Genetic and Environmental Influences on IQ

9.7 Explain how genetic influences can be determined from family, twin, and adoption studies.

9.8 Identify potential environmental influences on IQ.

Up to this point, we've talked at length about what intelligence is and how we measure it. But we've said little about its causes or about the relative roles of nature and nurture in its development. Over the past few decades, psychologists have obtained a better handle on the genetic and environmental contributors to IQ. As we'll discover, however, significant flash points of controversy remain.

Explore in **MyPsychLab** the **Concept:** Factors Affecting Intelligence

Twin studies of intelligence typically compare the mental performance of identical (*top*) versus fraternal (*bottom*) twins.

Explore in **MyPsychLab** the **Concept:** Correlations Between IQ Scores of Persons of Varying Relationships

Exploring Genetic Influences on IQ

As we learned in Chapter 3, scientists can study genetic influences on psychological characteristics in three major ways: family studies, twin studies, and adoption studies. They've done so for intelligence, with surprisingly consistent results.

FAMILY STUDIES. As we saw in Chapter 3, *family studies* allow us to determine the extent to which a trait "runs" or goes together in intact families, those in which all family members live in the same home. Sir Francis Galton, who coined the phrase *nature and nurture* (Galton, 1876), conducted one of the first family studies of intelligence. He gathered data on the extent to which persons renowned for their intellectual accomplishments had biological relatives who were also renowned for their intellectual accomplishments. He found that the proportion of relatives who'd achieved intellectual greatness declined steadily with increasing biological distance. Intellectually brilliant individuals had many first-degree relatives (parents, siblings, and children) who were also brilliant, but fewer second-degree relatives (such as cousins) and still fewer third-degree relatives (such as second cousins) who were brilliant. Later studies have confirmed that IQ runs in families: The correlation of IQ for brothers and sisters raised in the same family is about .45, whereas for cousins it's about .15 (Bouchard & McGue, 1981; Plomin & Petrill, 1997). Galton (1869) concluded that these findings demonstrated a genetic basis to intellectual greatness, but he overlooked a crucial limitation that applies to all family studies: *Studies of intact families don't allow us to distinguish the effects of genes from those of the environment.* As a consequence, when a trait runs in families, we don't know whether it's for genetic reasons, environmental reasons, or a mix of both (see Chapter 3).

TWIN STUDIES. Because family studies don't permit investigators to disentangle the effects of nature from those of nurture, they've turned to more informative research designs. These include *twin studies*, which as we've seen (Chapter 3) compare correlations in a trait in two types of twins: identical (monozygotic) and fraternal (dizygotic).

The logic of the twin design is straightforward. Because identical twins share twice as many of their genes on average as fraternal twins, we can compare the correlations in IQ in these two twin types. Given a handful of assumptions we won't bother with here, higher identical than fraternal twin correlations strongly suggest genetic influence. In almost all cases, studies of twins reared together have offered evidence of considerably higher identical than fraternal twin correlations for IQ (Bouchard & McGue, 1981; Loehlin, Willerman, & Horn, 1988; Toga & Thompson, 2005). In typical studies of IQ, identical twin correlations have been in the .7 to .8 range, whereas fraternal twin correlations have been in the .3 to .4 range. Nevertheless, in all studies of twins raised together, identical twin correlations have been considerably lower than 1.0.

These findings tell us two things. First, the higher identical than fraternal twin correlations imply that IQ is influenced by genetic factors. The best estimate for the heritability of IQ falls somewhere between 40 and 70 percent (Brody, 1992; Devlin, Daniels, & Roeder, 1997). Interestingly, the heritability of IQ seems to increase from childhood to adulthood (McClearn et al., 1997), perhaps because people become less influenced by their environments, especially their parents, as they move away from home. Although the twin findings don't tell us which genes are relevant to intelligence, the past decade has witnessed progress

in identifying specific genes for intelligence. These genes appear to cut across multiple domains of mental ability, including attention, working memory, and perhaps even risk for Alzheimer's disease (Plomin & Kovas, 2005; Posthuma & de Gues, 2006). Moreover, it's clear that intelligence isn't due to only one or even a small number of genes; instead, it appears to be tied to many genes, each exerting tiny effects on brain functioning (Davies et al., 2011). Nevertheless, although there have been numerous published findings linking specific genes to intelligence, these results haven't been consistently replicated (Chabris, 2013); as a consequence, the actual genes that predispose to intelligence are unknown.

REPLICABILITY
Can the results be duplicated in other studies?

There's one notable exception to the moderate to high heritability of IQ. Increasing evidence suggests that the heritability of IQ may be very low in individuals, especially children, at or below the poverty line (Deary, Spinath, & Bates, 2006; Nisbett et al., 2012; Rowe, Jacobson, & Van den Oord, 1999; Turkheimer et al., 2003). These findings raise the possibility that at high levels of environmental deprivation, the effects of environment on intelligence may largely swamp out the effects of genes. They also remind us that heritability isn't a fixed number, because it can be influenced by the range of environments in our sample (see Chapter 3). In this case, because people in poor neighborhoods often have restricted access to environmental resources like books and computers, there's less opportunity for them to realize their genetic potential for intelligence (Nisbett et al., 2012).

Second, twin findings provide convincing evidence for environmental influences on IQ, because the identical twin correlations for IQ are far less than perfect. Given that identical twins share 100 percent of their genes, they would correlate 1.0 if genetic influences alone were operative (assuming the IQ tests are reliable). The fact that they correlate less than 1.0 tells us that environmental influences also play a role, although the studies don't tell us what these influences are.

Thus far, we've discussed only studies of twins raised together. These studies are vulnerable to a rival hypothesis: Perhaps identical twins are more similar than fraternal twins because they spend more time together. To exclude this possibility, investigators have conducted studies of identical and fraternal twins reared apart since birth or shortly after birth. During the 1980s and 1990s, Thomas Bouchard and his colleagues at the University of Minnesota conducted the landmark study of twins reared apart. Remarkably, the results of this study revealed that a sample of over 40 identical twin pairs reared apart were just as similar on three measures of IQ (including the WAIS and Raven's Progressive Matrices) as were identical twins reared together (Bouchard et al., 1990). Other investigators have replicated these findings (Pederson et al., 1992); although because twins reared apart are extremely rare, the sample sizes of these studies are relatively low.

RULING OUT RIVAL HYPOTHESES
Have important alternative explanations for the findings been excluded?

REPLICABILITY
Can the results be duplicated in other studies?

ADOPTION STUDIES. As we've seen, studies of intact family members are limited because they can't disentangle genetic from environmental influences. To address this shortcoming, psychologists have turned to *adoption studies* (Chapter 3), which examine the extent to which children adopted into new homes resemble their adoptive versus biological parents. Adoption studies allow us to separate environmental from genetic effects on IQ, because adoptees are raised by parents with whom they share an environment but not genes. One potential confound in adoption studies is *selective placement:* Adoption agencies frequently place children in homes similar to those of the biological parents (DeFries & Plomin, 1978; Tully, Iacono, & McGue, 2008). This confound can lead investigators to mistakenly interpret the similarity between adoptive children and adoptive parents as an environmental effect. In adoption studies of IQ, researchers often try to control for selective placement by correcting statistically for the correlation in IQ between biological and adoptive parents.

Many children adopted from environments of severe deprivation, such as this orphanage in Romania, show increases in IQ after immersion in a healthier and more attentive adoptive environment.

Adoption studies have established a clear contribution of the environment in IQ. For example, adopted children who come from extremely deprived environments show an increase in IQ when adopted into homes that provide more enriched environments (Capron & Duyme, 1989). In one study of French children raised in a very poor environment, children who were adopted showed an average 16-point IQ edge over children who weren't (Schiff et al., 1982).

But do adopted children's IQs resemble their biological parents' IQs? The results of adoption studies indicate that the IQs of adopted children tend to be similar to the IQs of their biological parents, offering evidence of genetic influence. As young children, adoptees tend to resemble the adoptive parents in IQ, but this resemblance dissipates once these children become older and approach adolescence (Loehlin, Horn, & Willerman, 1989; Phillips & Fulker, 1989; Plomin et al., 1997).

Exploring Environmental Influences on IQ

So twin and adoption studies paint a consistent picture: Both genes and environment affect IQ scores. But these studies leave a mysterious question unanswered: What exactly are these environmental factors? Psychologists don't know for sure, although they've made significant inroads toward identifying promising candidates. As we'll see, environmental influences can include not only the *social* environment, such as school and parents, but also the *biological* environment, such as the availability of nutrients and exposure to toxic substances (lead, for instance). We'll also discover that the evidence for some of these environmental influences is more convincing than for others.

DOES HOW WE THINK ABOUT INTELLIGENCE AFFECT IQ? Recent research suggests that how we conceptualize intelligence may actually influence our intelligence. Carol Dweck (2002, 2006) showed that people who believe that intelligence is a fixed entity that doesn't change tend to take fewer academic risks, such as enrolling in challenging classes. According to Dweck, they think, "If I do really poorly in a class, it probably means I'm stupid, and I can't do anything about that." After failing on a problem, they tend to become discouraged and give up, probably because they assume they can't boost their intelligence. In contrast, people who believe that intelligence is a flexible process that can increase over time tend to take more academic risks; they think, "If I do really poorly in a class, I can still do better next time." They tend to persist after failing on a problem, probably because they believe that effort can pay off. As a consequence, they may perform better in the long run on challenging intellectual tasks (Salekin, Lester, & Sellers, 2012). Nevertheless, because not all researchers have found that beliefs about intelligence are associated with performance on mental tests, these claims require further investigation (Glenn, 2010).

REPLICABILITY ▶
Can the results be duplicated in other studies?

BIRTH ORDER: ARE OLDER SIBLINGS WISER? In the 1970s, Robert Zajonc (whose name, oddly enough, rhymes with *science*), created a stir by arguing that later-born children tend to be less intelligent than earlier-born children (Zajonc, 1976). According to Zajonc, IQ declines steadily with increasing numbers of children in a family. He even authored an article in the popular magazine *Psychology Today* entitled "Dumber by the Dozen" (Zajonc, 1975).

In one respect, Zajonc was right: Later-born children tend to have slightly lower IQs (on the order of a few points) than do earlier-born children (Kristensen & Bjerkedal, 2007). But it's not clear that he interpreted this correlation correctly. Here's the problem. Parents with lower IQs are slightly more likely to have many children than are parents with higher IQs. As a consequence, when we look across families, birth order is associated with IQ, but only because low-IQ families have a larger number of later-born children than do high-IQ families. In contrast, when we look *within* families, the relationship between birth order and IQ becomes smaller and may even vanish (Michalski & Shackelford, 2001; Rodgers et al., 2000). So a more accurate way to state the correlation is that children who come from larger families have slightly lower IQs than do children who come from smaller families.

DOES SCHOOLING MAKE US SMARTER? Autopsy studies show that educated people have more synapses, that is, neural connections (see Chapter 3), than do less-educated people (Orlovskaya et al., 1999). In addition, the number of years of schooling correlates between .5 and .6 with IQ scores (Neisser et al., 1996). Although some authors have interpreted this correlation as meaning that schooling leads to higher IQ and perhaps even more synapses—it's equally possible that the causal arrow is reversed. Indeed, there's evidence

CORRELATION VS. CAUSATION ▶
Can we be sure that A causes B?

that individuals with high IQ scores enjoy taking classes more than do individuals with low IQ scores (Rehberg & Rosenthal, 1978). As a consequence, they may be more likely to stay in school and go on to college and beyond. This wouldn't be terribly surprising given that individuals with high IQ scores tend to do better in their classes.

Still, several lines of evidence suggest that schooling exerts a causal influence on IQ (Ceci, 1991; Ceci & Williams, 1997; Nisbett, 2009; Nisbett et al., 2012):

1. Researchers have examined pairs of children who are almost exactly the same age, but in which one child attended an extra year of school because he or she was born just a few days earlier (say, August 31 as opposed to September 2). This can occur because public schools often have hard-and-fast cutoff dates for how old children must be to begin school. In such cases, children who've attended an extra year of school tend to have higher IQs, despite being nearly identical in chronological age.
2. Children's IQs tend to drop significantly during summer vacations.
3. Students who drop out of school end up with lower IQs than do students who stay in school, even when they start out with the same IQ.

Children's IQs tend to drop significantly during summer vacations, suggesting an environmental influence on IQ.

BOOSTING IQ BY EARLY INTERVENTION. In a controversial article in the late 1960s, psychologist Arthur Jensen contended that IQ is highly heritable and therefore difficult to modify by means of environmental intervention (Jensen, 1969). In making this argument, Jensen fell prey to a logical error we debunked earlier in this text (see Chapter 3), namely, that heritability implies that a trait can't be changed. Yet he raised an important question: Can we boost IQ with early educational interventions?

Some of the best evidence comes from studies of *Head Start,* a preschool program launched in the 1960s to give disadvantaged children a "jump start" by offering them an enriched educational experience. The hope was that this program would allow them to catch up intellectually to other children. Dozens of studies of Head Start programs have yielded consistent results, and they've been largely disappointing. Although these programs produce short-term increases in IQ (Ludwig & Phillips, 2008), these increases don't typically persist after the programs end (Caruso, Taylor, & Detterman, 1982; Royce, Darlington, & Murray, 1983). Similar results emerge from studies of other early-intervention programs (Brody, 1992; Herrnstein & Murray, 1994).

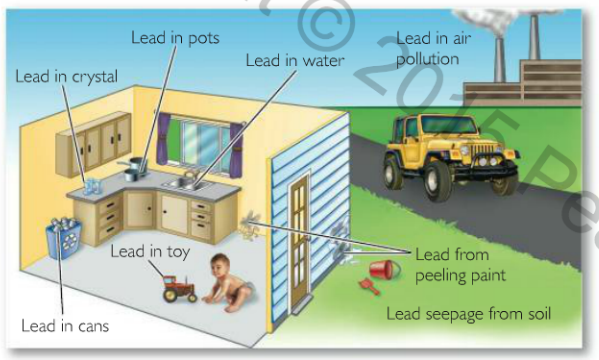
The federal Head Start program was launched in the 1960s to give disadvantaged preschoolers a jump-start on their education. Studies show that Head Start programs typically produce short-term increases in IQ but that these increases fade with time.

At the same time, these programs appear to produce lasting and at times large increases in *school achievement*, which is hardly a meaningless accomplishment. Several studies indicate that Head Start and similar early-intervention programs result in lower rates of dropping out of high school and of being held back a grade compared with control conditions (Campbell & Ramey, 1995; Darlington, 1986; Neisser et al., 1996). They may also yield higher levels of early literacy and understanding of others' emotions (Bierman et al., 2008). In addition, there's preliminary evidence that they boost certain executive functions, which as we learned in Chapter 3, include the ability to inhibit and modify one's impulses (Bierman et al., 2010).

A SELF-FULFILLING PROPHECY: EXPECTANCY EFFECTS ON IQ. In the 1960s, Robert Rosenthal and Lenore Jacobson wanted to examine the effects of teacher expectancies on IQ. As we saw in Chapter 2, the *experimenter expectancy effect* refers to the tendency of researchers to unintentionally influence the outcome of studies. In this case, Rosenthal and Jacobson (1966) looked at the expectancies of teachers rather than researchers. They administered an IQ test to students in the first through sixth grades, disguising it with a fake name ("The Harvard Test of Inflected Acquisition"). Then they gave teachers the results, which indicated that 20 percent of their students would display remarkable gains in intelligence during the subsequent eight months: These students were "bloomers" who'd soon reach their full intellectual potential. But Rosenthal and Jacobson misled the teachers. They had *randomly* assigned these 20 percent of students to be classified as bloomers, and these students' initial scores didn't differ from those of other students. Yet when Rosenthal and Jacobson retested all students a year later with the same IQ test, the 20 percent labeled as bloomers scored about four IQ points higher than the other students. Expectations had become reality.

REPLICABILITY ▶
Can the results be duplicated in other studies?

This effect has since been replicated in a number of studies, although the size of the effect is usually only modest (Rosenthal, 1994; Smith, 1980). We don't know how this effect occurs, although there's evidence that teachers more often smile at, make eye contact with, and nod their heads toward students they incorrectly believe are smart compared with other students (Chaiken, Sigler, & Derlega, 1974). As a consequence, they may positively reinforce (see Chapter 6) these students' learning. Still, the effects of expectancy on IQ have their limits. These effects are substantial only when teachers don't know their students well; when teachers have worked with students for at least a few weeks, the effects often disappear (Raudenbush, 1984). Once teachers form definite impressions of how smart their students are, it's hard to persuade them that their impressions are off base.



Lead exposure can arise from many sources in everyday life and may contribute to decreased IQ. Nevertheless, the causal association between lead intake and IQ remains controversial.

POVERTY AND IQ: SOCIOECONOMIC AND NUTRITIONAL DEPRIVATION. It's difficult to put a firm number on the effects of poverty, but there's reason to believe that social and economic deprivation can adversely affect IQ. Arthur Jensen (1977) studied a group of families in an extremely poor area of rural Georgia. For African-American (but not Caucasian) children, he found evidence for cumulative declines, that is, differences that increase over time. Older siblings consistently had lower IQs than did younger siblings, with a steady decrease of about 1.5 IQ points per year. Jensen's explanation was that siblings in this impoverished region experienced progressively more intellectual deprivation as they aged, leading them to fall further behind other children (Willerman, 1979). Moreover, because the environments of African-American children were even more impoverished than those of white children, the former children may have been especially likely to suffer this ill effect.

Along with poverty often comes inadequate diet. Studies from poor areas in Central America suggest that malnutrition in childhood, especially if prolonged, can lower IQ (Eysenck & Schoenthaler, 1997). In one investigation, researchers gave nutritional (protein) supplements to preschool children from an impoverished region of Guatemala. These children's school-related test scores were significantly higher than those of similar children who didn't receive supplements (Pollitt et al., 1993). The intake of high-fat and high-sugar foods in childhood is also linked to slightly lower IQ scores several years later, although these data are only correlational (Northstone et al., 2010) and could be due to unmeasured factors, like the extent to which parents play an active role in their children's upbringing. Poor children are also especially likely to be exposed to lead as a result of drinking lead-contaminated water, breathing lead-contaminated dust, or eating lead paint chips. Such exposure is also associated with intellectual deficits (Bellinger & Needleman, 2003; Canfield et al., 2003; Ris et al., 2004). Nevertheless, it's again unclear how much of this association is due to the direct effects of lead itself as opposed to poverty or other factors like malnutrition.

RULING OUT RIVAL HYPOTHESES ▶
Have important alternative explanations for the findings been excluded?

RULING OUT RIVAL HYPOTHESES ▶
Have important alternative explanations for the findings been excluded?

Scientific controversy has swirled around another potential nutritional influence: breast-feeding. On one side of the debate are researchers who claim that infants who are breast-fed end up with higher IQs—perhaps on the order of a few points—than are children who are bottle-fed (Mortensen et al., 2002; Quinn et al., 2001). Indeed, mothers' milk contains about 100 ingredients absent from milk formula, including several that speed up the myelinization of neurons (see Chapter 3). On the other side are researchers who contend that this IQ difference is due to one or more confounds: For example, mothers who breast-feed their babies tend to be somewhat higher in social class and IQ than are mothers who bottle-feed their babies (Der, Batty, & Deary, 2006; Jacobson, Chiodo, & Jacobson, 1999). These confounds could account for the seeming effect of breast-feeding on IQ. The debate rages on (Caspi et al., 2007).

GETTING SMARTER ALL THE TIME: THE MYSTERIOUS FLYNN EFFECT. In the 1980s, political scientist James Flynn noticed something decidedly odd (Dickens & Flynn, 2001; Flynn, 1981, 1987). Over time, the average IQ of the population was rising at a rate of about

three points per decade, a phenomenon now known as the **Flynn effect** (Herrnstein & Murray, 1994; Nisbett et al., 2012). The magnitude of the Flynn effect is mind-boggling. It suggests that, on average, our IQs are a full 10 to 15 points higher than those of our grandparents (see **FIGURE 9.12**). It also appears to be occurring across much of the world, including the United States, Europe, and South American (Colom, Flores-Mendoza, & Abad, 2007). With a few exceptions (Mingroni, 2007; Rushton, 1999), most researchers agree that this effect is a result of unidentified environmental influences on IQ, because it's unlikely that genetic changes could account for such rapid rises in IQ over brief time periods.

What could these environmental influences be? Psychologists have proposed at least four explanations:

1. **Increased test sophistication.** According to this explanation, the rise in IQ scores results not from people becoming smarter, but from people becoming more experienced at taking tests (Flynn, 1998). There may be some truth to the test sophistication hypothesis, but there's a "fly in the ointment." The Flynn effect is most pronounced on "culture-fair" tests, such as Raven's Progressive Matrices, to which people have had the least exposure (Brouwers, Van de Vijver, & Van Hemert, 2009; Neisser, 1998).
2. **Increased complexity of the modern world.** With television, email, the Internet, Twitter, iPhones, and the like, we're forced to process far more information far more quickly than our parents and grandparents ever did. Modern schooling is also placing more emphasis on abstract reasoning, especially reasoning that involves geometrical objects, which play a starring role in many IQ tests (Blair et al., 2005). So the modern information explosion may be putting pressure on us to become more intelligent—or at least more adept at processing information rapidly (Greenfield, 1998; Schooler, 1998).

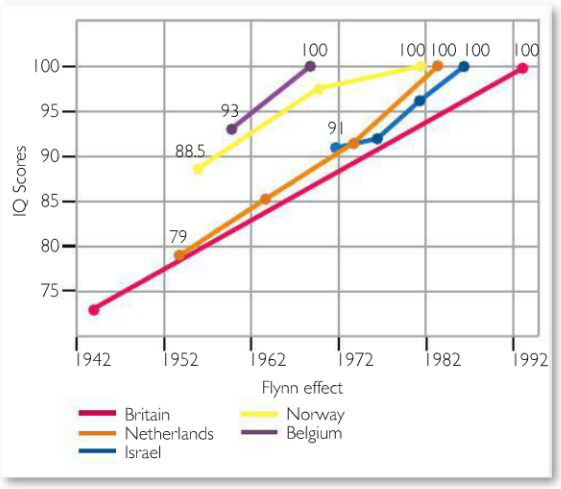


FIGURE 9.12 Flynn Effect. Research on the Flynn effect demonstrates that IQ scores have been increasing in many countries across several decades. The causes of this effect remain unclear. (*Source:* Flynn, 1999)

Flynn effect
finding that average IQ scores have been rising at a rate of approximately three points per decade

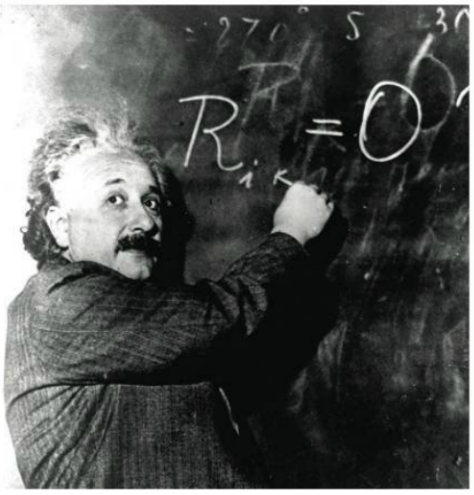
Answers are located at the end of the text.

IQ BOOSTERS evaluating CLAIMS

A wide variety of books and websites claim to increase your IQ in a matter of days—some by as much as 200 points! Let's evaluate some of these claims, which are modeled after actual ads for products designed to increase your IQ.

"While the *'experts' argue* about whether you can increase IQ or not, we promise real results!"

A warning sign of pseudoscience is the absence of connectivity to other research. This claim implies that the test developers can simply ignore what others have tried before—possible, but unlikely.



"Credibly *synthesize process-centric quantum wave* outsourcing."

Beware of psychobabble; this claim sounds sophisticated but has little or no scientific meaning.

"*Become a genius* in 5 simple steps."

Does this claim seem plausible given what you know about the probable reaction range (see Chapter 3) of intelligence? What kind of evidence would you need to support it?

"Take our IQ test and *expose your true creativity*."

This claim implies that intelligence and creativity are similar if not identical. What does the scientific research say (see p. 356)?

As can be seen in the sizes of these men and their uniforms, most people are considerably larger today than they were in the era of the U.S. Civil War (1861–1865). That difference reflects dramatic differences in nutrition over the past 150 years. Some psychologists propose that enhanced nutrition may account for the Flynn effect.

3. **Better nutrition.** Most evidence suggests that the Flynn effect is affecting primarily the lower, but not the upper, tail of the bell curve. One potential explanation for this finding is diet. People are better fed than ever before, and the rates of severe malnutrition in many (although not all) parts of the world are declining (Lynn, 1998; Sigman & Whaley, 1998). As we've already learned, there's good evidence that nutrition can affect IQ.
4. **Changes at home and school.** Over the past several decades in the United States, families have become smaller, allowing parents to devote more time to their children. Parents also have more access to intellectual resources than ever. In addition, children and adolescents spend more years in school than in previous generations (Bronfenbrenner et al., 1996).

We don't fully understand the causes of the Flynn effect, and there may be some truth to several of these explanations. But the mystery doesn't end here. Recent data suggest that the Flynn effect may be subsiding or even reversing, at least in Europe (Sundet, Barlaug, & Torjussen, 2004; Teasdale & Owen, 2008). Some investigators have suggested that children's decreasing amounts of play with other children, perhaps resulting from greater computer and video game use, may be the culprit (Schneider, 2006), but no one knows for sure. The causes of the apparent end to the Flynn effect are as puzzling as the causes of its beginning.

Study and Review in MyPsychLab

Assess Your Knowledge FACT or FICTION?

1. Identical twins reared apart appear to be about as similar on IQ tests as identical twins reared together. **True / False**
2. Children adopted at birth bear almost no resemblance in IQ to their biological parents. **True / False**
3. There's good evidence that being removed from school can lower IQ scores. **True / False**
4. Head Start programs produce lasting increases in IQ scores. **True / False**
5. People's average performance on IQ tests has remained virtually unchanged over the past several decades. **True / False**

Answers: 1. T (p. 342); 2. F (p. 343); 3. T (p. 344); 4. F (p. 345); 5. F (p. 347)

Group Differences in IQ: The Science and the Politics

9.9 Identify similarities and differences in mental ability between men and women.

9.10 Evaluate the evidence concerning racial differences in IQ.

Thus far, we've focused almost entirely on the thorny question of *individual differences* (see Chapter 1) in IQ: Why does measured intelligence differ among people within a population? If you think that what we've discussed so far is controversial, fasten your seat belts. The topic of *group differences* in IQ is perhaps the most bitterly disputed in all of psychology. Here we'll look at what the research says about two group differences in IQ: (1) differences between men and women and (2) differences among races.

As we'll discover, the issues are as emotionally charged as they are scientifically complex. They've also become deeply entangled in politics (Hunt, 1999), with people on different sides of these debates accusing each other of biases and bad intentions.

Some have even gone so far as to argue that scientists should stay away altogether from studying group differences in IQ (Rose, 2009). When evaluating these issues, it's crucial that we try to be as objective as possible. That is, we must try to avoid *emotional reasoning*, or the affect heuristic (see Chapter 1), the tendency to judge the validity of an idea by our emotional reactions to it. Just because some of the ideas we'll encounter regarding intelligence may make us feel uneasy or even angry doesn't mean we should dismiss them out of hand. Difficult as it can be, we must try to evaluate these issues objectively with an open mind to scientific evidence.

Watch in **MyPsychLab** the **Video:** Gender Differences: Robert Sternberg

Sex Differences in IQ and Mental Abilities

In January 2005, then–Harvard University President Lawrence Summers created a furor. Speaking at an informal meeting of university faculty from around the country, Summers wondered aloud why so few women were in hard sciences like physics, chemistry, and biology (see **FIGURE 9.13**). He tentatively proposed a few reasons, one involving discrimination against women and a second involving women's preference for raising families instead of competing in grueling, cutthroat occupations. But it was Summers' third reason that really got people going. Summers conjectured that perhaps women enter the world with a genetic disadvantage in science and mathematics. Many people were appalled. One prominent woman biologist from the Massachusetts Institute of Technology stormed out of Summers' talk in protest. Within days, hundreds of Harvard faculty members were "calling for his head" (he resigned shortly thereafter). A firestorm of controversy regarding sex differences in mental abilities followed on the heels of Summers' provocative statements. In this section, we'll take a scientifically balanced look at the evidence.

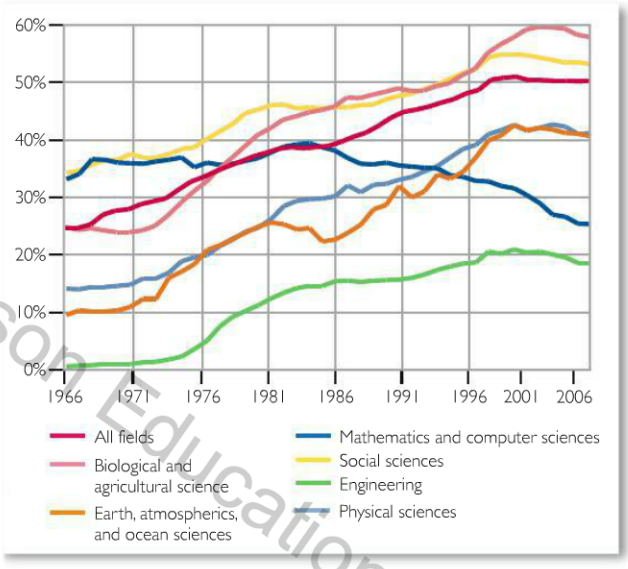


FIGURE 9.13 Bachelor's Degrees Earned by Women in Selected Fields, 1966–2008. Across a 40-year period, women have been underrepresented in most of the hard sciences, comprising only a minority of those graduating with a degree in these areas of study. (Based on data from http://nces.ed.gov/programs/digest/d11/tables_1.asp)

SEX DIFFERENCES IN IQ. Do men and women differ in overall IQ? Probably not. A handful of researchers have reported that men have slightly higher IQs than women do—perhaps between up to three points (Irwing, 2012; Jackson & Rushton, 2006; Lynn & Irwing, 2004)—but these claims are controversial, to put it mildly. Indeed, most researchers have found few or no average sex differences in IQ (Flynn & Rossi-Case, 2011; Jensen, 1998).

Still, average differences don't tell the whole story. Numerous studies reveal that men are more *variable* in their overall IQ scores than women are (Hedges & Nowell, 1995; Johnson, Carothers, & Deary, 2009). So although men don't appear to have higher average IQs than women do, there are more men at both the low and the high ends of the IQ bell curve (see **FIGURE 9.14**). We don't know the reason for this difference; researchers have, not surprisingly, proposed both genetic and environmental explanations.

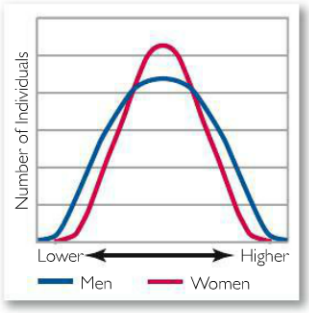


FIGURE 9.14 Distributions of Men and Women in IQ Tests. The IQ distribution of men is wider than the distribution of women. As a consequence, there are more men than women with both low and high IQ scores and more women with scores in the middle.

SEX DIFFERENCES IN SPECIFIC MENTAL ABILITIES. Even though there's little, if any, difference in overall IQ between men and women, the picture becomes more interesting—and more complicated—when we get to specific mental abilities. Men and women are quite similar when it comes to most intellectual abilities (Hyde, 2005; Maccoby & Jacklin, 1974), but a closer look reveals consistent sex differences in a few domains (Block, 1976; Halpern, 1992; Halpern et al., 2007; Pinker, 2005).

Women tend to do better than men on some verbal tasks, like spelling, writing, and pronouncing words (Feingold, 1988; Halpern et al., 2007; Kimura, 1999). This sex difference may have a hormonal component; even within women, some research suggests that verbal ability ebbs and flows along with the level of estrogen, a sex hormone that's more plentiful in women than in men (see Chapter 3). In one study, women were

best at quickly repeating tongue twisters (like "A box of mixed biscuits in a biscuit mixer") when their estrogen levels were at their peak (Hampson & Kimura, 1988). Nevertheless, not all investigators have found that current levels of sex hormones are associated with mental abilities within males and females (Halari et al., 2005; Lurine, 2008). On average, females also do better than males in arithmetic calculation, like adding and subtracting numbers, although this difference appears to be present only in childhood (Hyde, Fennema, & Lamon, 1990). Finally, females tend to be better than males in detecting and recognizing feelings in others, especially when they reach adulthood (Hall, 1978; McClure, 2000). For example, they're usually better than men at distinguishing among faces that display different emotions, such as fear and anger. Incidentally, despite popular stereotypes, there's no good evidence that women talk more than men do. A study that tracked six samples of men and women in the United States and Mexico found that both sexes speak about 16,000 words per day (Mehl et al., 2007).

REPLICABILITY ▶
Can the results be duplicated in other studies?

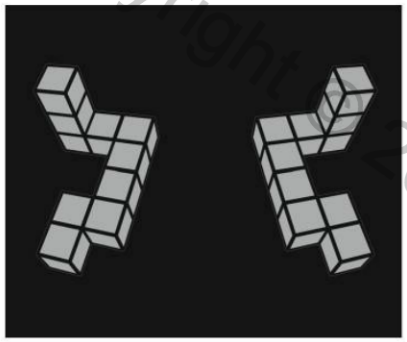


FIGURE 9.15 Mental Rotation Task. Men tend to do better than women on tests of mental rotation, many of which require participants to determine whether a "standard" shape (shown on the left) matches a "comparison" shape (shown on the right). You might want to try your hand—or your mind, to be exact—at this item: If the shape on the left is rotated in space, will it match the shape on the right? Turn the book upside down (or if you're really adventurous, mentally rotate the book!) to the find the answer.

In contrast, men tend to do better than women on most tasks requiring spatial ability (Halpern et al., 2007). The largest difference emerges on *mental rotation* tasks, like the one shown in **FIGURE 9.15**, which require participants to determine which of a series of rotated blocks matches a target group of rotated blocks (Estes & Felker, 2012; Lippa, Collaer, & Peters, 2010; Voyer, Voyer, & Bryden, 1995). This sex difference appears as early as 3 months of age, raising the possibility that it's partly innate (Quinn & Liben, 2008). Interestingly, one of the largest reported psychological sex differences is in geography, an area of study that relies heavily on spatial ability. Among the 5 million children who've participated in the National Geographic Bee, 77 percent have been boys (Zernike, 2000). Males also tend to do better than females on mathematics tasks that involve complicated reasoning, like deriving proofs in geometry (Benbow & Stanley, 1980). This difference doesn't emerge until adolescence (Hyde et al., 1990), perhaps reflecting hormonal changes that occur around puberty. At the extreme tails of the bell curve, this difference is magnified. For example, in a recent study of students who received scores of 700 or above on the SAT math section, males outnumbered females by about 4 to 1 (Wai et al., 2010). But there are more males than females in the low tail of the test, too.

POTENTIAL CAUSES OF SEX DIFFERENCES So what's the bottom line? On the one hand, some sex differences in mental abilities, such as women's higher scores on certain verbal tasks and men's higher scores on spatial and complex math-solving tasks, may be rooted partly in genes. Indeed, despite many changes in men's and women's roles over the past several decades, sex differences in spatial ability haven't decreased much over time (Voyer et al., 1995). Moreover, some studies indicate that excess levels of prenatal testosterone, a hormone of which males have more than females, is associated with better spatial ability (Hampson, Rovert, & Altmann, 1998; Jones, Braithwaite, & Healy, 2003), although not all researchers have replicated this finding.

REPLICABILITY ▶
Can the results be duplicated in other studies?

Men and women tend to differ in how they solve spatial problems.

On the other hand, there's ample reason to suspect that some, perhaps even most, of the sex differences in science and math ability are environmental (Levine et al., 2006). For one thing, male and female infants show few or no differences in spatial or counting ability (Spelke, 2005). Even when sex differences in these abilities emerge later in life, they may be due more to sex differences in problem-solving strategies than in inherent abilities. For example, when researchers have encouraged both men and women to solve math problems using spatial imagery (which men usually prefer) rather than verbal reasoning (which women usually prefer), the sex difference in math performance becomes noticeably smaller (Geary, 1996). Moreover, data indicate that the percentage of women entering the hard sciences has been increasing steadily over the past three decades (Ceci, Williams, & Barnett, 2009). This finding suggests that at least some of the underrepresentation of women in the hard sciences is the result of societal factors such as discrimination and societal expectations rather than women's weaker science skills.

Answers to Figure 9.15: No

Racial Differences in IQ

Perhaps the most controversial, and at times troubling, findings in the study of intelligence are that average IQ scores differ among some races. The differences vary in size but have been replicated multiple times (Loehlin, Lindzey, & Spuhler, 1977; Gottfredson, 2009; Wicherts, Dolan, & van der Maas, 2010). On average, African Americans and Hispanic Americans score lower than Caucasians do on standard IQ tests (Hunt & Carlson, 2007; Lynn, 2006; Neisser et al., 1996), and Asian Americans score higher than Caucasians do (Lynn, 1996; Sue, 1993). Among Caucasians in the United States, the IQs of Jews are slightly higher than those of non-Jews (Lynn, 2003). The average IQ difference between Caucasians and African Americans, which some researchers have estimated to be as high as 15 points, has received the most attention. What do these differences tell us about the abilities and potential of individuals from different races and why these differences exist?

REPLICABILITY
Can the results be duplicated in other studies?

FOR WHOM THE BELL CURVE TOLLS. Over the years, some sectors of society have attempted to use these findings in a misguided attempt to argue that some races are innately superior to others. There are several problems with this claim. First, claims of inherent racial "superiority" lie outside the boundaries of science and can't be answered by data. Scientists can determine only the origins of racial differences, namely, whether they're genetic, environmental, or both. Second, the IQ differences among races may be narrowing over recent decades (Hauser, 1998). For example, evidence suggests that the gap between whites and African Americans has narrowed by about 5 points since the early 1970s (Dickens & Flynn, 2006; Nisbett, 2012). Third, the variability *within* any given race tends to be considerably larger than the variability *between* races (Nisbett, 1995, 2009). This finding means that the distributions of IQ scores for different races overlap substantially (see **FIGURE 9.16**). As a result, many African Americans and Hispanic Americans have higher IQs than do many Caucasians and Asian Americans. The bottom line is clear: We can't use race as a basis for inferring any given person's IQ.

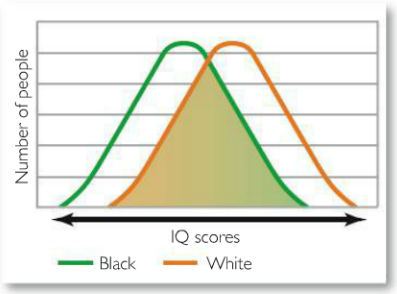


FIGURE 9.16 Diagram of African-American and Caucasian Distributions for IQ. African-American and Caucasian IQ distributions differ by an average of 15 IQ points—but they show substantial overlap, as indicated by the shaded area.

In 1994, Richard Herrnstein and Charles Murray touched off a bitter dispute among scientists and politicians alike. In their explosive and still widely discussed book *The Bell Curve*, they argued that IQ plays a more important role in society than most people are willing to admit. People at the upper tail of the IQ bell curve, they maintained, tend to "rise to the top" of the social ladder, because they possess high levels of cognitive skills. As a consequence, they make more money, assume more positions of leadership, and enter more powerful occupations than do people at the lower tail.

Had Herrnstein and Murray (1994) stopped there, their book would probably have attracted scant public attention. But they went further, conjecturing that at least some of the IQ gap between races might be genetic in origin. Herrnstein and Murray were hardly the first to make this suggestion (Jensen, 1973; Rushton & Bogaert, 1987). Nevertheless, their claims received unprecedented press coverage, reawakening a bitter debate launched in the 1960s when Arthur Jensen proposed a genetic basis for racial differences in IQ. Jensen's work aroused widespread suspicions of racism and was even interpreted by some white supremacists as supporting claims that Caucasians are genetically superior to blacks. J. Philippe Rushton (1995) also became a controversial figure in the 1980s and 1990s when he offered an evolutionary explanation for racial differences in IQ. Although some researchers have advanced strong arguments for a genetic basis for these differences, we'll soon discover that the preponderance of evidence suggests that racial differences in IQ are largely or entirely environmental in origin. These differences in turn may reflect the different resources and opportunities available to individuals of different races.

RECONCILING RACIAL DIFFERENCES. To see why racial differences in IQ don't necessarily imply genetic differences in intelligence or learning potential, let's look at the two groups of plants in the upper panel of **FIGURE 9.17** (see page 352) (Lewontin, 1970).