as the average 8-year-old, his or her IQ according to Stern's formula would be 80 (a mental age of 8 divided by a chronological age of 10, multiplied by 100). Conversely, if an 8-year-old child does as well on an IQ test as the average 10-year-old, his or her IQ according to Stern's formula would be 125 (a mental age of 10 divided by a chronological age of 8 multiplied by 100).

Although Stern's formula does a respectable job of estimating intelligence for children and young adolescents, it soon became evident that the formula contains a critical flaw. Mental age scores increase progressively in childhood, but start to level out at around age 16 (Eysenck, 1994). Once we hit 16 or so, our performance on IQ test items doesn't increase by much. Because our mental age levels off but our chronological age increases with time, Stern's formula would result in everyone's IQ getting lower as they get older.

That's why almost all modern intelligence researchers rely on a statistic called **deviation IQ** when computing IQ for adults (Wechsler, 1939). Basically, using a statistical measure of variability (see Chapter 2), the deviation IQ expresses each person's IQ relative to the norms for his or her age group. An IQ of 100, which is average, means that a person's IQ is exactly typical of people of his or her age group. An IQ of 80 is a standard amount below average for any age group, and an IQ of 120 is a standard amount above. In this way, the deviation IQ gets rid of the problem posed by Stern's formula, because it doesn't result in IQs decreasing after age 16.

The Eugenics Movement: Misuses and Abuses of IQ Testing

Soon after French psychologists Binet and Simon had developed their test, researchers in other countries began translating it into various languages. Among the first was American psychologist Henry Goddard, who translated it into English in 1908. In only a matter of years, IQ testing became a booming business in the United States. It was no longer merely a vehicle for targeting schoolchildren in need of special help, however, but a means of identifying adults deemed intellectually inferior.

Factoid

The popularity of the eugenics movement of the early twentieth century led the name *Eugene* to become one of the most frequently used boys' names in the United States.

The IQ testing movement quickly spiraled out of control. Examiners frequently administered these tests in English to new American immigrants who barely knew the language. It's hardly surprising, then, that about 40 percent of these immigrants were classified as having mental retardation. Moreover, Goddard and others adapted childhood tests for use in testing adults, without fully understanding how the IQ scores applied to adults (Kevles, 1985). As a consequence, legions of adults given his tests, including prison inmates and delinquents, scored in the range of mental retardation.

Eventually, concern with the low IQs of many immigrants and some Americans led to a social movement called **eugenics** (meaning "good genes"), a term coined by none other than Sir Francis Galton (Gillham, 2001). Eugenics was the effort to improve a population's "genetic stock" by encouraging people with "good genes" to reproduce, by discouraging people with "bad genes" from reproducing, or both. Galton had been a proponent of only the first type of eugenics, but many later psychologists advocated both.

Although eugenics was by no means unique to America (Kuntz & Bachrach, 2006), it became immensely popular there in the early twentieth century, especially from 1910 to 1930. Dozens of universities, including several Ivy League schools, offered courses in eugenics (Selden, 1999). Most high school and college biology texts presented eugenics as a scientific enterprise.

Acceptance of eugenics brought about some disturbing practices. Beginning in the 1920s, the U.S. Congress passed laws designed to restrict immigration from other countries supposedly marked by low intelligence, especially those in eastern and southern Europe (Gould, 1981). Even worse, 33 U.S. states passed laws requiring the sterilization of low-IQ individuals with the aim of halting the supposed deterioration of

deviation IQ
expression of a person's IQ relative to his or her same-aged peers

eugenics
movement in the early twentieth century to improve a population's genetic stock by encouraging those with good genes to reproduce, preventing those with bad genes from reproducing, or both

the population's intelligence (see **FIGURE 9.6**). When all was said and done, about 66,000 North Americans, many of them African Americans and other poor minorities, underwent forced sterilizations (Reynolds, 2003). Disturbingly, the U.S. Supreme Court upheld these sterilization practices in 1927 in the case *Buck v. Bell*. Ruling to uphold the sterilization of 18-year-old Carrie Buck, who'd come from two generations of purportedly "feeble-minded" ancestors, Justice Oliver Wendell Holmes wrote that "three generations of imbeciles are enough." Fortunately, the practice of sterilization slowed in the 1940s and had subsided almost completely by the early 1960s, although involuntary sterilization laws remained on the books in America for years. Virginia became the last state to repeal them in 1974.

We can still feel the impact of the eugenics movement today. Many people are understandably suspicious of claims regarding IQ and its genetic bases, as these claims remind them of the efforts by eugenics advocates to "purge" low-IQ individuals from the gene pool. Still, we must be careful not to confuse a claim's validity with the people who advocate it (otherwise known as the error of "guilt by association"). It's true that many eugenics supporters were strong proponents of IQ testing and research on the genetic bases of IQ. But this fact doesn't, by itself, imply that we should dismiss the science of IQ testing or research on genetic bases of IQ. Although it's entirely appropriate to be dismayed by the tragic history of the eugenics movement in America, the two issues are logically separable.

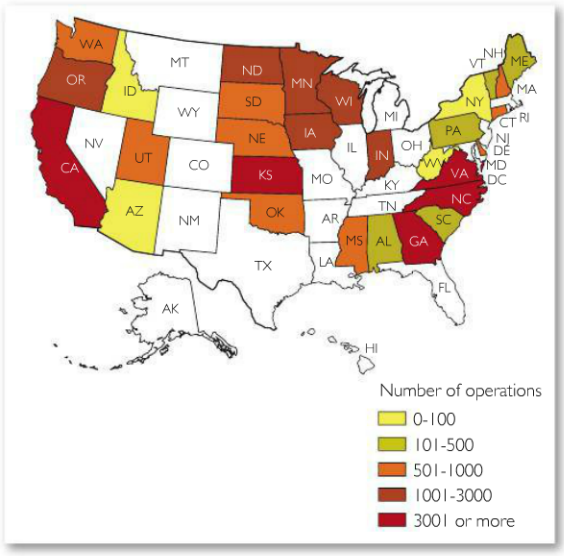


FIGURE 9.6 A Sterilization Map of the United States. Between 1905 and 1979, many U.S. states had mandatory sterilization laws, a legacy of the eugenics movement.

IQ Testing Today

Today, the IQ test stands as one of psychology's best-known, yet most controversial, accomplishments. In 1989, the American Academy for the Advancement of Science listed the IQ test as one of the 20 greatest scientific achievements of the twentieth century (Henshaw, 2006). Whether we agree with this assessment, there's no question that IQ testing has been remarkably influential. Although psychologists have developed dozens of IQ tests, a mere handful have come to dominate the modern testing scene. We'll discuss these tests next, along with standardized tests like the SAT and measures of infant intelligence.

COMMONLY USED ADULT IQ TESTS. The IQ test administered most widely to assess intelligence in adults is the **Wechsler Adult Intelligence Scale (WAIS)** (Watkins et al., 1995). Ironically, David Wechsler, a psychologist who developed this test, was a Romanian immigrant to the United States who was among those classified as feebleminded by early flawed IQ tests. Perhaps not surprisingly, Wechsler's negative experience led him to construct an IQ test based on more than verbal abilities. The most recent version of his test, the WAIS-IV (Wechsler, 2008), consists of 15 "subtests," or specific tasks, designed to assess such varied mental abilities as vocabulary, arithmetic, spatial ability, reasoning about proverbs, and general knowledge about the world. We can find sample items from several of these subtests in **FIGURE 9.7** (see page 334). The WAIS-IV yields five major scores: (1) overall IQ, (2) verbal comprehension, (3) perceptual reasoning, (4) working memory, and (5) processing speed. Verbal comprehension relates primarily to crystallized intelligence, while perceptual reasoning, working memory, and processing speed relate primarily to fluid intelligence.

COMMONLY USED CHILDHOOD IQ TESTS. Two widely used IQ tests for children are the Wechsler Intelligence Scale for Children (WISC) and the Wechsler Primary and Preschool Scale of Intelligence (WPPSI; pronounced "WHIP-see"), the former in its fourth edition

Lee Anderson, 87, shown August 8, 2006, at her home in Fayetteville, North Carolina, was involuntarily sterilized in 1950 by the Eugenics Board of North Carolina after the birth of her last child.

Wechsler Adult Intelligence Scale (WAIS)
most widely used intelligence test for adults today, consisting of 15 subtests to assess different types of mental abilities

and the latter in its third edition. Both measures are versions of the WAIS adapted for older children and adolescents (the WISC-IV) or younger children aged 2 1/2 to 7 years old (the WPPSI-III) (Kaplan & Sacuzzo, 2008).

CULTURE-FAIR IQ TESTS. One longstanding criticism of IQ tests has been their heavy reliance on language. Test takers who aren't fluent in the native language may do poorly on IQ tests largely because they don't comprehend the test instructions or the questions

Wechsler Adult Intelligence Scale (WAIS) Sample Items*

Test	Description	Example
Information	Taps general range of information	On which continent is France?
Comprehension	Tests understanding of social conventions and ability to evaluate past experience	Why do people need birth certificates?
Arithmetic	Tests arithmetic reasoning through verbal problems	How many hours will it take to drive 150 miles at 50 miles per hour?
Similarities	Asks in what way certain objects or concepts are similar; measures abstract thinking	How are a calculator and a typewriter alike?
Digit span	Tests attention and rote memory by orally presenting series of digits to be repeated forward or backward	Repeat the following numbers backward: 2 4 3 5 1 8 6
Vocabulary	Tests ability to define increasingly difficult words	What does *repudiate* mean?
Digit symbol	Tests speed of learning through timed coding tasks in which numbers must be associated with marks of various shapes	Shown: 1 2 3 4 Fill in: 4 2 1 3
Picture completion	Tests visual alertness and visual memory through presentation of an incompletely drawn figure; the missing part must be discovered and named	Tell me what is missing:
Block design	Tests ability to perceive and analyze patterns presenting designs that must be copied with blocks	Assemble blocks to match this design:
Visual Puzzles	Tests ability to organize parts of a figure into a larger spatial array	Which three of these pieces go together to make this puzzle?
Figure Weights	Tests ability to reason logically about numbers	Which one of these goes here to balance the scale?

FIGURE 9.7 Sample Items from WAIS. Eleven of the 15 subtests of the WAIS-IV (the newest version), along with items similar to those on the test.
**Note:* For copyright reasons, we can't present the items on the actual test.

themselves. Moreover, cultural factors can affect people's familiarity with test materials—and in turn their performance on intellectual tasks (Neisser et al., 1996). In one study, a researcher asked schoolchildren in England and Zambia (a country in southern Africa) to reproduce a series of visual patterns using both paper and pencil—a medium with which British children tend to be familar—and wire—a medium with which Zambian children tend to be familiar. The British children did better than the Zambian children when using paper and pencil, but the Zambian children did better than the British children when using wire (Serpell, 1979).

As a consequence of these problems, psychologists have developed a variety of **culture-fair IQ tests**, which consist of abstract-reasoning items that don't depend on language (Cattell, 1949). Presumably, these tests are less influenced by cultural differences than standard IQ tests are.

Perhaps the best-known culture-fair test is Raven's Progressive Matrices, used widely in Great Britain as a measure of intelligence, especially fluid intelligence (Raven, Raven, & Court, 1998). As **FIGURE 9.8** shows, this test requires examinees to pick out the final geometrical pattern in a sequence (the matrices are "progressive" because they start off easy and become increasingly difficult). Raven's Progressive Matrices is an excellent measure of *g* (Neisser et al., 1996; Nisbett et al., 2012).

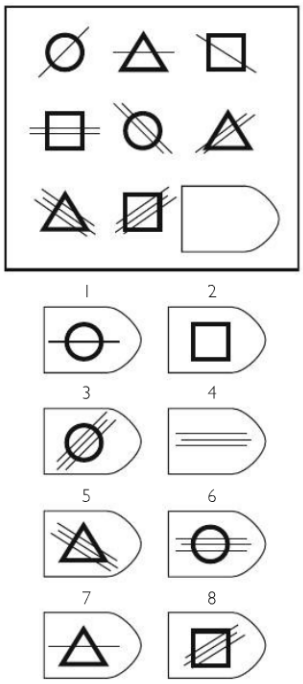


FIGURE 9.8 Item Similar to That on Raven's Progressive Matrices. An item similar to those in the *Raven's Progressive Matrices—Advanced Progressive Matrices*. The answer is positioned upside down at the bottom of the page.

psychomythology

DO COLLEGE ADMISSIONS TESTS PREDICT GRADES?

Psychologists designed the SAT, ACT, Graduate Record Exam (GRE), and other admissions tests to forecast performance in undergraduate and graduate courses. Yet the correlations between these tests and college grades are often below .5 and in a few cases close to zero (Morrison & Morrison, 1995). Moreover, although SATs and GREs tend to predict first-year grades at reasonable levels, they generally do a worse job of predicting performance in later years of college (Kuncel & Hezlett, 2007).

These low correlations have prompted many critics to conclude that the SAT and GRE aren't helpful for making predictions about grades (Oldfield, 1998; Sternberg & Williams, 1997). More than one-fourth of major liberal arts colleges in the United States no longer require the SAT, and these numbers are growing (Lewin, 2006). Ralph Nader, a consumer advocate and former presidential candidate, argued that the SAT is so invalid that it should be banned (Kaplan, 1982; Nairn, 1980). In 2001, the chancellor of the University of California State system, Richard Atkinson—himself a prominent psychologist—argued that the SAT is only weakly predictive of students' actual achievement (Atkinson, 2001).

Are Nader and Atkinson right? Yes and no. They're right that the SAT and GRE are highly imperfect predictors and that they don't correlate highly with future grades. But they're wrong that this fact renders the tests largely useless. To understand why, let's look at the graph in **FIGURE 9.9a** (see page 336). We call this graph a *scatterplot* (see Chapter 2), because it's a plot of the correlation between two variables, in this case between SAT scores and grade point average (GPA) in college. As we can see, the SAT scores (combined across all three subtests) range from 700 to 2,300, and GPA ranges from 1.5 to almost 4.0. The correlation in this scatterplot is .65, which is fairly high. Recall from Chapter 2 that high positive correlations display a pronounced upward tilt.

But let's now look at **FIGURE 9.9b**, which is a close-up of the dots that are 1,500 or higher on the *x* (horizontal) axis. As we can see, the range of SAT scores is now between only 1,500 and 2,300 combined. This range is typical of what we find at many highly competitive colleges. That's because few people with SAT scores much below 1,500 combined get into these colleges. What does the correlation look like now? As we can see, it's much lower than that in Figure 9.9a; in fact, the correlation is close to zero (it's even slightly negative). The upward tilt of this correlation has clearly disappeared.

culture-fair IQ test
abstract reasoning measure that doesn't depend on language and is often believed to be less influenced by cultural factors than other IQ tests are

Answer to Figure 9.8: 6

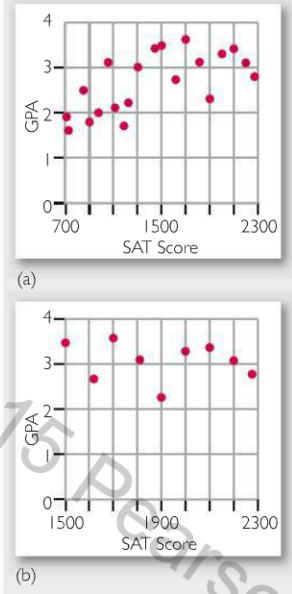
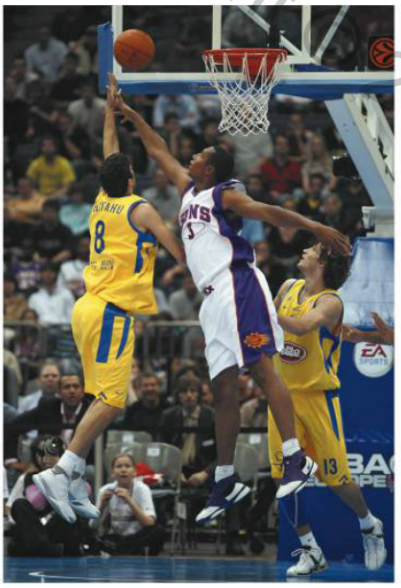


FIGURE 9.9 Scatterplot of Correlation between SAT Scores and College GPA. In the graph depicted in (a), SAT scores are clearly correlated with GPA. We can see an upward slant to the data points as we move from lower to higher scores. In the graph depicted in (b), the same data are depicted but only for the narrow range of higher SAT scores (1,500–2,300). As we can see, there is no clear correlation between SAT scores and GPA in this range.



Among professional basketball players, height isn't an especially good predictor of who scores the most points, because the range of heights is dramatically restricted.

These two scatterplots illustrate a crucial phenomenon overlooked by many critics of the SAT and GRE (for example, Sternberg & Williams, 1997): restriction of range. *Restriction of range* refers to the fact that correlations tend to go down when we limit the range of scores on one or both variables (Alexander et al., 1987). To understand restriction of range, think of the relation of height to basketball playing ability. In a group of ordinary people playing a pickup basketball game on a Saturday afternoon, height will correlate highly with who scores more points. But in a game of professional basketball players, height barely matters, because almost everyone who makes it to a professional basketball team is tall.

Restriction of range helps to explain why the SAT and GRE aren't highly predictive of scores in college and graduate school: Colleges and graduate schools rarely admit low scorers (Camara, 2009). Indeed, when two researchers examined the validity of the GRE in a graduate department that admitted applicants regardless of their GRE score, the GRE correlated highly (between .55 and .70) with measures of graduate GPA (Huitema & Stein, 1993). So when we remove restriction of range, the GRE becomes highly predictive of later grades. Restriction of range also probably accounts for why SATs and GREs are less predictive of later grades than of first-year grades. When students get to pick the classes in which they do well, they tend to obtain higher grades, thereby limiting the range of GPAs (Sackett, Borneman, & Connelly, 2008).

To return to the question posed at the outset—Do standardized tests predict grades?—the answer is, "When we measure the full range of scores, yes, although by no means perfectly."

College Admissions Tests: What Do They Measure?

The odds are high you've taken at least one, and perhaps many, college admissions tests in your life. In fact, to get into college you may have endured the misery of the SAT, once called the Scholastic Assessment Test, and before that, the Scholastic Aptitude Test (oddly enough, the initials "SAT" no longer stand for anything) or the ACT (which formerly stood for the American College Test, which also no longer stands for anything). The SAT now consists of three sections—Mathematics, Critical Reading, and Writing—with scores on each ranging from 200 to 800.

COLLEGE ADMISSIONS TESTS AND IQ. College admissions tests are designed either to test overall competence in a specific domain or to predict academic success. For many years, the Educational Testing Service apparently collected data on the correlation between the SAT and IQ, but didn't release them until about a decade ago (Seligman, 2004). When Murphy Frey and Douglas Detterman (2004) analyzed these data, they found that the SAT correlates highly (between about .7 and .8) with two standard measures of intelligence, including the Raven's Progressive Matrices. So the SAT is clearly linked to measured intelligence.

COACHING ON COLLEGE ADMISSIONS TESTS. You've probably heard of companies such as Princeton Review and Kaplan that prepare students for the SAT and other college admissions tests. Many of these companies guarantee whopping increases of 100 points or more when taking the tests a second time (Powers & Rock, 1999).

Nevertheless, the actual benefits of these courses aren't entirely clear (DerSimonian & Laird, 1983). There's definitely a positive *correlation* between whether people take coaching courses and their SAT scores, but this association may be due

to a third variable: Students who take coaching courses tend to be more educated and better prepared for these tests to begin with (Camara, 2009). Still, the evidence suggests that commercial coaching improves SAT scores slightly, probably by 10 to 15 points on average per section (Kulik, Bangert-Drowns, & Kulik, 1984; Powers, 1993).

In addition, the companies are probably neglecting to consider an alternative explanation for their advertised increases in test scores: practice effects (Shadish, Cook, & Campbell, 2002). By *practice effects*, we mean that people frequently improve on tests as a result of practice alone. So the companies may be concluding mistakenly that people who take their courses are improving *because* of these courses rather than merely *after* them. When researchers have controlled for practice effects by including a control group of people who take the SAT a second time but haven't taken an SAT preparation course, the improvements resulting from these courses has been much smaller than the companies claimed (Camara, 2009; Powers & Rock, 1999).

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

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

Watch in **MyPsychLab** the **Video:** SAT Alternatives: Robert Sternberg

Reliability of IQ Scores: Is IQ Forever?

We often think of people's IQ scores in much the same way we think of their Social Security numbers: as sticking with them for life. Joe's a 116, Maria's a 130, and Bill's a 97. Yet IQ scores aren't fixed. They almost never remain the same over time; in fact, they occasionally shift for the same person by as much as 10 points or more over a matter of months.

STABILITY OF IQ IN ADULTHOOD. IQ scores usually remain reasonably stable in adulthood. As we learned in Chapter 2, *reliability* refers to consistency of measurement. As we also learned one important type of reliability is *test-retest reliability*, which refers to the extent to which scores on a measure remain stable over time. For adult IQ tests like the WAIS-IV, test-retest reliabilities tend to be about .95 over an interval of several weeks (Wechsler, 1997). As you may recall, .95 is an extremely high correlation, nearly but not quite perfect. Even across long stretches of time, IQ scores tend to be reasonably stable (Gow et al., 2011). In one study of 101 Scottish schoolchildren followed up over time, IQ scores obtained at age 11 correlated .73 with their IQ scores at age 77 (Deary et al., 2000).

Seated comfortably on mom's lap, a baby takes an experimental measure of infant intelligence that assesses response to novelty. The baby had previously viewed a number of identical pairs of photos of two people playing with toys and is now viewing two different photos of people playing with different toys. The extent to which infants look at the novel photo modestly predicts their adult intelligence.

STABILITY OF IQ IN INFANCY AND CHILDHOOD. There's a key exception to the rule regarding the high test-retest reliability of IQ tests. Prior to age 2 or 3 in children, IQ tests aren't stable over time. In fact, IQ measured in the first six months of life correlates just about zero with adult IQ (Brody, 1992). Nor do IQ scores obtained in the first few years of life do a good job of forecasting outcomes, unless they're extremely low, such as under 50; such scores tend to be predictive of later mental retardation. IQ tests designed for very young children assess the sensory abilities that Galton emphasized, which bear little association with intelligence. In contrast, IQ tests designed for older children and beyond assess the abstract reasoning emphasized by Binet and Simon. This reasoning, as we've discovered, lies at the heart of what we call intelligence.

Some measures of infant intelligence are slightly more promising when it comes to predicting later IQ. One is speed of habituation. As we discovered in Chapter 6, habituation refers to the tendency to stop responding to repeated presentations of the same stimulus. Infants who habituate to a visual stimulus (like a red circle) more quickly—as measured by how long they stare at it—turn out to have higher IQs in later childhood and adolescence than do other children, with most correlations in the .3 to .5 range (McCall & Carriger, 1993; Slater, 1997).

It's not entirely clear why this is so. Perhaps this correlation reflects a direct causal association between intelligence and habituation: Infants who are smart "take in" information from novel stimuli quickly, so they're ready to move on to new things. Alternatively, this correlation may reflect the influence of a third variable, like interest in new stimuli (Colombo, 1993). Maybe infants who are more interested in new things habituate more quickly *and* learn more things, resulting in higher intelligence later on.

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

A related approach presents babies with pairs of pictures, like photos of faces. For many trials, the two faces are the same. Then suddenly, a novel face appears along with the familiar face. Infants who attend more to the new face later tend to have higher IQs in childhood and adolescence than other infants (DiLalla et al., 1990; Rose et al., 2012; Smith, Fagan, & Ulvund, 2002). Still, this measure has its problems. In particular, its test-retest reliability is fairly low (Benasich & Bejar, 1992).

It remains to be seen whether researchers will develop even better measures of infant intelligence. Ultimately, these measures may yield clues regarding how intelligence develops and perhaps even what intelligence is.

Validity of IQ Scores: Predicting Life Outcomes

Whatever we think of IQ tests, there's little question that they're valid for at least some purposes. As we learned in Chapter 2, *validity* refers to the extent to which a test measures what it purports to measure. One important indicator of a test's validity is its ability to relate to outcomes measured at about the same time the test is administered, or what psychologists call "concurrent" validity (think of the word *current*). Modern IQ tests possess strong concurrent validity; for example, they correlate moderately to highly with other IQ tests given during the same session (Wechsler, 1988).

Watch in **MyPsychLab** the **Video:** Are Intelligence Tests Valid: Robert Guthrie

Another important indicator of a test's validity is its capacity to forecast future outcomes, or what psychologists call "predictive" validity. IQ scores do a good job of predicting academic success; they correlate about .5 with grades in high school and college (Neisser et al., 1996). Still, because this correlation is considerably lower than 1.0, it tells us there's more to school success than IQ. Motivation, intellectual curiosity, effort, and *mental energy*—the ability to focus on difficult problems for long periods of time (Lykken, 2005)—also play crucial roles. IQ scores also forecast other important life behaviors; for example, people with high IQs tend to be more politically active regardless of their views (Deary, Batty, & Gale, 2008).

How typical are people like Chris Langan, who have extremely high IQs but unremarkable occupational success? Less than we might think. IQ scores predict performance across a wide variety of occupations, with the average correlation again being about .5 (Chen & Furnham, 2012; Ones, Viswesvaran, & Dilchert, 2005; Sackett et al., 2008). By comparison, the correlation between ratings of how well people do in job interviews and job performance is only about .15, which is ironic given that many employers place heavier weight on interviews than on IQ when selecting job applicants (Dawes, Faust, & Meehl, 1989; Hunter & Hunter, 1984). The correlation between IQ and job performance is higher in more mentally demanding occupations such as physician and lawyer than in less mentally demanding occupations like clerk and newspaper delivery person (Salgado et al., 2003). Using estimates from biographers and historians, one researcher found that presidents' estimated IQ predicted the quality of leadership among U.S. presidents, with correlations in the .3 to .4 range (Simonton, 2006).

Perhaps the link between IQ and achievement is more complex than we've implied. Some people, like journalist Malcolm Gladwell, author of the best-selling book *Outliers* (2009), claim that the correlation between high IQ and life accomplishments holds up to only a moderate IQ level, after which the correlation becomes essentially nonexistent. This phenomenon, which psychologists call a *threshold effect*, implies that above a certain level of IQ, intelligence is no longer predictive of important real-world accomplishments. Yet the evidence doesn't support that assertion: The correlation between IQ and life achievements remains essentially identical even at extremely high levels of IQ (Kuncel, Ones, & Sackett, 2010; Lubinksi, 2009; Sackett et al., 2008).

IQ also predicts a variety of important real-world behaviors outside the classroom and workplace. For example, low IQ is associated with health-related

a.


b.


c.


Low levels of health literacy, which are associated with IQ, can lead to dangerous misunderstandings of medication instructions. Some participants in a study interpreted these warning labels to mean: a) you need to chew the pill before swallowing; b) you should use caution when taking the medication; and c) you shouldn't leave the medication in the sun (Davis et al., 2006).

outcomes, including sickness and car accidents (Gottfredson, 2004; Johnson et al., 2011; Lubinski & Humphreys, 1992). At least some of the negative correlation between IQ and illness may be attributable to *health literacy*, the ability to understand health-related information such as instructions from doctors and on drug labels. People with low health literacy may have difficulty maintaining good health behaviors, such as getting enough exercise, eating the right foods, or taking the right dosage of their medications. IQ is also associated with criminal tendencies: The IQs of delinquent adolescents are about seven points lower than those of other adolescents (Wilson & Herrnstein, 1985).

But there's a potential confound here (see Chapter 2). IQ is positively associated with social class, as poorer people tend to have lower IQs (Strenze, 2007). So poverty, rather than IQ, may explain at least some of the associations we've discussed. Researchers have tried to address this rival hypothesis by determining whether the correlations hold up even when accounting for social class. In most cases, including the association between IQ and both health outcomes and crime, they do (Herrnstein & Murray, 1994; Johnson et al., 2011; Neisser et al., 1996). Still, to some extent, the causal arrow probably runs in both directions. Poverty may contribute to low IQs, but low IQs may also contribute to poverty, because people with low IQs may lack some of the cognitive abilities that allow them to obtain and keep well-paying jobs.

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

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

A Tale of Two Tails: From Mental Retardation to Genius

Within a population, IQ scores are distributed in a **bell curve**, across the range of possible IQ scores. In this distribution, discovered by the German mathematician Karl Friedrich Gauss (1777–1855), the bulk of the scores fall toward the middle, with progressively fewer scores toward the "tails" or extremes, forming the shape of a bell.

FIGURE 9.10 shows that the bell curve fits the distribution of IQ scores in the population fairly well, with one minor exception. Most of the scores fall in the broad middle of the distribution; about 95 percent of us have IQs between 70 and 130. The curve contains a small bump on the left, indicating that there are more very low IQ scores than we'd expect from a perfect bell curve. These extreme scores are probably the result of *assortative mating* (Mackintosh, 1998): the tendency of individuals with similar genes to have children. In this case, individuals with mental retardation are especially likely to parent a child with other individuals with mental retardation, probably because they frequent the same locations (such as special schools), then develop a relationship and have children.

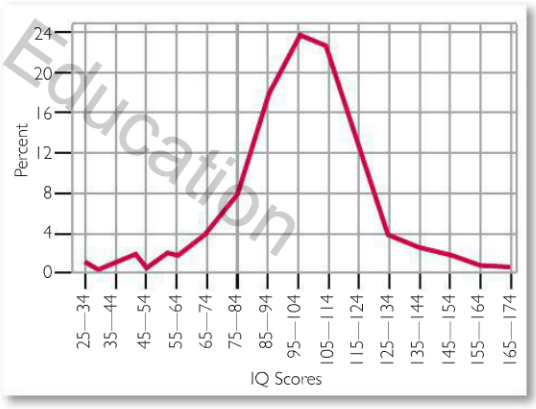


FIGURE 9.10 Distribution of IQ Scores in the General Population. The bell curve roughly approximates the distribution of IQ scores in the general population.

Let's now look at what we know about the two tails of the IQ score distribution: mental retardation and genius.

MENTAL RETARDATION. Psychologists define **mental retardation**, sometimes now termed "intellectual disability," using three criteria, all of which must be present: (1) onset prior to adulthood; (2) IQ below approximately 70; and (3) inadequate adaptive functioning, as assessed by difficulties with dressing and feeding oneself, communicating with others, and managing other basic life skills (Greenspan & Switzky, 2003). The adaptive functioning criterion largely explains why about two-thirds of children with mental retardation lose this diagnosis in adulthood (Grossman, 1983); as individuals acquire life-functioning skills, they no longer qualify for this diagnosis. The definition of mental retardation has taken on new importance over the past decade with the 2002 Supreme Court decision of *Atkins vs. Virginia*, which ruled that criminals with mental retardation can't be executed.

Some experts also emphasize *gullibility* (the susceptibility to being duped by others) as a criterion for mental retardation, in part for social policy reasons. A diagnosis of mental retardation qualifies individuals for additional government services. For this reason, the

bell curve
distribution of scores in which the bulk of the scores fall toward the middle, with progressively fewer scores toward the "tails" or extremes

mental retardation
condition characterized by an onset prior to adulthood, an IQ below about 70, and an inability to engage in adequate daily functioning

Most individuals with Down syndrome have mild or moderate mental retardation. Nevertheless, many have been successfully mainstreamed into traditional classrooms.

Factoid

The terms *moron*, *imbecile*, and *idiot*, today used in everyday language as insults, once referred to differing levels of mental retardation: mild (moron), moderate to severe (imbecile), and profound (idiot) (Scheerenberger, 1983).

inability to protect oneself from being taken advantage of by others should be weighted heavily in determining whether a person has mental retardation (Greenspan, Loughlin, & Black, 2001).

About 1 percent of persons in the United States, most of them males, fulfill the criteria for mental retardation (American Psychiatric Association, 2013). The current system of psychiatric diagnosis classifies mental retardation into four categories: mild (once called "educable"), moderate (once called "trainable"), severe, and profound. Contrary to popular conception, most individuals with mental retardation—at least 85 percent—fall into the "mild" category. In most cases, children with mild retardation can be integrated or *mainstreamed* into regular classrooms. Still, the term *mild mental retardation* is misleading, because individuals in this category still have significant deficits in adaptive functioning.

Contrary to what we might expect, the more severe the mental retardation, the *less* likely it is to run in families (Reed & Reed, 1965). Mild forms of mental retardation are typically due to a mix of genetic and environmental influences that parents pass on to their children. In contrast, severe forms of mental retardation are more often the result of rare genetic mutations or accidents during birth, neither of which tend to be transmitted within families.

There are at least 200 different causes of mental retardation. Two of the most common genetic conditions associated with mental retardation are fragile X syndrome, which is produced by a mutation on the X chromosome (females have two copies of this chromosome; males, only one), and Down syndrome, which is the result of an extra copy of chromosome 21. Most children with Down syndrome have either mild or moderate retardation. Nevertheless, a subset of individuals with Down syndrome known as *mosaics* (so called because only some of their cells contain an extra chromosome 21) have relatively normal IQs. People with Down syndrome typically exhibit a distinctive pattern of physical features, including a flat nose, upwardly slanted eyes, a protruding tongue, and a short neck. The prevalence of Down syndrome rises sharply with the birth mother's age; at age 30, it's less than one in 1,000, but by age 49, it's about one in 12 (Hook & Lindsjo, 1978).

Fortunately, societal attitudes toward individuals with mental retardation have improved dramatically over the past century. The Americans with Disabilities Act (ADA), passed in 1990, outlawed job and educational discrimination on the basis of mental and physical disabilities, and the Individuals with Disabilities Education Act (IDEA), passed in 1996, provided federal aid to states and local educational districts for accommodations for youth with mental and physical disabilities. Both ADA and IDEA have helped bring those with mental retardation out of institutions and into our workplaces and schools. As we increase our regular contact with these individuals, such laws may further erode the lingering stigma that some Americans feel toward these members of society.

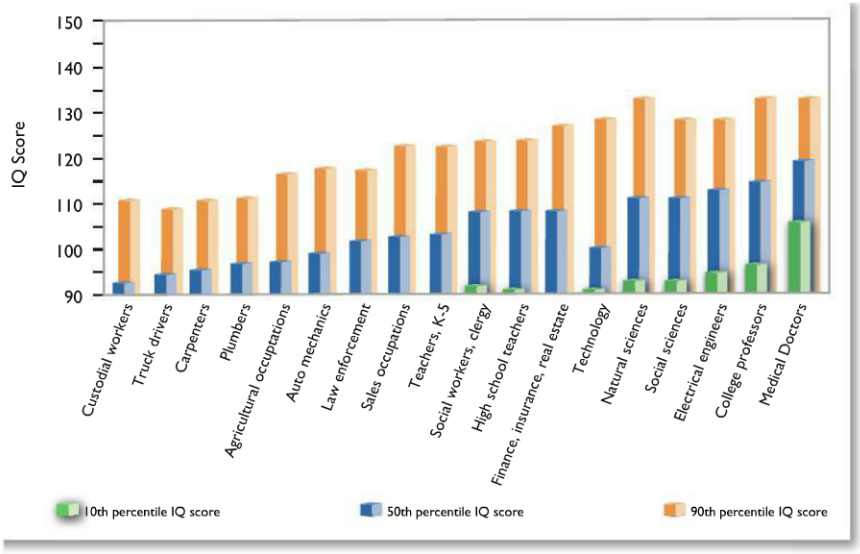


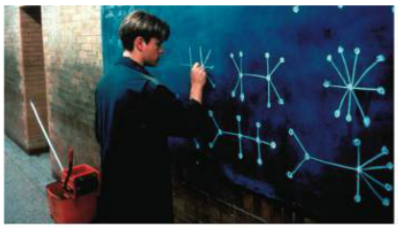
FIGURE 9.11 IQ Scores among Select Professions. A study of IQ scores reveals that among a range of professions, medicine, college-level teaching, and engineering attract those with the highest average IQs. However, at least 50 percent of those in every profession score above 90 on IQ tests. There are intelligent people in every profession. (*Source:* Based on Hauser, 2002)

GENIUS AND EXCEPTIONAL INTELLIGENCE. Let's now turn to the opposite tail of the bell curve. If you're fortunate enough to score in the top 2 percent of the IQ range, you'll qualify for membership in an organization called Mensa. A large proportion of individuals with IQs at or near this range populate certain occupations, such as doctors, lawyers, engineers, and college professors (Herrnstein & Murray, 1994; Sorjonen et al., 2012) (see **FIGURE 9.11**). Yet we know relatively little about the psychological characteristics of individuals with high IQs or their academic, occupational, and social performance over time. Several research studies offer tantalizing clues.

In the 1920s, Lewis Terman and his colleagues (Terman & Oden, 1959) initiated one of the classic studies of intellectually gifted individuals. From some 250,000 junior high school students in California, Terman selected about 1,500 who had IQs of about 135 or higher. He tracked these individuals, known affectionately as Terman's "Termites," for several decades (some are still alive today). Although Terman's study was flawed, in part because he didn't recruit a control group of individuals with average or low IQs, it refuted two common misconceptions regarding people with high IQs.

First, contradicting the common belief that almost all child prodigies "burn out" in adulthood, Terman's particpants became a highly distinguished group: 97 earned doctoral degrees, 57 earned medical degrees, and 92 earned law degrees. These numbers are all much higher than what we'd expect from the general population (Leslie, 2000). A later study of an even more select group—young adolescents who scored in the top .001 percent (that's 1 in 10,000) on tests of verbal or mathematical ability—generated similar results. By their early twenties, these individuals were attending graduate school at a rate more than 50 times higher than that in the general population and many had already published scientific or literary articles (Lubinski, 2009; Lubinski et al., 2006). Second, Terman's results disputed the popular notion that there's an intimate link between genius and madness. Although the absence of a control group makes it difficult to know for certain, his findings pointed to slightly lower rates of mental illness and suicide among his adult Termites compared with the general population. Later researchers have found broadly similar results (Simonton & Song, 2009), although a few have reported that exceedingly intelligent children, such as those with IQs over 180, may be at heightened risk for selected mental health problems, especially loneliness and depression (Janos & Robinson, 1985; Winner, 1999). These negative outcomes may stem from the greater ridicule and isolation that these children experience. Still, there's scant evidence that high intelligence is associated with high levels of severe mental illness.

What's the recipe for creating a genius like Chris Langan? We don't know, although as we'll soon discover, genetic factors probably play a significant role. Still, as the brilliant inventor Thomas Edison said famously, "Genius is 1 percent inspiration, 99 percent perspiration." Here common wisdom is correct: Practice makes perfect—or at least pretty darned good. The best predictor of exceptional career success in violin, piano, ballet, chess, and sports is the sheer amount of time we spend in practice. The most talented musicians practice twice as much as the less talented ones (Ericsson, Krampe, & Tesch-Römer, 1993; Gladwell, 2009). Of course, the causal arrow here isn't clear. Greater amounts of practice could be causing greater success, or greater levels of initial talent could be causing greater amounts of practice. We won't spend ten hours a day perfecting our guitar playing unless we're decent at it to begin with. In addition, research shows that across many domains, such as science, art, and music, individuals rarely attain remarkable intellectual accomplishments until they've dedicated themselves intensely for at least ten years—or to be a bit more precise, 10,000 hours—in that domain (Gladwell, 2009; Simonton, 1997). So the familiar Hollywood stereotype of the teenager or young adult who achieves astonishing intellectual brilliance with virtually no effort is exceedingly unrealistic.



? Are Hollywood movies like the 1997 movie *Good Will Hunting* accurate in their portrayal of childhood or adolescent geniuses exerting minimal effort to make astonishing intellectual discoveries? Why or why not? (See answer upside down on bottom of page.)

◀ CORRELATION VS. CAUSATION

Can we be sure that A causes B?

Assess Your Knowledge FACT or FICTION?

1. Today, IQ is measured as mental age divided by chronological age, multiplied by 100. **True / False**
2. Standard IQ tests administered in infancy tend not to be highly predictive of later IQ scores. **True / False**
3. Although IQ scores predict school achievement, they're almost useless for predicting occupational success. **True / False**
4. The most prevalent form of mental retardation is mild retardation. **True / False**
5. Research suggests a close link between extremely high intelligence and severe mental illness. **True / False**

Answers: 1. F (p. 332); 2. T (p. 337); 3. F (p. 338); 4. T (p. 340); 5. F (p. 341)

Study and **Review** in **MyPsychLab**

Answer: No, because research shows that such discoveries almost always require a decade or more of hard, concentrated work in a specific area.