tune in the style and manner of the composers of these symphonies (Treffert, 1989, 1992).



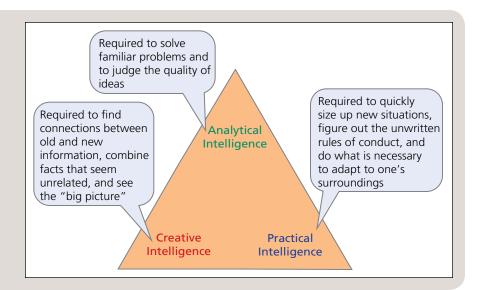
Howard Gardner's theory of multiple intelligences proposes that we have evolved separate brain systems for different mental abilities. Musical intelligence entails the ability to analyze, compose, or perform music.

Prodigies Individuals who easily master skills in a particular intellectual area

Savant Intellectually disabled individuals who demonstrate exceptional ability in one specific intellectual area

Sternberg's Triarchic Theory of Intelligence

According to Robert Sternberg, intelligence consists of analytical, creative, and practical abilities. You use analytical thinking to solve familiar problems, creative thinking to think about problems in new ways, and practical thinking to apply what you know to everyday situations. Of these three types of abilities, which do you think you employ most efficiently?



Triarchic theory of intelligence Sternberg's theory that three sets of mental abilities make up human intelligence: analytic, creative, and practical

Not everyone agrees with Gardner's theory. For instance, some critics question how athletic prowess can be considered a mental ability and instead believe it should more properly be labeled a talent (Hoberman, 1997). Others charge that Gardner's list of intelligences is arbitrary and that it is simply wrong to deny the existence of a general intelligence factor (Brody, 1992). Robert Sternberg (2005) agrees with Gardner's idea of multiple intelligences; yet his **triarchic theory of intelligence** (*triarchic* means "ruled by threes") asserts that human intelligence can be more simply described as comprising three sets of mental abilities, not eight (see Figure 8-9):

- Analytical intelligence is required to solve familiar problems and to judge the quality of ideas. This is the type of intelligence that is valued on tests and in the classroom; thus, people who are high in analytical intelligence tend to score high on general intelligence.
- Creative intelligence is required to develop new ways of solving problems (Zhang & Sternberg, 2011). People with a high degree of creative intelligence have the ability to find connections between old and new information, combine facts that appear unrelated, and see the "big picture."
- Practical intelligence is required to apply, utilize, and implement ideas in
 everyday situations. People who are high in practical intelligence have what
 we call "street smarts"; they are quick to size up new situations, figure out
 the unwritten rules of conduct, and do what is necessary to adapt to—and
 shape—their surroundings (Sternberg et al., 1995; Wagner, 2000).

Although some tasks require us to utilize all three intelligences, the triarchic theory does not define intelligence by how skilled we are in all three aspects. Some people are more intelligent in solving abstract, theoretical problems, whereas others are more intelligent when the problems are more concrete and practical. Sternberg contends that *successful intelligence* is knowing when and how to use analytic, creative, and practical abilities (Sternberg, 2003). People who are successfully intelligent will seek challenges that capitalize on their intellectual strengths and downplay their weaknesses. This is exactly what personnel departments try to do when selecting employees: match people's intellectual strengths with specific jobs within the organization. Successful organizations have workers who are skilled at analyzing existing problems, others who are best at using this analysis to create new ideas, and still others who can adeptly apply these new ideas as effective solutions.

TABLE 8-5 Four Theories of Intelligence						
Theory	Summary					
Spearman's general intelligence (g-factor)	A basic or general form of intelligence predicts our abilities in various academic areas.					
Thurstone's primary mental abilities	Intelligence involves seven primary mental abilities: reasoning, verbal fluency, verbal comprehension, perceptual speed, spatial skills, numerical computation, and memory.					
Gardner's multiple intelligences	Intelligence is best thought of as comprising at least eight distinct intelligences that are developed differently in each person: linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, naturalist, interpersonal, and intrapersonal.					
Sternberg's triarchic theory of intelligence	Three sets of mental abilities make up intelligence: analytic, creative, and practical.					

So where are we in the scientific debate concerning the existence of general intelligence versus multiple intelligences? As of this writing, research still supports both perspectives. There is solid evidence that we have distinct mental abilities, and there is also evidence of a general intelligence factor. As previously noted, brain scans indicate that when people work on tasks requiring different intellectual abilities, the same area of the frontal cortex is activated (Duncan et al., 2000). The fact that these different abilities rely on some of the same underlying neurological processes is consistent with the "g-factor" hypothesis. In an attempt to settle this controversy, many modern theories propose that although intelligence may encompass a general ability to deal with a wide variety of cognitive tasks and problems, it also can be expressed in many ways, perhaps even in the form of multiple intelligences. Table 8-5 summarizes the four theories of intelligence discussed in this chapter. Self-Discovery Questionnaire 8-2 and the end-of-chapter "Psychological Applications" section analyze two types of intelligence that fit into the multiple-intelligences viewpoint.



What Does It Mean to Be Emotionally Intelligent?

Related to Gardner's idea of intrapersonal intelligence is what various researchers have called **emotional intelligence**,

Emotional intelligence

The ability to recognize and regulate our own and others' emotions

which is the ability to recognize and regulate our own and others' emotions (Matthews et al., 2012). Individuals with high emotional intelligence are attentive to their own feelings,

can accurately discriminate between them, and can use this information to guide their own thinking and actions. For example, when they experience negative moods, emotionally intelligent people try to create a more positive state of

mind by doing something they enjoy or by finishing a task that will bring them a reward (Tice & Baumeister, 1993). In contrast, those who are less emotionally skilled tend to be "ruled" by their emotions: They not only have quick tempers but also "stew in their own negative juices" when things don't go their way (Caprara et al., 1996). Of the two extremes of the spectrum of emotional intelligence, which do you think leads to greater happiness and success?

Emotionally intelligent people are aware not only of their own emotional states but of those of others as well (O'Sullivan, 2005). For example, in one study, participants being rated on their emotional intelligence

watched a computer screen as people's faces morphed into different emotional expressions. The participants' task was to click a key as soon as they could identify the morphing expression. Results indicated that the emotionally intelligent participants were faster at identifying the expressions than their less emotionally intelligent counterparts (Petrides & Furnham, 2003).

People with emotional intelligence are those we seek out when we are troubled. Their emotional attentiveness makes them sympathetic



People with emotional intelligence are sympathetic listeners, and we seek them out when we are troubled. Are emotionally intelligent people generally happier than those who are less emotionally intelligent?

that they often provide us with good advice on how to resolve our difficulties. Due to their ability to accurately measure the "pulse" of social relationships, emotionally intelligent people get along well with others, have many friends, and often achieve great success in their careers (Salovey et al., 2003). Based on these findings, it isn't surprising that our skill at managing the emotional realm significantly determines the extent to which our lives are successful and fulfilling. Before reading further, spend a few minutes

listeners, and their skill at managing social conflict means answering the items in Table 8-6.

TABLE 8-6 Measuring Your Level of Empathy for Others

Instructions: One aspect of emotional intelligence is the ability to be attentive to the feelings of others. *Empathy* is a feeling of compassion and tenderness toward those who encounter unfortunate life events. Research indicates that people differ in their levels of empathy. To discover your level of empathy or *empathic concern* for others, read each of the following items and then, using the following response scale, indicate how well each statement describes you.

0 = extremely uncharacteristic (not at all like me)

- 1 = uncharacteristic (somewhat unlike me)
- 2 = neither characteristic nor uncharacteristic
- 3 = characteristic (somewhat like me)
- 4 = extremely characteristic (very much like me)
- 1. When I see someone being taken advantage of, I feel kind of protective toward them.
- 2. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.*
- 3. I often have tender, concerned feelings for people less fortunate than me.
- 4. I would describe myself as a pretty soft-hearted person.
- 5. Sometimes, I don't feel very sorry for other people when they are having problems.*
- 6. Other people's misfortunes do not usually disturb me a great deal.*
- 7. I am often quite touched by things that I see happen.

Scoring your responses: Three of the items on this scale are reverse-scored; that is, for these items, a lower rating actually indicates a higher level of empathic concern or personal distress. Before summing the items, recode those with an asterisk (*) so that 0 = 4, 1 = 3, 3 = 1, 4 = 0.

The mean score for female college students is about 22, and the mean score for male students is about 19 (M. H. Davis, 1996). The higher your score, the higher the level of empathic concern you have for others.

Source: From Empathy: A Social Psychological Approach by Mark H. Davis. Copyright © 1996. Reprinted by permission of Westview Press, a member of Perseus Books, L.L.C.





- The first useful intelligence test was developed by Alfred Binet to identify lower-performing children needing special education; however, Henry Goddard inappropriately used the Binet-Simon test to assess the intelligence of diverse groups, including immigrants.
- Intelligence tests are aptitude tests; achievement tests measure what you have already learned.
- Standardization is the process of establishing uniform procedures for administering a test and for interpreting its scores.
- Test reliability indicates the degree to which a test yields consistent results.
- Test validity indicates the degree to which a test measures what it is designed to measure.
- Reliability of intelligence tests is higher than their validity.
- Intelligence tests are not "culture-free," and care is needed when comparing people from different cultural backgrounds.
- Spearman's factor-analytic research suggested a general intelligence, or g-factor, underlying all mental abilities and a set of specific factors (s-factors) underlying certain individual mental abilities.
- Gardner's theory of multiple intelligences proposes at least eight separate abilities: linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, naturalist, interpersonal, and intrapersonal.
- According to Sternberg's triarchic theory, intelligence comprises three sets of mental abilities: analytical, creative, and practical.
- Emotional intelligence helps us achieve and maintain personal and career success.

8.4 Neurological, Hereditary, and Environmental Influences on Intelligence

We have all heard people described as "quick-witted" and "dim-witted." When individuals substantially differ in their intelligence levels, how do they differ in their neurological functioning? Further, to what degree does heredity determine intelligence, and to what degree do the physical and social environment in which we are raised determine it? Are there group differences in intellectual ability? These are some of the questions we will address in this final section of the chapter.

8.4a People Appear to Differ in Their Neural Complexity, Quickness, and Efficiency.

Is the size of people's brains an indicator of their intelligence? When magnetic resonance imaging (MRI) scans directly measure brain size and then adjust it for body size, brain size has a moderately high correlation (r = +.44) with IQ scores (Cairo, 2011; Rushton & Ankney, 1996). In explaining the brain size-IQ correlation, some neuroscientists point to the fact that larger brains have more neurons than

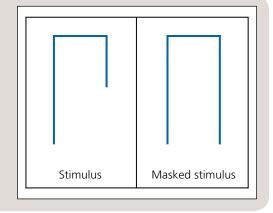
do smaller brains (Olszewski-Kubilius & Lee, 2011). The higher intelligence found among those with bigger brains might be caused by these individuals having a larger number of neural connections and a correspondingly greater cognitive capacity (Vernon et al., 2000). One problem with this "greater neuron" explanation is that men, on average, have about 4 billion (or 16 percent) more neurons than women; yet men do not outscore women on IQ tests. In addition, archeological records indicate that Neanderthals had larger brains than modern humans, but no scientists have suggested that our extinct hominid cousins were more intelligent than we are. Another possibility is that the brain size—IQ correlation is related to different levels of *myelin* in the brain (Miller, 1994). As you recall from Chapter 2, Section 2.1b, the myelin sheath is the protective coating of glial cells around an axon that hastens the transmission of the neuron's electrochemical charge. The possibility that intelligence might be related to myelin is one of the reasons intelligence researchers have devoted a great deal of attention to the brain's processing speed.

A number of studies indicate that intelligence is partly based on neural complexity, quickness, and efficiency (Bassett & Gazzaniga, 2011). For example, IQ scores tend to be correlated with the complexity of electrical activity in the brain. When responding to simple stimuli, high scorers have more complex brain patterns than low scorers (Barrett & Eysenck, 1992). Regarding neural "quickness," the speed at which neural impulses travel (see Figure 8-10) is positively correlated with IQ about +.40—suggesting that intelligent people are literally more quick-witted than the less intelligent (McGarry-Roberts et al., 1992). Finally, additional studies suggest that smarter brains are not only quick and complex but also more efficient (Jausovek & Jausovek, 2003). Using PET scans, Richard Haier and his coworkers (1992, 1995) found that people with higher intelligence tend to consume less glucose—a simple sugar required for brain activity—while working on problem-solving tasks. They also found evidence suggesting that the brains of intelligent people become more efficient with practice than the brains of those with less intelligence. That is, after practicing a relatively complex computer game, intelligent participants' brains subsequently consumed less glucose overall when playing this game, even though certain brain areas actually consumed more glucose. Haier and his coworkers contend that, by concentrating the processing of information in relatively small areas of their brains, intelligent people use their brains more efficiently. Although the origins of these biological differences in brain functioning could be genetic, the fact that greater efficiency is achieved with practice suggests that these differences also develop from experience. Together, these findings suggest that intelligence is a product of both our biology (nature) and our experience (nurture).

FIGURE 8-10

An Inspection Time Task

In a typical experiment measuring neural "quickness," researchers will often study how fast participants can process perceptual information presented to them. An incomplete stimulus is quickly flashed on a computer screen, but its lingering afterimage is immediately hidden (or *masked*) by another stimulus. The participant is then asked whether the long side of the original stimulus appeared on the left or right. Researchers determine how much time participants need to inspect the stimulus in order to answer such questions correctly 80 percent of the time. Participants who need less time to correctly answer these questions tend to score higher on intelligence tests.



Extremes of Intelligence

Although intellectual performance can be improved through learning, researchers have devoted considerable time and energy to studying people who score at the two extremes of the IQ normal distribution. The diagnosis of **intellectual disability** is given to people who not only have an IQ score at or below 70, but also have difficulty adapting to the routine demands of independent living (Detterman et al., 2000). Estimates are that only about 1 to 2 percent of the population meets both criteria, with males outnumbering females by 50 percent (Toth & King, 2010). Within this designation, there are four intellectual disability categories, which vary in severity. As you can see in Table 8-7, most intellectually disabled people are only mildly disabled.

Also included among organic causes are genetic disorders, the most common being **Down syndrome**, which is caused by an extra chromosome coming from either the mother's egg (the primary source) or the father's sperm (Davis, 2008). The production of this extra chromosome is strongly related to maternal age. Among mothers under age 33, the rate of Down syndrome is only 0.9 per 1,000 live births. This rate increases to 3.8 in mothers who are age 44 or older (Grigorenko, 2000). Characteristic signs of Down syndrome are small head, nose, ears, and hands; slanting eyes; short neck; and thin hair. Individuals with this disorder have IQs that place them in the mild-to-severe range of intellectual disability. When given proper training and placed within a supportive family environment, many people with Down syndrome can care for themselves, hold a job, and lead happy, fulfilling lives.

Approximately 75 percent of intellectual disability cases cannot be linked to any organic cause; instead, they are thought to result from unfavorable social conditions or subtle and difficult-to-detect physiological effects (Handen, 1997). Most of these cases involve less-severe forms of intellectual disability, and poor children are 10 times more likely to be classified in this manner than those from the general population. Among the remaining 25 percent of cases, doctors are able to identify a specific organic cause, such as the developing fetus or infant child being exposed

people who not only have an IQ score below 70 but also have difficulty adapting to the routine demands of independent living

Intellectual disability A diagnostic category used for

Down syndrome A form of intellectual disability caused by an extra chromosome in an individual's genetic makeup

TABLE 8-7	Degrees of	intellectu	al Disability
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IADEL 07	begices of intencetaal bisability				
Level	Typical IQ Scores	Percentage of the Disabled	Adaptation to Demands of Life		
Mild	50–70	85%	May learn academic skills up to the sixth-grade level. With assistance, adults often can learn self-supporting social and vocational skills.		
Moderate	35–49	10%	May progress to second-grade level. Within sheltered workshops, adults can contribute to their own support through manual labor.		
Severe	20–34	<4%	May learn to talk and to perform simple work tasks under close supervision but are generally unable to profit from vocational training.		
Profound	Below 20<	2%	Limited motor development and little or no speech. Require constant aid and supervision.		

Source: Reprinted with permission from the *Diagnostic and Statistical Manual of Mental Disorders, Text Revision*, Fourth Edition. Copyright © 2000 American Psychiatric Association.

to harmful substances (for example, alcohol and lead) or trauma to the child's head (Yeargin-Allsopp et al., 1997).



When the English physician Langdon Down identified Down syndrome in 1866, it was called "Mongolism" because the slanting eyes of Down syndrome people bore some resemblance to Asian eyes in the minds of Westerners. Consistent with then existing scientific theories of White intellectual superiority, nineteenth-century European scientists claimed that Down syndrome individuals failed to develop beyond the physical and

intellectual level of Asians, such as Mongolians.

At the other extreme of the IQ normal distribution is the "gifted" category. This term has commonly been reserved for those people with IQs above 130 or 135. Consistent with theories of multiple intelligences, U.S. federal law designates that giftedness should be based on superior potential in any of six areas: general intelligence, specific aptitudes (for example, math and writing), performing arts, athletics, creativity, and leadership (Callahan, 2000). Although more school districts are beginning to identify gifted students based on these broader standards, most continue emphasizing IQ scores (Dai & Renzulli, 2008; Lewis et al., 2012).

To adequately challenge gifted students in school, educators have developed two separate intervention strategies (Keen & Howard, 2002). Acceleration involves admitting gifted students to school early and encouraging them to skip grades. Enrichment, in contrast, keeps gifted students in their normal grade level but supplements their course work with advanced material, independent study projects, and other special learning experiences. Both intervention strategies can be effective; many gifted students in these programs still complain, however, that their classes move too slowly, involve too much repetition of already mastered material, and place too much emphasis on the mastery of facts rather than the use of thinking skills (Gallagher et al., 1997). One problem is that these programs are underfunded. Relative to the money provided for the education of intellectually disabled students, little money is spent on education for gifted children, especially those who are poor or live in rural areas.

One common belief about gifted individuals is that their "gift" is really a curse because it makes them social misfits who lead lonely, unsatisfying lives. Is this stereotype true? In 1921, in an attempt to answer this question, Lewis Terman began tracking the lives of over 1,500 California children with IOs above 135 (Terman, 1925). Over the course of the next 70 years, Terman and later researchers discovered that, by and large, these men and women led healthy, well-adjusted lives, with slightly more successful marriages and much more successful careers than the average person (Holahan & Sears, 1995; Terman & Oden, 1947). Other longitudinal studies of gifted individuals have replicated these findings. Counter to prevailing stereotypes, research clearly indicates that children with high IQs are less likely to be social misfits than their less-gifted counterparts (Lubinski et al., 2001). However, childhood giftedness does not guarantee adult eminence. For example, although the "Termanites" (as the gifted children tracked by Terman affectionately called themselves) generally grew up to be very successful adults in their chosen careers, very few became the best and brightest members of their generation (Pyryt, 1993). Thus, although IQ is an important contributor to a person's life path, it is only one factor determining a person's life accomplishments. This is certainly good news to the vast majority of us who do not fall within the lofty 1 percent upper realm of the IO normal distribution!

Doing easily what others find difficult is talent; doing what is impossible for talent is genius.

—Henri-Frederic Amiel, Swiss critic, 1821–1881



Is this your stereotype of a gifted student? Does research support this stereotype? How do the lives of gifted people differ from those of the average person?

8.4b Twin and Adoption Studies Indicate That Both Genes and Environment Influence Intelligence.

Psychologists and behavior geneticists who study the heritability of intelligence express the degree to which heredity determines intelligence within a particular human group in terms of a **heritability coefficient**, which ranges from 0 to 1 (Sternberg & Kaufman, 2002). A coefficient of 0 would mean that heredity has no influence on intelligence, while a coefficient of 1 would mean that heredity is the only influence. As with most of the intelligence testing conducted today, heritability coefficient estimates are almost always based on standard IQ tests, which define intelligence primarily in terms of analytic and verbal ability. To gain a better understanding of heritability research, let us first examine studies of twins and then turn our attention to the adoption studies.

Heritability coefficient A statistical coefficient, ranging from 0 to 1, that estimates the degree to which heredity determines intelligence within a particular human group

Twin Studies

Why would researchers studying the role of genetic factors in intelligence be so interested in studying identical and fraternal twins? As you learned in Chapter 2, identical twins have identical genes, whereas fraternal twins share only about half of the same genes. The rationale for studying twins is that they normally are raised in similar environments. If the IQ scores of identical twins were more similar than those of fraternal twins, this presumably would be due to their greater genetic similarity. Or would it?

As you can see from Figure 8-11, the findings of more than 100 twin studies indicate that the average correlation of identical twins' IQ scores is .86, while that of fraternal twins is significantly lower, .60 (Bouchard & McGue, 1981; McGue et al., 1993). These results seem to support the genetic contribution to intelligence. However, these same twin studies also point to environmental effects on intelligence (Lytton & Gallagher, 2002). Fraternal twins—who are genetically no more similar than regular siblings, but who are exposed to more similar experiences due to their identical ages—have more similar IQ scores than other siblings. In addition, nontwin siblings raised together have more similar IQs (r = .47) than siblings raised apart (r = .24).

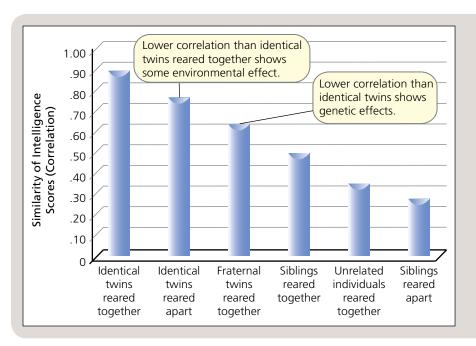


FIGURE 8-11

Studies of IQ Similarity: The Nature-Nurture Debate

The results of over 100 studies correlating the IQ scores for people with different genetic and environmental backgrounds found that the most genetically similar people had the most similar IQ scores. Do these findings suggest that intelligence is partly inherited? How do the other findings reported here support the argument that intelligence is partly determined by environmental factors?

Together, do these findings suggest that genes and environment both contribute to intelligence, but that genes have a greater influence?

That is a reasonable conclusion, but environmentally oriented researchers argue that the higher IQ correlations among identical twins than among fraternal twins may be substantially caused by environmental factors. According to this argument, parents of identical twins tend to treat them more alike than parents of fraternal twins, often even dressing them identically. As a result, fraternal twins' environments often are not as similar as are the environments of identical twins. Perhaps it is this greater environmental similarity that explains the higher IQ correlations among the identical twins than among the fraternal twins.

Genetically oriented researchers respond that identical twins raised apart still have higher IQ correlations (r = .72) than fraternal twins raised together (r = .60). Isn't this convincing evidence for genetic effects? Maybe not, say the environmentally oriented researchers. These higher IQ correlations for identical twins reared apart may be due to *prenatal environmental factors*. About two-thirds of identical twins share the same placenta and amniotic sac in the uterus, which makes their prenatal environment more alike than that of fraternal twins, who are almost always in separate sacs (Phelps et al., 1997). Twins in the same sac share the same blood, which contains chemicals that affect brain development. Perhaps the high IQ correlations among identical twins separated at birth are due to shared early environment as well as shared genes.

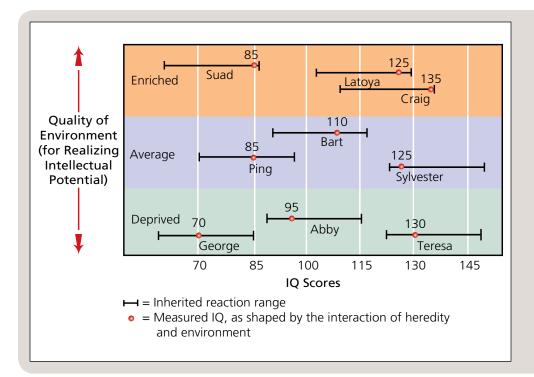
Adoption Studies

Given the competing ways in which twin study findings can be interpreted as supporting either genetic or environmental effects on IQ, researchers have sought further clues among adopted children. Biological parents supply these children their genes, while adoptive parents provide them their environment. If heredity matters more than environment, the children's IQ scores should correlate higher with their biological parents' IQ scores than with their adoptive parents' scores. The reverse finding should occur if environment matters more than heredity.

A number of adoption studies have found that children who were adopted within two weeks to one year of birth were later found to have higher IQ correlations with their biological parents than with their adoptive parents (Scarr & Weinberg, 1983; Turkheimer, 1991). Furthermore, many of these same studies find that as adopted children grow up, their IQ correlation with their biological parents doesn't decrease; it increases! How could this be if environment is more important than genetics in determining intelligence? These and other findings suggest that heredity makes a somewhat larger contribution than environment (Loehlin et al., 1997; Teasdale & Owen, 1984).

Although adoption studies point toward a substantial hereditary contribution to intelligence, they also report evidence of significant environmental influences. For instance, in France, the IQ scores of lower-class children adopted by upper-class families were compared with the IQ scores of their siblings who had not been adopted (Capron & Duyme, 1989; Schiff et al., 1978). Although the average adopted children's scores in these studies ranged between 104 and 111, the average scores for their brothers and sisters reared in the original lower-class households ranged between 92 and 95, a significant difference. Furthermore, when children of upper-class parents were adopted, their later average IQ score was 120 if their adoptive parents were from upper-class families, but only 108 if lower-class families adopted them.

Based on the twin and adoption studies combined, the best estimate is that heredity accounts for a little over 50 percent of the variation in intelligence, with environmental factors being responsible for a little less than 50 percent. However, this



Reaction Range

Reaction range indicates the extent to which the environment can raise or lower IQ scores, given the preexisting hereditary limits. Each person has her or his own individual reaction range. People who grow up in enriched environments should score at the top of their reaction range, whereas those who grow up in impoverished settings should score closer to the bottom of their range.

does not mean that a little over half of *your* intelligence is inherited and a little less than half is environmentally influenced. It simply means that genetics and environmental factors are respectively responsible for a bit more and a bit less than about half of the differences among individuals in the population (R. E. Nisbett et al., 2012).

So how do genes and environment interact in determining intelligence? The concept of **reaction range** provides a possible answer (see Figure 8-12). Our genes establish a range of potential intellectual growth, and our environmental experiences interact with our genetic makeup in determining where we ultimately fall in this reaction range. For example, children with a natural aptitude for writing are more likely to spend leisure time writing and to also select writing and literature courses in high school. If their parents and teachers further nourish this natural aptitude by offering them enrichment opportunities, their skills are further enhanced. Thus, their subsequently high scores on verbal aptitude tests are due to both their natural ability and their experience. For most people in most environments, their reaction range is about a 25-point spread on an IQ test. A number of studies find that exposing children to healthy and stimulating environments can enhance their intellectual abilities (Grotzer & Perkins, 2000). For example, in a longitudinal study, inner-city children who received a great deal of intellectual stimulation at home and in day care or school had, by age 12, average IO scores 15 to 30 points higher than those of inner-city children who were not exposed to enriching environments (Campbell & Ramey, 1994).

Reaction range A person's genetically determined range of potential intellectual growth, with environmental factors influencing where the person ultimately falls in this range.

8.4c There Are Group Differences in IQ Scores.

As discussed at the beginning of this chapter, claims about group differences in intelligence have often been used to rationalize racial, ethnic, and gender discrimination. For this reason, claims about group differences must be subjected to very careful analysis. In this section, we examine research regarding gender differences in intelligence and then focus on racial differences.



Cross-cultural studies find that although male and female IQ scores are virtually identical, females tend to outperform males on verbal aptitude tests, and males tend to do better on visual-spatial tests. What are some possible explanations for these differences?

Gender Differences

Although male and female IQ scores are virtually identical, a few differences in certain aptitudes are worth mentioning (Ardila et al., 2011; Olszewski-Kubilius & Lee, 2011). Females tend to do better on verbal aptitude tests, such as naming synonyms and verbal fluency, while males tend to do better on visual-spatial tests, such as mental rotation and tracking a moving object through space. These gender differences have been found in at least 30 countries around the world (Beller & Gafni, 1996; Vogel, 1996).

As discussed in Chapter 2, Section 2.3f, some studies suggest that these female-male differences in verbal and spatial abilities might be linked to sex differences in the organization of those areas of the cerebral hemispheres

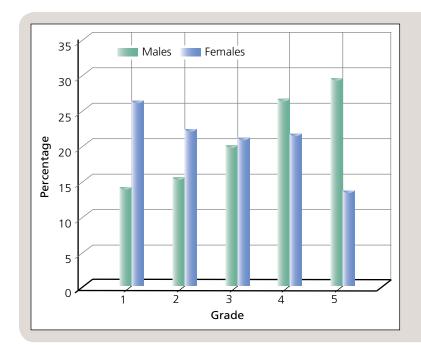
controlling verbal and spatial abilities and to hormonal fluctuations (Burgaleta et al., 2012). Other studies suggest that these differences are a product of gender socialization and the different skills taught to girls and boys (Halpern, 2012). For example, girls not only receive greater encouragement to talk during infancy and early childhood than do boys, but in school they are more likely to be praised for their reading and writing. On the other hand, boys are more often encouraged to play sports and engage in other activities that develop their visual-spatial skills.

Gender differences have also been found in mathematical ability. For example, in the 60-item SAT math test, male high-school seniors average about four more correct answers than their female counterparts (Held et al., 1993). Are these differences caused by genetics, socialization, or some combination of the two? In contrast to the substantial gender differences found in verbal and spatial abilities (about one standard deviation), a meta-analysis of 242 studies published between 1990 and 2007, representing the testing of 1,286,350 people, found no gender differences in math abilities (Lindberg et al., 2010).

Despite the fact that gender differences in math abilities seem to have disappeared, there is still a considerable disparity in the gender composition of undergraduate and graduate college programs that require extensive mathematical knowledge and skills. In fact, it is still the case that men are more likely than women to score very high or very low on tests of mathematical ability. In fact, men are much more likely than women to score in the top one percentile on math tests used for college admissions. For example, many colleges use the Physics C (Mechanics) College Board Advanced Placement Test to select incoming students for their accelerated and advanced physics and science courses and programs. However, as you can see in Figure 8-13, a much higher percentage of male students than female students achieve the highest grade (5) on this test. This means that many more men than women are being admitted to the top science and engineering programs. These gender differences probably do not reflect any innate differences between men and women; they are most likely, instead, due to cultural stereotypes and the resulting ways in which we socialize men and women to think about their mathematical abilities (Cvencek et al., 2011).

Racial Differences

In the United States, African Americans score between 10 and 15 points lower on intelligence tests than White Americans and Asian Americans, whose IQ averages are about 100 (Cosmides & Tooby, 2002; Sackett & Shen, 2010). Hispanic Americans achieve IQ scores somewhere in between those of Blacks and Whites, and Asian



Gender Differences in Physics Advanced Placement Exam Grades

Colleges often use the Physics C (Mechanics) College Board Advanced Placement Test to select incoming students for their accelerated and advanced physics and science courses and programs. The highest grade level that a student can attain on this exam is a 5. How might the gender difference depicted in this figure have an impact on who is admitted to elite math and science programs in college or on who receives academic scholarships to those programs?

Source: From "Stability and change in gender-related differences on the College Board Advanced Placement and Achievement Tests" by H. Stumpf and J. C. Stanley in Current Directions in Psychological Science, 1998, 192–196.

Americans score about 5 points higher than Whites. Although research suggests that the average IQ scores for Black children have risen over the past 20 years, these group-based IQ differences persist (Hartmann et al., 2007). As mentioned in Section 8.3c, critics of conventional intelligence tests argue that these group differences are caused by culturally biased test items; however, defenders of these tests respond that these differences also occur on nonverbal test items—such as counting digits backward—that do not appear to be culturally biased against ethnic minorities.

In making sense of these findings, we must remember that group differences tell us nothing about the intellectual ability of any specific person. As you can see in Figure 8-14, tens of millions of African American and Hispanic individuals have IQs higher than those of the average White or Asian American. Yet, if heredity

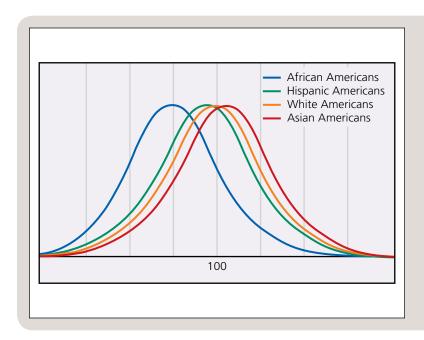


FIGURE 8-14

Racial Differences in IQ Scores

The average score of Asian Americans on IQ tests is about 3 to 5 points higher than White Americans' average score of 100. White Americans, in turn, average about 7 points higher than Hispanic Americans and 10 to 15 points higher than African Americans. However, as you can see by examining the graph, the IQ variation within these groups is much greater than the differences among their average IQ scores.

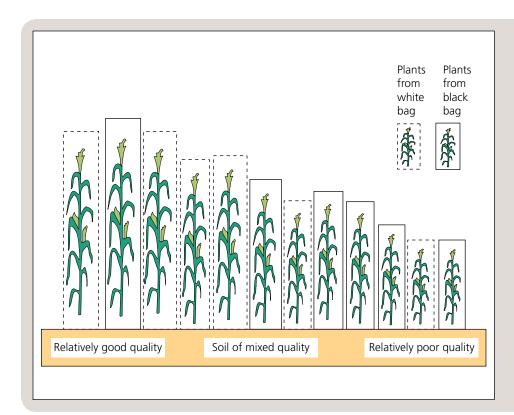
Source: Data from N. J. Mackintosh. (1998). *IQ and human intelligence*. Oxford: Oxford University Press. Neisser, U. (1998). *The rising curve: Long-term gains in IQ and related measures*. Washington, D.C.: American Psychological Association. Herrnstein, R. J., & Murray, C. (1994). *The bell curve: Intelligence and class structure in American life*. New York: The Free Press.

influences individual differences in intelligence, does it also substantially explain these group differences?

Research by Sandra Scarr is a good example of how scientists have sought answers to this question. In her first line of research, Scarr and Richard Weinberg (1976) examined the IQ of lower-class Black and White children adopted by both Black and White middle-class families. They found that adopted African-American children had an average IQ of 110, over 20 points higher than children who were raised in their original lower-class African-American families. Even when these adopted children reached adulthood, their IQ scores remained 10 points higher than those of African Americans raised in lower-class Black families (Weinberg et al., 1992). The researchers concluded that these findings suggest that Black-White IQ differences in the general population are substantially affected by environmental factors, such as unequal economic and educational conditions. Scarr and her colleagues (1977) also examined the chemical composition of blood among African Americans. Because many African Americans have European ancestors, Scarr reasoned that if Black-White IO differences were predominantly caused by genetics, then African Americans with a greater proportion of European ancestry in their blood should have the highest IQ scores. Counter to a genetic explanation of racial differences in IQ scores, no correlation was found between IO and racial ancestry. In fact, virtually all the studies that have sought to find the source of these Black-White IQ differences have failed to find evidence for genetic effects (Eyeferth, 1961; Loehlin et al., 1973; Nisbett, 1995). Indeed, although scientists have discovered some genes weakly associated with intelligence, they have not found that these genes are more prevalent in one racial group than another (Burdick et al., 2006). Based on these converging findings from different research avenues, the general scientific consensus is that it is "highly unlikely" that genetic differences between the races cause the observed group differences in IQ scores (Nisbett et al., 2012).

To understand group-based differences in IQ scores in the United States, think of contemporary American society as if it were a field that has large patches of both fertile and barren soil (Feldman & Lewontin, 2008). As depicted in Figure 8-15, imagine that you have corn seeds with some degree of individual genetic variation. Further imagine filling a white bag and a black bag with an equal number of these seeds. Next, plant these seeds in this field of nonuniform soil. Distribute the white bag of corn seeds so that a much higher percentage grows in the rich, fertile areas of soil than in the poor, barren soil areas. In contrast, distribute the black bag of seeds so that a much higher percentage grows in the poor, barren areas of soil than in the rich, fertile soil areas. As the plants from these two bags mature, you will observe that the average height of the plants from the white bag is greater than that of the plants from the black bag. This group difference is caused entirely by environmental factors (differences in soil nutrients). However, if you do not acknowledge the environmental differences, you would mistakenly conclude that the seeds from the white bag are genetically superior to the seeds from the black bag.

As this corn/field analogy illustrates, the fact that IQ differences within groups are partly or even completely caused by genetic variation does not mean that average IQ differences between groups are due to genetics (Block, 2002). An important question that needs to be asked before attributing between-group IQ differences to genetics is this: Are the groups' environments the same? Many children living in poverty do not receive proper nutrition, which impedes neurological development and causes attention problems at school (Brody, 1992). They also have fewer role models who can teach them skills and habits necessary to flourish academically, and they attend schools with lower-quality learning resources and lower expectations for academic



Between-Group Variation and Environmental Impact

The same corn seeds are placed in a white bag and a black bag. They are then distributed unevenly within a field that has areas of both rich and poor soil. Some of the height variation in the grown plants may reflect genetic differences. However, the overall height difference between the corn plants that came from seeds in the black bag and those from seeds in the white bag are due to the overall differences in the environment where the "black-bag" and "white-bag" seeds grew.

achievement. Either singly or together, these aspects of an impoverished environment interfere with intellectual growth.

Due to the dissimilarity in environments, it is a mistake to assume that IQ differences between Blacks and Whites stem from genetic factors. Although intelligence researchers generally agree that individual differences in IQ scores are substantially influenced by genetic factors, there is no compelling evidence that group differences in IQ are due to genetics.

8.4d Cultural and Social Psychological Factors May Explain Group IQ Differences.

Beyond socioeconomic disadvantages accounting for lower IQ scores among Blacks and other selective minority groups, some social scientists also contend that certain cultural and psychological forces contribute to these between-group differences.

Voluntary versus Involuntary Minorities

One way to distinguish among minority groups in the United States is in terms of how they became a "minority" (Ogbu, 2004). *Voluntary minorities* are people who have freely come to this country because they perceived it as "the land of opportunity," whereas *involuntary minorities* are people who are a part of this country because their ancestors were conquered, colonized, or enslaved. Instead of seeking out the United States, the ancestors of involuntary minorities were forced against their will to become a part of this country. Involuntary minorities include Native Americans, most African Americans, early Mexicans in the Southwest, native Hawaiians, Alaskan natives, and Puerto Ricans.

Numerous studies indicate that involuntary minorities in the United States achieve lower IQ scores than voluntary minorities (Brand, 1996; Lundy & Firebaugh, 2005).

Similar findings have also been reported in Canada, Europe, India, Japan, and New Zealand. For example, in Japan the Burakumin are an involuntary minority group that comprises 2 percent of the population. They have the same ethnic and national origins as the dominant Ippan Japanese, yet they have been discriminated against for centuries. Over the past 20 years, the Japanese government has engaged in a substantial effort to improve the educational and social opportunities of the Burakumin. However, members of this involuntary minority still encounter negative stereotypes and discrimination in mainstream Japanese society. When the IQ scores of the Burakumin and the Ippan are compared, the Burakumin score 16 points lower, which is comparable to the 15-point IQ difference found between U.S. Blacks and Whites (Ikeda, 2001). Interestingly, when the Burakumin immigrate to the United States as voluntary minorities, they perform very well on IQ tests, actually doing slightly better than other Japanese immigrants (Ito, 1967).

What is it about the involuntary minority status that might cause these lower IQ scores? Two of the likely causes are (1) persisting negative cultural stereotypes within the dominant culture concerning involuntary minorities' intellectual abilities and (2) the self-protective defensive reaction many involuntary minority members subsequently develop against the rejecting mainstream culture (Shimahara & Holowinsky, 2001).

Oppositional Identities

Anthropologist John Ogbu (2002) believes that some members of stigmatized racial and ethnic groups respond to negative ethnic stereotypes and discrimination by developing an oppositional ethnic identity and cultural frame of reference that defensively opposes the rejecting dominant culture (see Chapter 3, Section 3.5d, for a discussion of ethnic identity development). This type of reaction makes a good deal of sense, in certain respects. If you live in a society in which your racial or ethnic group is devalued, developing an oppositional identity may help you cope with your hostile environment by clearly defining your racial or ethnic group in contrasting ways with the larger culture (Crocker & Major, 1989; Crocker et al., 1998). Although an oppositional identity can psychologically insulate you—the stigmatized person—from some of the negative effects of social injustice, such as loss of self-esteem, it can also constrict your personal identity. For example, among many African American youths with oppositional ethnic identities, committing themselves to academic excellence and learning to follow the academic standards of the school are often perceived as adopting a White American cultural frame of reference and "acting White" (Ford, 1996). Unfortunately, by rejecting these academic pursuits, not only are African Americans and other minorities more likely to score lower on IQ tests than their White counterparts, but also this rejection will hinder them from fully taking advantage of the civil rights advances that have occurred over the past 50 years (Bankston & Caldas, 1997; Fordham & Ogbu, 1986).

Stereotype Threat

In addition to the problem that oppositional identities pose to minority students' academic achievement, social psychologist Claude Steele (2011) asserts that for those minority students who do want to excel academically, negative cultural stereotypes about their supposed inferior intellectual abilities can create feelings of anxiety and vulnerability, especially when they are in the company of people outside their racial group. That is, if you are a student who is often one of only a few members of your race enrolled in a particular course, your individual performance is often looked upon

by students not of your race as representing the "typical" student of your racial group. Accompanying this scrutiny is the added social stigma associated with your minority label, which often implies a suspicion of intellectual inferiority. Because these negative stereotypes are widely known throughout society, you are susceptible, as the target of such stereotyping, to developing **stereotype threat**, which is the disturbing awareness that your performance on some task might confirm the negative stereotype as something that you personally possess (Schmader et al., 2008). According to Steele, when highly motivated minority students take an intelligence test while simultaneously worrying that a low score will confirm that they fit the "mentally inferior" stereotype, this added pressure is often sufficient to significantly hinder their performance.

Evidence for the stereotype threat effect among African American college students comes from a series of experiments that Steele and Joshua Aronson (1995) conducted. In one of these studies, Black and White students were given a difficult English test. In the stereotype threat condition, the test was described as a measure of intellectual ability, while in the nonstereotype threat condition, it was described as a laboratory problem solving task that didn't measure intelligence. Because one of the more salient racial stereotypes is that Blacks are intellectually inferior to Whites, the researchers presumed that describing the test as an intellectual measure would make this negative stereotype relevant to the Black students' performance. In turn, researchers also expected this stereotype relevance to establish for these Black students a fear of confirming the stereotype ("If I do poorly, my performance will reflect badly on my race and on me"). Steele and Aronson hypothesized that the anxiety created by such thinking would interfere with the Black students' performance. In contrast, when the task was described as not measuring intelligence, the researchers assumed that this would make the negative racial stereotype irrelevant to the Black students' performance, and therefore not arouse anxiety. Figure 8-16 shows that when the test was presented as a measure of ability, Blacks performed worse than Whites,

Stereotype threat The apprehension people feel when preforming a task in which their group is stereotyped to lack ability

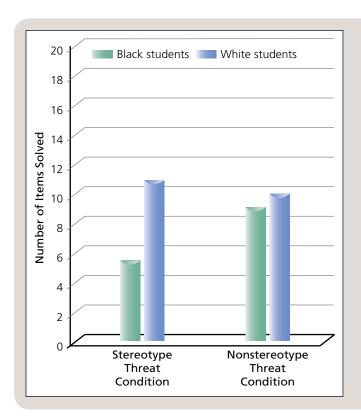


FIGURE 8-16

African American Intellectual Test Performance and Stereotype Threat

Steele and Aronson (1995) administered a difficult English test to Black and White college students. When the test was described as a measure of intellectual ability (stereotype threat condition), Blacks performed worse than Whites. However, when it was not associated with ability (nonstereotype threat condition), no significant racial differences were found. How are these findings consistent with the stereotype threat hypothesis?

consistent with the stereotype threat hypothesis. However, when it was not associated with ability, no significant racial differences were found.

One common reaction in academic settings is for those affected by stereotype threat to *disidentify* with the activity that is the source of the threat, namely, academic achievement. That is, you change your self-concept so that academic achievement is no longer very important to your self-esteem (Steele, 1992, 1997). This sort of academic disidentification is much more common among African American and other involuntary minority students than among White American and voluntary minority students (Ambady et al., 2001; Major et al., 1998). Although such disidentification protects self-esteem and is a coping response to racial prejudice and discrimination, it also is one of the psychological factors that undermines involuntary minority students' school achievement.

Academic disidentification resulting from stereotype threat also occurs among lower-class Whites and among female students of all races and ethnic categories who are in male-dominated majors, such as engineering and chemistry. For example, Steven Spencer and his colleagues (1999) found that women performed as well as men on a difficult English test where they suffered no social stigma, but women underachieved relative to men on a comparably difficult math test where they were more vulnerable to suspicions of intellectual inferiority. In a follow-up to this study, the researchers gave female and male college students a difficult math test but divided it into two halves and presented it as two distinct tests. Half the students were told that the first test was one on which men outperformed women and that the second test was one on which there were no gender differences. The other students were told the opposite—test one was described as exhibiting no gender differences, but men outperformed women on test two. Consistent with the stereotype threat hypothesis, when told that the test yielded gender differences, women performed significantly worse than men. However, when the test was described as not exhibiting any gender differences, women and men performed at the same level. This dramatic change occurred even though the two tests were the same! Similar to African American students' disidentification process described earlier, women are most likely to disidentify with math and math-related careers where negative gender stereotypes are salient (Spencer et al., 1999).



Journey of Discovery

Stereotype threat in academia can also occur among members of privileged groups, such as White middle-class men. Can you guess what ethnic group might cause White middle-class men to experience stereotype threat in academia?

Considered together, these studies inform us that negative stereotypes can create damaging self-fulfilling prophecies among members of many different social groups by inducing stereotype threat. Further, these findings raise the very real possibility that stereotype threat may partly explain both the racial differences found in intelligence testing and the gender differences found in advanced-math testing (refer back to Section 8.4c).

Valuing Academic Achievement

Thus far, we have examined cultural and social psychological factors that might depress IQ scores among selective racial and ethnic groups. Yet, why do elementary school children in Taiwan and Japan outscore American children by about 15 points (roughly one standard deviation) in math ability, and to a lesser extent, in reading skills? Interviews with the parents of these children conducted by Harold Stevenson and his coworkers (1986) found that the Chinese and Japanese parents downplayed the importance of innate intellectual ability and stressed, instead, hard work. They also considered doing well in school to be the *most important* goal for their children. In contrast, the American parents were more likely to believe that intelligence is genetically determined, and they designated academic achievement as a much lower-valued goal for their children. Follow-up studies found that the achievement differences between these Asian and American children persisted through high school (Stevenson et al., 1993). Overall, this research suggests that intellectual growth is nurtured when parents and the larger culture stress the value of education and the importance of working hard to achieve intellectual mastery (Deslandes & Bertrand, 2005; Li, 2004). In contrast, intellectual growth is stunted when cultural beliefs impress upon the child that his or her own academic success is either unlikely (due to negative cultural stereotypes) or not highly valued (due to it being incompatible with more important cultural values).

8.4e Intellectual Ability Is Shaped by Self-Fulfilling Prophecies.

In 1948, the sociologist Robert Merton introduced the concept of the **self-fulfilling prophecy** to describe a situation in which someone's expectations about a person or group actually lead to the fulfillment of those expectations. As illustrated in Figure 8-17, the self-fulfilling prophecy involves a three-step process. First, the perceiver (the "prophet") forms an impression of the target person. Second, the perceiver acts toward the target person in a manner consistent with this first impression. Third, in response, the target person's behavior changes to correspond to the perceiver's actions. Research indicates that behavior changes due to self-fulfilling prophecies can be permanent and can markedly change the course of an individual's life (Smith et al., 1999). How might self-fulfilling prophecies influence the development—for better or worse—of children's intellectual abilities?

Self-fulfilling prophecy The process by which someone's expectations about a person or group lead to the fulfillment of those expectations

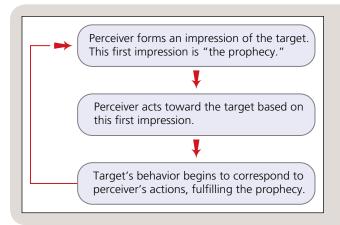


FIGURE 8-17

The Development of a Self-Fulfilling Prophecy

Self-fulfilling prophecies often involve three stages, or steps. In step 1, the perceiver forms an impression of the target. In step 2, the perceiver behaves in a manner consistent with this first impression. In step 3, the target responds to the perceiver's actions in a way that confirms the perceiver's initial impression.

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Academic Achievement and the Self-Fulfilling Prophecy

Robert Rosenthal and Lenore Jacobson (1968) explored this very question by studying the academic achievement of elementary schoolchildren. Rosenthal and Jacobson first gave IQ tests to first- and second-grade children at the school and then told their teachers that the tests identified certain students as "potential bloomers" who should experience substantial IQ gains during the remaining school year. In reality, the children identified as potential bloomers had simply been randomly selected by the researchers and did not differ intellectually from their classmates. Eight months later, when the students were again tested, the potential bloomers not only exhibited improved schoolwork but also showed higher gains in their IQ scores than those who had not been identified as bloomers. Additional research indicates that teachers treat students who are positively labeled in this manner differently from others in the following ways (Jussim, 1989; Meichenbaum & Turk, 1976):

- Teachers create a warmer socioemotional climate for gifted students.
- Teachers provide gifted students with more feedback on their academic performance.
- Teachers challenge gifted students with more difficult material.
- Teachers provide gifted students with a *greater opportunity to respond* to material presented in class.

Treated in this favorable manner, positively labeled students are likely to assume either that the teacher especially likes them and has good judgment or that the teacher is a likable person. Whichever attribution is made, the positively labeled students work harder and begin thinking of themselves as high achievers. Through this behavioral and self-concept change, the prophecy is fulfilled.

Unfortunately, self-fulfilling prophecies can also cause some students' academic potential to be destroyed by negative expectations. Teachers and fellow students often treat children labeled as "troubled" or "intellectually inferior" in a way that reinforces the negative label so it is more likely to be internalized. In educational settings, this form of self-fulfilling prophecy is all too common, and over time it leads to negative self-beliefs and low self-esteem among those targeted students. The children most likely to be identified early as problem students are those from involuntary minority groups. Although similar negative expectations also occur for certain White children and those from voluntary minorities, they are more the exception than the rule. The resulting differences in how these students are treated may be small and subtle, but their cumulative effects can be profound.

Can Your Beliefs About Intelligence Affect Your Intellectual Potential?

Besides others' expectations either enhancing or diminishing our intellectual potential, research also suggests that our beliefs about intelligence itself can have similar effects. Carol Dweck (2002, 2006) identifies people who believe that intelligence is basically fixed at birth as *entity theorists*. These persons believe that life experiences cannot substantially change inborn intelligence. In contrast, Dweck identifies people who believe that intelligence is flexible and malleable as *incremental theorists*. These individuals believe that life experiences can substantially alter inborn intelligence. Dweck's research finds that entity theorists' beliefs about intelligence can handicap them in their academic pursuits.

After performing poorly on an intellectual task, entity theorists are more likely than incremental theorists to lose their motivation and give up; and they are less

likely to learn from their mistakes. Incremental theorists respond very differently to academic setbacks. Believing that intelligence is malleable, they tend to work harder after failure and seek to learn from their mistakes. Achieving success after failure increases their motivation to learn new material that will make success even likelier in the future.

How might thinking of intelligence as flexible and malleable counter the negative effects of stereotype threat previously discussed in Section 8.4d? Joshua Aronson and his colleagues (2002) explored this question by teaching African American and European American college students to think of intelligence as changeable, rather than fixed. Compared to students in a control condition who did not receive this information, students in the "incremental theory" condition significantly improved their grade point averages and also more strongly believed that academic achievement was personally important. Further, the African American students benefited more from learning about the malleable nature of intelligence than did the European American students, suggesting that this intervention reduced their stereotype threat. In other words, realizing that their intellectual ability and potential could be improved through hard work might have been a potent stereotype antidote for Black students who have historically been the targets of negative stereotypes alleging limited inborn intelligence. Subsequent longitudinal studies have replicated these findings among middle-school students (Blackwell et al., 2007). Overall, this research identifies a very cost-effective method for improving students' academic motivation and achievement. In a very real sense, reteaching students to think of intelligence as being malleable and changeable is another example of the self-fulfilling prophecy.





- Intelligence is partly based on neural complexity, quickness, and efficiency.
- Seventy-five percent of intellectual disability cases result from a harmful environment or subtle physiological effects; 25 percent are linked to organic causes.
- Gifted students are less likely to be social misfits than the nongifted.
- Twin and adoption studies indicate substantial hereditary contribution to individual intelligence but also significant environmental influences.
- Females perform better on verbal aptitude tests, and males do better on visual-spatial tests.
- Little scientific evidence exists to support hereditary explanations of racial differences in IQ scores.
- In cultures throughout the world, involuntary minority groups score lower on IQ tests than do voluntary minority groups.
- Racially based IQ differences are most likely due to environmental factors such as unequal economic and educational conditions, differing cultural values surrounding education, and negative effects of racial stereotypes on minority students' self-confidence.
- Self-fulfilling prophecies can enhance or diminish intellectual ability.
- Thinking of intelligence as being malleable can short-circuit stereotype threats related to intellectual achievement.



How Can You "Create" a Creative Environment?

Creativity is the ability to produce novel, high-quality products or ideas (Glaveanu, 2012; Stokes, 2006). In trying to understand the creative process, psychologists have distinguished between two types of thinking: *convergent thinking* and *divergent thinking* (Guilford, 1959). **Convergent thinking** involves applying logic and conventional knowledge to

arrive at (or converge upon) a single solution to a problem. Most formal education emphasizes this type of thinking. For example, when teachers ask students to solve a math problem, they encourage the students to focus on one particular approach and work through a series of steps until they find the "right" answer. Traditional IQ tests primarily require the use of convergent thinking. In contrast, divergent thinking involves pursuing many different and often unconventional paths to generate many different solutions to a problem (Plucker et al., 2011). When engaged in this type of thinking, you often are moving away (or diverging) from the problem and considering it from a variety of perspectives. Groups searching for new directions and novel ideas may sometimes encourage their members to engage in divergent thinking during brainstorming sessions (Kurtzberg & Amabile, 2001). In these sessions, members are instructed to say the first thing that comes to mind without worrying about its logic or social acceptability. The goal in brainstorming is to generate as many different ideas as possible to help the group meet existing challenges. Unfortunately, one of the biggest obstacles to success in such brainstorming sessions is that members often censor their own creative ideas out of concern for how other group members might respond (Boddy, 2012).

Creativity The ability to produce novel, high-quality products or ideas

Convergent thinking

Applying logic and conventional knowledge to arrive at (or converge upon) a single solution to a problem

Divergent thinking Pursuing many different and often unconventional paths to generate many different solutions to a problem

Psychologists have traditionally considered divergent thinking to be a more important ingredient in creativity than convergent thinking because people who are divergent thinkers are more likely to break out of mental sets that hinder the adoption of new ideas (see Section 8.2c). However, it is also true that successful completion of a creative project often requires frequent convergent thought as well as divergent thought. Overall, despite the contribution of convergent thinking to creative endeavors, creativity tests generally contain items that emphasize divergent thinking (Diakidoy & Spanoudis, 2002). For example, test takers might be asked to list as many white, edible things as they can think of in three minutes, or to list all the uses they can think of for a brick. Responses to such items are scored in terms of the number of unique or novel ideas generated, with higher scores indicating higher levels of creativity. Creativity is also measured by asking people to generate a creative product—a poem, a story, a drawing, or perhaps a photo—which judges then rate. Despite the obvious subjectivity of such creativity ratings, the agreement level among judges is quite high (Amabile, 1996). To give you some idea of how judges might rate the creativity of such projects, examine the two photos in Figure 8-18. How would you rate each photo's level of creativity? What criteria are you using in making your judgments? Is one photo more creative than the other?

Most creative people have an intermediate level of education—enough formal schooling to have learned the necessary skills to generate creative products, but not so much formal education as to stifle the creative spirit (Simonton, 2000). During the early stages of their careers, creative people tend to rely heavily on a few close friends for advice and encouragement. However, their intense devotion to work often causes strained relationships with other people (Gardner, 1993).

Does Culture Shape Creative Expression?

Cultural values often channel creative energy into specific fields (Chiu & Kwan, 2010; Simonton & Ting, 2010). When a culture values a particular form of creative expression, it teaches its children how to express themselves in this manner. For example, the birth of the Renaissance—a period of immense artistic creativity at the beginning of the fifteenth century in Florence, Italy—was made possible due to the generous support of artists by the entire population, especially those who had wealth and power. Cultures can also restrict creativity. In the Omaha Indian culture, for instance, there is only one way to sing a song; and if anyone deviates from that format, ritual weeping occurs (Colligan, 1983). As you might guess, this response is an effective way to prevent people from taking "creative liberties" with music. A similar social norm prevents singers in the United States from engaging in too much creative expression when performing "The Star-Spangled Banner."

What is considered "creative" is also shaped by culture. An important feature of creativity in Western cultures is producing an observable product. In contrast, the Eastern view of creativity is less product-focused and more related to personal fulfillment or the expression of an inner sense of ultimate reality (Kuo, 1996). In Hinduism, creativity is thought of as entailing spiritual or religious expression rather than as providing an innovative solution to a problem (Aron & Aron, 1982). This Eastern sense of creativity has a great deal to do with what humanistic psychologists in the West refer to as self-actualization, or the process of achieving one's full potential (see Chapter 9, Section 9.1f).



How Creative Are These Photos?

The assignment here was to take a photo in which a common hair clip was the subject of focus. No other instructions were given to the participants. Using the scale provided below the photos, rate the creativity of each photo and then ask others to do so as well. Is there agreement on which photo is more creative? What criteria did you and others use in making your judgments?

Another distinction between Western and Eastern views of creativity is the way creativity is related to traditional views. The Western approach to creativity typically involves a break with tradition. This is consistent with the Western philosophy of individualism, which values nonconformity and the expression of ideas that run counter to the group. In contrast, the Eastern approach to creativity is more likely to involve the *reinterpretation* of traditional ideas so that traditional truths come alive and become revitalized in daily activities. This conception of creativity is consistent with the Eastern philosophy of collectivism, which values conformity and the upholding of traditional values and beliefs.

As you can see, culture has an important influence on the nature of creativity, in both how it is defined and how it is channeled. You may be born with a certain degree of creative potential, but how that potential develops and is later expressed will be significantly shaped by your social reality. Yet in most cultures, creative individuals tend to share the following characteristics (Simonton, 2011):

- They have wide interests.
- They like to work hard.
- They are open to new experiences.
- They are risk takers.
- They have at least moderate intelligence.
- They are willing to tolerate rejection.

Do you remember Jasper Fforde, the best-selling author of the *Thursday Next* book series highlighted at the beginning of this chapter? Fforde embodies many of these characteristics. Although he was recognized as an intelligent child, young Fforde was disinterested in traditional schooling and thrived academically only after his parents placed him in a school with a more progressive attitude toward learning. In adulthood, Fforde pursued a wide variety of interests, including working at odd jobs, like being a cameraman in the movie industry, and flying vintage airplanes. Even during the years in which publishing houses repeatedly rejected his manuscripts, he continued to hone his skills after completing his regular workday.

Fostering Creativity

Beyond possessing important personal characteristics, to be creative you need to have a lot of things go your way (Sternberg & Lubart, 1996). For example, many highly creative artists' talents go unrecognized because their works remain obscure, through no fault of their own. In Fforde's case, his first *Thursday Next* book was never even recognized by his own literary agent as anything special until the agent was so desperate for material that he read the whole thing. This makes it sound

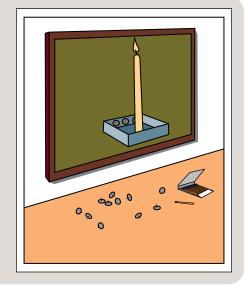
like creativity is a fragile and illusive form of intelligence, but it's not. Creativity experts contend that you have the power to construct the necessary conditions that foster creative accomplishments. They recommend the following six steps to increase your own creativity. Accompanying each recommendation is a qualification concerning its limits.

- Redefine problems. As discussed in Section 8.2c, a number of cognitive tendencies act as barriers to problem solving. Although certain thinking strategies may have effectively solved problems for us in the past, creative solutions often require us to look "through" and "around" problems rather than directly at them. Warning: Don't feel that you must "reinvent the wheel" for every new problem. Often, tried-and-true problem-solving strategies are the best tools for creative products.
- Make a habit out of questioning tradition. Since childhood, we have been rewarded for conforming to the way other people think and act. Such conformity is often necessary for a society to properly function, but it does not provide a fertile environment for creative ideas. One of the defining characteristics of creative people is that they regularly question traditional ways of thinking and behaving. Warning: Defying tradition simply because it brings you attention is not the purpose of this exercise!
- Find something you love to do. Creative people, whether they are children or adults, are motivated primarily by the enjoyment, challenge, and satisfaction they derive from working on their projects, rather than from the external rewards they receive. Warning: Being rewarded for doing things you naturally enjoy can undermine your enjoyment of those activities (see the discussion on intrinsic motivation in Chapter 9, Section 9.1e).
- Become an expert in your area of interest. Case studies of 120 creative people from diverse professions found that high-quality training preceded great accomplishments (Bloom, 1985). This research suggests that you will have a much better chance of being a creative success if you have developed a good base of knowledge in your chosen interest area. By tapping your accumulated learning, you will be able to generate more ideas and make more mental connections that will ultimately lead to creative problem solving. Warning: Don't feel you need to know everything about your area of interest before you can make a creative contribution to it.
- Tolerate ambiguity and take sensible risks. Because creative ideas run against the grain of everyday thinking and often do not fit neatly into clearly defined categories, you must have sufficient confidence in your ideas so that you are not easily discouraged when others don't understand or accept what you have to offer. Warning: Do not totally ignore feedback from others because you can profit from others' advice.
- Choose friends and associates who will support your creative endeavors. Analysis of the lives of over 2,000 successful scientists and inventors found that the most creative individuals were not isolated geniuses. Rather, they had high emotional intelligence and surrounded themselves with people who encouraged them in their work (Simonton, 1992). Warning: Do not surround yourself with "yes people" who will agree with anything you say. Blind conformity does not foster a creative environment.

FIGURE 8-4b

Solution to The Candle Problem

The solution to The Candle Problem in Figure 8-4a (page 345) relies on realizing that the box is not just a container for the tacks, but can itself be used as part of the solution.



Suggested Websites

The Psychology of Language Page

http://www.duke.edu/~pk10/language/psych.htm

This website discusses the controversy concerning "nature versus nurture" explanations for language development.

Center for the Study of Language and Information (CSLI)

http://www-csli.stanford.edu

This website is the home page for CSLI, an independent research center at Stanford University.

History of Influences in the Development of Intelligence Theory and Testing

http://www.indiana.edu/~intell/map.shtml

This website discusses the history of intelligence testing and theory development.

Multiple Intelligences

http://www.thomasarmstrong.com/multiple_intelligences.htm

This website outlines Gardner's theory of multiple intelligences and how it might apply in educational settings.

IQ Tests

http://www.2h.com/iq-tests.html

This website contains a number of intelligence tests and brainteasers.

Key Terms

Achievement test, 353 Algorithm, 342 Aptitude test, 353 Availability heuristic, 348 Categorization, 341 Child-directed speech, 338 Cognition, 341 Communication, 330 Concept, 341 Confirmation bias, 344 Content validity, 358 Convergent thinking, 384 Creativity, 384 Divergent thinking, 384 Down syndrome, 369 Emotional intelligence, 365 Eugenics, 351 Factor analysis, 360 Flynn effect, 356 Functional fixedness, 347 General intelligence factor

(g-factor), 361

Heritability coefficient, 371 Heuristic, 343 Insight, 343 Intellectual disability, 369 Intelligence quotient (IO), 353 Intelligence, 351 Language acquisition device, 335 Language, 330 Linguistic relativism, 339 Mental set, 345 Morphemes, 336 Multiple intelligences, 362 Need for cognition, 350 Normal distribution, 356 Phonemes, 336 Predictive validity, 358 Problem solving, 342 Prodigies, 363 Prototype, 342 Psychometrics, 351

Generic masculine, 339

Reaction range, 373 Reliability, 357 Representativeness heuristic, 348 Savant, 363 Self-fulfilling prophecy, 381 Speech, 330 Standardization, 356 Stanford-Binet Intelligence Test, 353 Stereotype threat, 379 Telegraphic speech, 337 Trial an error, 342 Triarchic theory of intelligence, 364 Validity, 358 Wechsler Intelligence Scales, 354

Review Questions

- The content and comprehension of language is associated with which area?
 - Broca's area
 - the right cerebral hemisphere
 - Wernicke's area
 - d. the larynx
 - the location of the hippocampus
- A weaker version of Whorf's linguistic relativity hypothesis is supported by which of the following?
 - research showing that bilinguists focus on personal needs when speaking English and social needs when speaking Japanese
 - Rosch's research on cross-cultural color perception, showing that the Dani people have only two words for color
 - research showing that the structure of language determines the structure of thought
 - the finding that Chinese languages have many self-focused words
 - research showing that language does not influence thinking in collectivist cultures
- The way language calls attention to an individual's gender, and the use of generic masculine pronouns and nouns support which of the following notions?
 - Language determines thought.
 - Cultural thinking can influence people's style of
 - Gender-neutral language erases females from our thinking.
 - Collectivist cultures exhibit more gender bias than individualist cultures.
 - Language influences thought.
- Categorizing, or forming concepts, is accomplished by which of the following?
 - identifying features that define all members of a concept
 - learning specific concept formation rules
 - learning the fixed boundaries between objects' properties
 - identifying features that define typical members of a concept
 - learning the specific rules that define the meaning of fuzzy boundaries

- 5. Which of the following is true about trial-anderror problem-solving strategies?
 - They guarantee success because you can keep guessing until you get it right.
 - They are faster and more efficient than using complex algorithms.
 - They are slower than heuristic strategies.
 - d. They follow a systematic and methodical step-by-step procedure.
 - e. They involve a gradually increasing focus on concepts important to the solution.
- Confirmation bias leads to problem-solving errors
 - because we seek only information that confirms our beliefs
 - only when we waste time testing alternative hypotheses rather than seeking confirming evidence
 - only when we pursue information that disconfirms our beliefs
 - when we fail to rely on solutions that worked in
 - because we tend to confirm what experts tell us
- Research on decision-making strategies and shortcuts indicates which of the following?
 - Representative heuristics are the best way to eliminate the base-rate fallacy.
 - Only people with a low need for cognition take Ь. shortcuts in their decision making strategies.
 - A useful decision-making strategy that can narrow our choices is to rely on the ease with which previous examples of an event are recalled.
 - Heuristics are complex cognitive processes used primarily by those with a high need for
 - Heuristics are used more frequently when we are in a hurry than when we have time to think about our choices.

- 8. Intelligence has been assessed or scored in a variety of ways since Galton's measures of sensory abilities and head size. Most intelligence tests today rely on a scoring method known as _____.
 - a. ratio IQ
 - b. deviation IQ
 - c. an intelligence quotient
 - d. mental age/chronological age (x 100)
 - e. verbal IO
- 9. Standardization, or establishing rigid test administration and interpretation procedures, typically results in which of the following?
 - a. a reliable test
 - b. a standard test
 - c. a valid test
 - d. a normal distribution of scores
 - e. the Flynn effect
- 10. Research investigating the nature of intelligence has supported all except which of the following
 - a. Intelligence consists of a single general factor, referred to as g.
 - b. Intelligence consists of several specific factors.
 - c. The same areas of the frontal cortex "light up" for different intellectual tasks.
 - d. Seven clusters of primary mental abilities are needed to explain intelligence.
 - e. Factor analysis consistently indicates five factors of intelligence.
- 11. Which of the following is true of research evidence for multiple intelligences?
 - a. It is lacking.
 - b. It is provided by the existence of savants.
 - c. It is negated by the existence of prodigies.
 - d. It contradicts Thurstone's approach to understanding intelligence.
 - e. It has shown that athletic ability is not a talent but a specific type of intelligence.

- 12. According to Sternberg's triarchic theory of intelligence, which of the following is true?
 - a. Creative intelligence is the type valued in academic settings.
 - b. Practical intelligence is superior to creative intelligence.
 - Intelligence is defined by how skilled an individual is in all three aspects of intelligence.
 - d. Successful intelligence is knowing how and when to use analytical, creative, and practical intelligence.
 - e. Analytical intelligence is related to nonconformity, risk-taking, and openness to new experiences.
- 13. An individual with high emotional intelligence would likely exhibit all except which of the following?
 - a. an ability to read their own emotions, but not others' emotions
 - b. a tendency to finish rewarding tasks
 - c. an ability to discriminate between different feelings
 - d. success in their career
 - e. reliance on their emotions to guide their thinking and actions.
- 14. Research by neuroscientists on the relationship between intelligence and the brain has shown which of the following?
 - a. The strong relationship between head size and intelligence supports Galton's views.
 - b. Women have more neurons than men, on average.
 - c. Larger brains may be associated with higher intelligence because they have more myelin.
 - d. There is no relationship between intelligence and mental quickness.
 - e. the brains of more intelligent people use more glucose, explaining their intelligence and the larger size of their brains.

- 15. Research on intelligence has relied extensively on twin and adoption studies, which have indicated which of the following?
 - Identical twins raised apart have similar IQ correlations to fraternal twins raised together.
 - Reaction range refers to the range of similarity in twins' IQ scores.
 - Prenatal environmental factors have been discounted as a source of IO differences among twins.
 - d. Heredity has a slightly larger effect on intelligence than environment.
 - Adopted infants' IQ scores are more similar to their adopted parents' IQ scores than to their biological parents' IO scores.
- 16. Research on group differences in intelligence has indicated which of the following?
 - It is highly unlikely that Black-White IQ score differences are due to genetic differences.
 - b. Gender differences in math abilities have been growing larger.
 - Gender socialization of boys and girls fully explains differences in verbal and spatial abilities.
 - d. Individual abilities can be predicted by examining group differences in ability.
 - The strong correlation between IQ and racial ancestry supports Jensen's view of racial differences in intelligence.

- 17. Developing an oppositional ethnic identity may do what?
 - eliminate the constriction of personal identity
 - help explain racial and ethnic differences in IQ
 - expose the individual to increased negative c. effects of social injustice
 - cause a loss of self-esteem
 - e. lead Blacks to identify with White cultural values, thus increasing their IQ scores