

Intelligence

In this chapter, you will learn about:

- theories for understanding intelligence
- intelligence testing
- the range of mental abilities from creativity and giftedness to mental retardation

Prompted by the achievements of his half-cousin Charles Darwin, Sir Francis Galton in the mid-1800s became interested in what accounts for individual differences. From his work emerged the concept of measuring intelligence. Because Galton believed that intelligence was inherited, his work also sparked a great deal of controversy, which has followed this field of study for over a century.

How much of intelligence is inherited, and how much is due to upbringing? What exactly is intelligence, and what do test scores mean? Why do some people with high IQ scores become underachievers, while others with average IQ scores become leaders? How does intelligence relate to creativity and artistic or athletic abilities?

Human beings are uniquely intelligent, and the form of that intelligence is unique in each of us.

What Is Intelligence?

Think of someone you recently met and ask yourself how you could tell if that person is intelligent. You may list things such as “catches on to new ideas quickly, speaks well, reads a lot.” We think we can recognize intelligence—and its opposite!

Intelligence can be defined as the ability to learn and to adapt to the environment. But not even psychologists who have spent their entire careers researching intelligence can agree on what intelligence really is.

Ask 25 experts in the field what intelligence is, as Robert Sternberg and Douglas Detterman did in 1986, and you’ll get 25 different responses with little overlap. Here are a few replies:

- * Different abilities to solve problems.
- * Proficiency in mental performance.
- * Knowledge and skills available at a single time.
- * Independent abilities operating as a complex system.

Psychologists who study intelligence tend to fall into **two** general groups:

GROUP 1: believes that there is one measurable, general intelligence.

GROUP 2: proposes that there are multiple kinds of intelligence, such as musical, interpersonal, and practical intelligences, in addition to the logical-mathematical intelligence that is traditionally tested.



What Is Intelligence?

acquiring and using knowledge

solving problems

mental performance

juggling many ideas at one time

making sense of things

ability to reason, to understand complex ideas

The Origins of Intelligence Testing

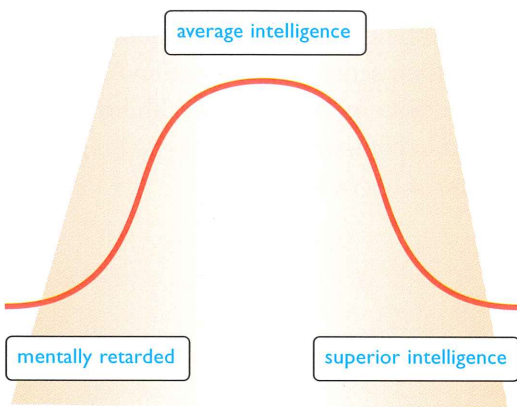
While the controversy over what defines intelligence grows, people continue to search for ways to measure it. An entire field of psychology has developed around testing. **Psychometrics** is the field of psychology that measures psychological characteristics, such as intelligence. For much of the twentieth century, the psychometric view of intelligence has dominated. That view holds that individual differences in mental ability can be measured by tests and that intelligence can be defined by variations in test scores.

The first tests were developed before anyone had attempted to study the meaning of intelligence. The roots of some current theories on intelligence grew out of concerns that traditional intelligence tests weren't assessing all there is to being intelligent. Many psychologists feel that intelligence is more than a score on a test, though tests are still used to define intelligence. A history of intelligence testing is a good place to start to understand the current theories on the nature of intelligence.

The Grandfathers of Testing

The achievements in the study of evolution of his half-cousin, Charles Darwin, prompted the British aristocrat Sir Francis Galton (1822–1911) to try to measure intelligence. Galton, who was interested in individual differences, wrote *Hereditary Genius* in 1869. He claimed that intelligence was inborn. He applied statistical concepts (then used only in astronomy) to intelligence, plotting intelligence in a population on a bell-shaped curve, with the average intelligence at the top of the curve.

Galton's Bell-Shaped Curve



We sometimes say that someone who is overly confident has a “big head.” French psychologist Alfred Binet actually began his explorations of intelligence before 1900 by measuring the size of people's heads. He thought at first that the bigger the head, the more intelligent the person, but this didn't prove to be true.

The testing movement grew out of Binet's studies when the director of public education in France asked for his help. Binet devised a test to measure the intelligence of Paris schoolchildren. He wanted to establish what was normal for each age from 3 to 11 years and to identify who would need special help. Binet had children put puzzles together, order objects by weights, define words, copy a figure from memory, and perform other activities that tested reasoning, judgment, persistence, and how well they could make adjustments to solve a problem. From his observations, he computed **mental age**, the age that he established was normal for a particular level of performance.

It was German psychologist William Stern who took this concept of mental age and developed a measure of intelligence called the **intelligence quotient: IQ** = $\text{mental age} \div \text{chronological age}$ (how old you are) multiplied by 100. If the Binet test showed that 17-year-old Jane had a mental age of 20, her IQ would be equal to $20 \div 17 \times 100 = 118$. IQ is no longer figured this way; it is calculated by comparing a person's score against the average score of others of his or her age.

IQ Testing Takes Hold in America

You may not remember ever taking an intelligence test, since they are not given as routinely now, but at one time in the United States, every schoolchild was tested. There are several intelligence tests in use, but the two oldest are considered the standards against which any new tests are compared. They are the Stanford-Binet Intelligence Scale and the Wechsler Intelligence Scales.

The Stanford-Binet Intelligence Scale

Binet's scale had been translated and used in the United States at the turn of the century, but the popularity of intelligence testing soared after 1916 when Lewis M. Terman revised it. While working at Stanford University, Terman gave his revised test the name Stanford-Binet Intelligence Scale, which became the gold standard of all IQ tests that followed.

The test increased the number of tasks required from Binet's 54 to 90 and, unlike Binet's, used the intelligence quotient as the end result. The Stanford-Binet launched the era of mass testing of IQ.

The Stanford-Binet is an individual test, which means that a trained psychologist gives the test one-on-one to each test-taker. It scores in **four** areas of cognitive ability:

1. Verbal reasoning (understanding words and their use).
2. Abstract/visual reasoning (forming mental pictures).

3. Quantitative reasoning (using numbers and measurement).
4. Short-term memory (remembering things just taught).

The Wechsler Scales

The other major individual tests were devised by David Wechsler (1896–1981) to assess a person's "overall capacity to understand and cope with the world around him." He put the emphasis in his tests on factors that didn't require using words. Rather than one final score, the Wechsler gives **three** scores:

1. Verbal scale (language, reasoning, and memory skills as are found in the Binet test).
2. Nonverbal performance scale (spatial relations, such as putting puzzles together, sequencing, and problem solving).
3. Full score, calculated by adding the two scores together.

There are three Wechsler tests, each aimed at a different age group: preschool, children, adults.

Unlike the original Stanford-Binet, which used a ratio IQ (mental age divided by chronological age), the Wechsler tests based their scores on a deviation IQ. This means that a person's mental ability is scored in comparison with the average person of his or her age.

Scoring Intelligence

An IQ above 130 = superior intelligence

120–129 = very high intelligence

110–119 = bright normal

90–109 = average

85–89 = low average

70–84 = borderline mental functioning

below 70 = mental retardation

Group Tests

Individual tests such as the Stanford-Binet and Wechsler require a trained psychologist to sit at a table with the student, ask questions, observe responses and the reasoning behind the responses, and then score the test. This is acknowledged to be the most accurate method, but it is also expensive to implement. Group tests are given to many people at one time, are done entirely on paper, and are scored by a computer. They are much less expensive and are considered reasonably accurate, but they test only verbal, not performance, skills.

An example of a group test is the Scholastic Aptitude Test (SAT), which you may already have taken. Millions of students have taken it since it was developed in the 1920s. The SAT is not, strictly speaking, an intelligence test, but in testing your aptitude (ability) to do college work, it is also measuring aspects of intelligence. Originally all multiple choice, since 1994 the SAT has featured some short-answer questions as well.

Questions About Testing

Several issues surround IQ tests, each fertile ground for further research and debate.

What Makes a Good Test?

A good psychological test should be **reliable** and **valid**. A test is considered reliable if the results are repeatable each time it is taken by the same people.

Reliability is established in **two** ways:

1. **Test/Retest.** The same person takes the same test at two different times, and the two scores are compared.
2. **Internal Consistency.** The same person responds to different questions that test the same concept to see if responses are consistent.

Validity is the true measure of a test's usefulness: Does the test score correspond to what it is supposed to be measuring? In the case of an intelligence test, is it an accurate measurement of intelligence? This is particularly hard to determine since there is no agreed-upon definition of intelligence. A great deal of work is being done on how to establish a test's validity. One way to check validity is to see if the test score corresponds with scores on more established tests—like the Wechsler—or with school grades. There is a growing sense that validation should also include an ethical question: Should the test be used for its proposed purpose?

What Do Test Scores Mean?

Psychologist Earl Hunt suggested that instead of thinking of intelligence tests as yardsticks, think of them as mental track meets. We should infer ability by combining scores within the test, much as athletic ability is inferred by combining the scores in a decathlon.

IQ has been strongly correlated to many important things that happen in life: schooling, occupation, and even whether someone follows the law. Much of life entails decision-making ability and reasoning power, which IQ is meant to predict. The higher your IQ, the more able you should be to deal with complex situations and decisions. A high IQ, however, no more guarantees success in life than a low IQ predicts failure. Intelligence is not the only factor affecting how you perform in school or on a job, but it may be the most important factor.

Other talents, abilities, and experiences are certainly essential to good performance in many jobs. Some psychologists in the field call these factors *personality traits* or *talents* and others call them *intelligences* (see the section on multiple intelligences later in this chapter).

Are IQ Tests Culturally Biased?

Intelligence tests are based on the premise that intelligence can be measured indirectly by testing people's knowledge and how they use it. But people have had different opportunities to obtain knowledge. And what knowledge is considered to be

important in one culture, even within the United States, differs from what other cultures value. IQ tests have been criticized for having **cultural bias**—that is, favoring one culture—white, middle-class American culture—over other cultural groups.

This charge has created controversy in the field of intelligence studies, and recently federal and state courts have ruled that IQ tests cannot be used alone to make decisions about children's placement in particular schools or classes.

Heredity and Environment

Intelligence is considered to be the result of both genetic and environmental factors.

Effects of Heredity

Most psychologists believe that heredity plays an important role in intelligence. There is no single gene for intelligence, just as there isn't a single gene for personality or even height. There are many, as yet unidentified, genes involved.

An important way researchers have tried to tease out the genetic versus the environmental influences on people's differences in intelligence is through twin and adoption studies. Studying twins is a great way to get a handle on **genetic inheritability**—how much intelligence is due to genes—because identical twins have inherited the exact same genes from their parents. Fraternal twins and siblings share half of the same genes.

Effects of Environment

Environmental influences are usually divided into **two** categories:

- 1. Shared Environment.** You and your brothers and sisters are influenced by your shared environment: you were all raised in the same family, in which such factors as socioeconomic status and the level of your parents' education was the same for each of you.
- 2. Nonshared Environment.** Some things about your upbringing are unique to just you, such as the quality of attention you received from your parents; your friends; your life experiences; and the choices you make of activities, hobbies, and higher education. These are examples of a nonshared environment.

Twin Studies

There are **two** kinds of twins:

- 1. Identical Twins.** These twins developed in their mother's womb from a single fertilized egg. They are both the same sex. They have exactly the same genes.
- 2. Fraternal Twins.** These twins are as different genetically as any brothers or sisters. They developed in the womb from different eggs. They can be the same sex, or they can be of opposite sexes.

Researchers have found that identical twins who are adopted at birth by different people and raised apart have IQs more similar than fraternal twins who are raised together. This shows the power of genes

over shared environment. Adoption studies have also shown that siblings raised in the same family (shared environment) are no more similar than siblings adopted away by different families. Genes are important, nonshared environment is important, but shared environment does not appear to be important at all.

Twin studies by Thomas Bouchard at the University of Minnesota and others have found that the effects of the environment on intelligence fade, rather than grow, with time. How much control have your parents and schools had in your life up until now? As you become more independent and make your own choices, it is your genetically influenced personality and preferences that may lead you to choose your experiences.

Recent Research

The American Psychological Association in 1996 appointed a task force of psychologists, chaired by Ulric Neisser, to examine what is known and unknown about intelligence and its measurement. They tried to distinguish sharply between scientific research and politics. As the report stated, "The study of intelligence . . . needs self-restraint, reflection, and a great deal more research." Here are some of their findings:

- * Intelligence includes a genetic component, but just how genes contribute to individual differences in intelligence is not known.

- * Environmental factors—such as attendance at school—are important to the development of intelligence, though it is not known what aspects of schooling are important.
- * No important gender differences appear in overall intelligence test scores, though there are differences in specific abilities: males tend to score higher on visual-spatial and math skills, and females on verbal skills.
- * Intelligence scores partially predict achievement in school—grade point average and number of years of education you complete—and to some extent what you accomplish outside of school, such as your career choice.
- * Traditional tests do not sample all forms of intelligence, particularly not creativity, wisdom, practical sense, and sensitivity.

Exciting research continues to investigate the role of genes in intelligence. In May 1998, Robert Plomin of the Institute of Psychiatry in London reported the discovery of a gene variation that is statistically linked to high intelligence, perhaps by influencing the brain's metabolic rate. Reports in September 1999 claimed that scientists had genetically changed a protein in mice to make them more intelligent. Genes are not the whole answer to the question of what makes us intelligent. It remains to be seen how much of the answer they are.

Approaches to Understanding Intelligence

It pays to be smart, but we are not all smart in the same way. You may know every baseball score over the past five years for your home team but may be only average at math. You may be a talented musician but might not like to read books. Each of us is different.

Psychologists disagree about what is true intelligence and what are talents or personal abilities. As a result, different theories abound on what intelligence is. Experts on intelligence tend to fall into one of two camps: those who believe there is one general intelligence and those who assert that there are many different intelligences.

Some psychologists say:

"There is one general intelligence."

Charles Spearman
Arthur Jensen

"There are many intelligences."

Howard Gardner
Robert Sternberg
L. L. Thurstone

One General Intelligence

This approach to intelligence is the bedrock on which the industry of intelligence testing is based. Proponents say there is one factor for intelligence, called **G**, that can be measured with IQ tests and that predicts success in life. They point to data that show that people who do well on one kind of test for mental ability do well on others—whether it is a test using words, numbers, or pictures; and whether it is an individual or group test, written or oral. Those who do poorly also do so consistently on all tests.

Spearman's G

It was British psychologist Charles Spearman (1863–1945), at the turn of the twentieth century, who identified this consistent marker of intelligence and called it “G,” using a statistical method called **factor analysis**. G is the factor isolated statistically that distinguishes those who are considered gifted, average, or retarded. Spearman also theorized another factor, called “s,” for special factors: various abilities that together with G determine the depth and direction of intelligence. For example, how someone does in math is dependent on his or her G, general intellectual ability, and on his or her aptitude and education in math: s. But Spearman considered G by far the most important factor.



Artificial Intelligence (AI)

Simple tasks such as picking up blocks are easy for humans to do. But how do you get a computer to accomplish a task like that? It takes a complex number of steps to program a computer to accomplish those same simple tasks. Computer scientists have come a long way in their study of artificial intelligence (AI), which is the attempt to make machines and computers act or think as we expect people to. To mimic human thought, computers are being programmed to adapt and learn, detect patterns and draw conclusions, and improve upon them-

selfs. A great deal about the workings of the human mind—learning, planning, explaining, perception, emotion, reasoning—has been learned in the process. AI technology is being used in medicine to assist doctors in making diagnoses of illnesses and in the banking industry to spot credit card fraud. Computers may someday be able to give advice, but will they have common sense? No one knows whether a computer will ever be able to think and feel like a human. But it is worth remembering that computers and robots are designed to help humans, not replace them.

Many intelligence theorists have cited the importance of G, although they don't necessarily agree on what this G actually means. Some describe it in terms of its statistical regularity, others as mental energy, general ability in abstract reasoning, or as an index for measuring neural processing speed.

Speed and Efficiency

Studies have shown a biological basis for general intelligence. The speed of nerve conduction is related to IQ: the brains of bright people use less energy during problem solving. The brain waves of people with higher IQs show a quicker and more consistent reaction to simple triggers such as clicks. This has led some researchers to suppose that differences in G result from differences in the speed and efficiency of information processing along nerve pathways of the nervous system.

Arthur Jensen and others have done simple reaction-time tests to see if there are differences among people with different IQ levels. In the simplest reaction-time studies, the person being tested places her index finger on a button and must immediately lift the finger and press a response button when a light comes on. The time between the light and the release of the finger from the first button is called the decision time: this is slightly faster in those with higher IQs. As the tasks are made more complex, an even stronger relationship between IQ and *decision times* develops. This relationship is the same across all age groups, racial-ethnic groups, and for both men and women.

Much other work on the biological basis of intelligence points to intelligence being the "efficient functioning of the brain," wrote Hans Eysenck in 1999. In his view, G is the energy of the brain that enables it to do its intellectual work.

Multiple Intelligences

L. L. Thurstone (1887–1955) was among the first to propose that a person can be intelligent in numerous ways. His Multiple-Factors Theory states that intelligence is made up of seven distinct mental abilities: verbal comprehension, word fluency, number facility, spatial visualization, associative memory, perceptual speed, and reasoning. He viewed them all as independent abilities that were not associated with one G factor.

Many others believe in more than one intelligence, claiming that traditional IQ tests ignore creative, artistic, and practical skills. Few agree, however, on how many or what these other intelligences are. J. P. Guilford constructed a three-dimensional cube that identified 150 intelligences! Daniel Goleman has made a case for a different way of being smart—emotional intelligence—which includes self-awareness, self-discipline, and empathy. And many alternative views to intelligence propose that it is learnable—that you can learn to increase your mental abilities.

Two theories that have received a great deal of attention are Howard Gardner's Theory of Multiple Intelligences and Robert Sternberg's Triarchic Theory.

Gardner's Eight Intelligences

Intelligence	Description	Examples in People
1. Linguistic intelligence	Using language; expressing what's on your mind and understanding people	Poets, writers, editors, journalists, speakers, lawyers
2. Logical-mathematical intelligence	Using numbers and quantities; reasoning well, understanding the underlying principles of things	Mathematicians, scientists, economists, computer programmers
3. Spatial intelligence	Forming a mental model of some kind of physical space	Navigators, chess players, architects, sculptors, cartoonists, hairdressers
4. Musical intelligence	Thinking in terms of music; hearing and recognizing patterns; creating music	Musicians, composers
5. Interpersonal intelligence	Understanding other people, perceiving their feelings, knowing how to communicate and work collaboratively	Group members, leaders, teachers, counselors
6. Intrapersonal intelligence	Understanding yourself, who you are, and what you can and can't do	Useful in any pursuit
7. Body-kinesthetic intelligence	Using your whole body or parts of your body to solve a problem, make something, or put on some kind of production	Athletes, performing artists such as dancers and actors
8. Naturalist intelligence	Recognizing and classifying landforms and bodies of water, plants, minerals, and animals	Mapmakers, farmers, hunters, botanists, chefs

Gardner's Theory of Multiple Intelligences

There is an old saying about developmental psychologists: when a developmental psychologist has one child, all children are seen as alike; when he or she has two children, the world is seen as split into two kinds of people: extroverts and introverts, masculine and feminine. But when a developmental psychologist has three children, all children are acknowledged to be different.

Howard Gardner, a developmental psychologist at the Harvard School of Education, has four children and does indeed believe that all children are different and shouldn't be assessed by one narrowly defined test of verbal and logical-mathematical intelligence. He doesn't deny that G exists, but he doesn't think it predicts much outside of formal schooling. He believes that the human mind has a range of intelligences, which allow us to solve the kinds of problems we are presented with in life. Each of us has differing abilities within these intelligences, and he believes that the purpose of school should be to encourage the development of all of our intelligences.

Gardner cites a biological base for his theory: when one part of the brain is injured, for example the area for musical abilities, the person can still talk; people who lose their linguistic abilities can still sing. There is not just one intelligence to lose, he maintains. In 1983 he identified seven intelligences, to which he added an eighth ten years later.

The Triarchic Theory of Intelligence

Robert J. Sternberg performed so poorly on his first IQ test in the sixth grade that school authorities had him retake the test with fifth-graders. This seemed so absurd to him that he didn't suffer from test anxiety and easily scored well. As a science project that year, he devised his own Sternberg Test of Mental Ability, a foreshadowing of his professional interest to come. He graduated from Yale, earned a Ph.D. from Stanford, and has been on the faculty of Yale's Department of Psychology ever since.

Good test-takers on traditional tests, he believes, tend to be great in analytical intelligence but not necessarily in the creative and practical aspects of intelligence. His triarchic theory proposes that there are **three** major intelligences that interact and are expressed in many different skills and abilities:

1. **Componential mental processes** together produce the ability to learn and use new knowledge effectively.
2. **Experiential intelligence** is illustrated by the use of past experience to gain insight for new situations. This intelligence is seen when someone adjusts well to new tasks.
3. **Contextual intelligence** involves matching one's activities to the environment wisely. (A study of Brazilian street children revealed they can do the math that they need to run their street businesses, but are unable to pass a math class in school.)

The Diversity of Mental Ability

Intelligence was once thought to be like a can of paint: a genius would have a gallon of it; the person with retardation would have only half a pint; the rest of us would have varying amounts between those extremes. But this is really only part of the story. Many other ingredients make intelligence what it is.

We all have intellectual gifts. We are all athletic and musical. But only to a degree. We don't all achieve at the same level. Not everybody can win an Olympic medal or a Nobel Prize, write a masterpiece, or come up with a scientific equation that will change the concept of life as we know it. Clearly, in the powers of intellect that we all possess, there are extremes.

Giftedness

Usually when we say that someone is gifted—as in “gifted musician” or “gifted athlete”—we know that person has exceptional abilities. But in terms of intelligence, there is much disagreement over the definition of giftedness. IQ is the standard means of identifying superior intelligence, and **giftedness** most commonly implies an IQ above 130 or 140 or that the child is in the top 3 to 5 percent of all students. But those theorists who criticize IQ testing as a measure of intelligence certainly don't believe in defining giftedness by IQ! Howard Gardner, for example, would say that someone could be gifted in any one or more of his eight areas of intelligence.

As the concept of intelligence has expanded, so too has giftedness to include not just superior intelligence but high performance in creativity, leadership, and performing arts. Giftedness shows up in children with excellent memories, vocabularies, or attention spans; exceptional imaginations, curiosity, or powers of observation; unusual abilities in music or the arts; and in the complexity and creativity of the ways they process information.

A major study started by Lewis Terman in the 1920s debunked many of the myths surrounding gifted children. They are not socially maladjusted loners, nor are they usually geniuses. These children are more likely to excel physically, emotionally, and socially in their lives. They become productive and accomplished as adults, but their achievements are not necessarily extraordinary.

Gifted children tend to thrive on encouragement. Young gifted children need intensive nurturing of their abilities to reach their potential. There is no consensus on how best to educate—or even how to identify—gifted children, however. Should gifted children remain in regular classes, or should they be placed in special classes? Parents and educators continue to debate this question.

A few who are gifted make great achievements in life, but perhaps only a few in every generation might be called geniuses, those with extraordinary intellect or creativity.



Intelligence and Mozart

Listening to Mozart may develop your enjoyment of classical music, but it will likely have little effect on your IQ. The weight of evidence is now against the existence of the “Mozart Effect,” the IQ-boosting powers of a 10-minute sonata, first described in a 1993 study. The subjects in this study were college students, but the results were applied to many different groups of people. For example, based on that study, a whole industry of Mozart baby products sprung up. Pregnant women bought Mozart CDs to play to their babies even before birth. But soothing though classical music may be, two studies in the journal *Nature* in 1999 found it has no effect on intelligence.

Creativity

What is creativity? What role does it have in intelligence? Consider the role creativity played in the lives of these inventors.

- * Edward Land was taking pictures of his family while on vacation when his young daughter asked, “Why do we have to wait to see the pictures?” Why

indeed? thought Land, who, when he returned to his laboratory in Boston, invented the Polaroid camera and instant photography.

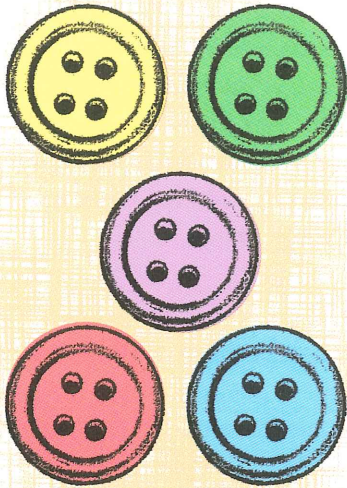
- * While sitting on a hillside in Idaho at age 14, Philo Farnsworth had the inspiration that resulted in television. The neat rows on a nearby farm gave him the idea of creating pictures on a cathode ray tube out of rows of light and dark dots. He used this concept in a science project in school the next year and, when he was 21, demonstrated the first working model of a television.
- * Albert Einstein started his work on relativity by imagining what things would look like if he traveled on a beam of light. For him, figuring out how to think about the problem was key to coming up with his Theory of Relativity.

There is a mystique about creativity. Where does it come from? Why do some people seem to have lots of it? How can we be more creative? **Creativity** is simply defined as the ability to develop ideas or products that are original, valued in a particular culture, and useful when completed. As you can see from the examples above, giftedness and talent often overlap with creativity.

Creative people are those who come up with new ideas or products, the creative process results in them, and a creative environment fosters their production. These three areas—creative people, the creative process, and the creative environment—are the major focus of research on creativity.

Creative Exercise

Rearrange five buttons so that each button touches every other button.



▲ Creativity is imagining different possibilities. It is seeing the same thing as others see, but seeing it in a new way. Turn the page to find a solution to this exercise.

J. P. Guilford spurred on creativity with his presidential address to the American Psychological Association in 1950. He presented the argument that traditional intelligence testing measures **convergent thinking**, the ability to choose a logical answer from a selection of possibilities, but not **divergent thinking**, a thought process that results in many original and different solutions or ideas.

For example, an airline pilot can be highly intelligent in terms of memory (knowing what all the dials and buttons mean), reasoning powers, and following routine instructions. But if a situation comes up for which the pilot was not

trained—a terrorist has planted a bomb that will be activated when the landing gear goes down—an entirely new set of responses requires divergent thinking.

A flurry of work followed Guilford's presentation. At first people tried to develop tests of creativity and deductive thinking. E. P. Torrance, for example, devised a number of creativity tests for children and documented the relation between test scores and "creative" real-life performances decades later (starting a business, a journal, or an organization). But other researchers question whether testing high on divergent thinking really reflects all the mental processes that over a lifetime lead to genuine creative contributions.

Others have attempted to use mathematical or computer simulations of the creative thought process or have studied the lives of well-known creative people. Studies of creative people, for example, find that they have such traits in common as:

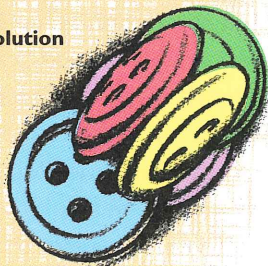
- * Self-reliance.
- * Sensitivity.
- * Living on the fringes of the culture they inhabit.
- * Behaving in a childlike way.

Creativity is not just useful in the arts. Scientists tap their creativity to make discoveries. Business executives want creative employees to develop new product ideas and innovations that will bring in more money. We could all benefit from more creativity in our lives. But only a few people in any generation break through with radically new ideas. The mental processes it takes to do this are still a mystery.

Solution to Creative Exercise



Two Views of the Solution



▲ You can arrange the five buttons so that each touches the other in this manner.

Mental Retardation

A person is defined as **mentally retarded** if his or her IQ is below 70 to 75 on either the Stanford-Binet Scale or the Wechsler intelligence scales and he or she is significantly limited in the skills necessary for daily functioning.

Mental retardation affects one out of every ten American families of every racial, ethnic, social, and educational background. It is caused by something that impairs the development of the brain before birth (abnormal genes, use of alcohol or drugs by the pregnant mother), during birth (oxygen deprivation), or in the childhood years (from disease, head injury).

IQ tests originally measured the various extremes of retardation from “borderline,” “mild,” “moderate,” and “severe” down to “profound.” But since 1992 when the American Association of Mental Retardation revised its classification system, the emphasis is no longer on establishing the level of disability. It is focused instead on what abilities an individual does have and what community supports he or she needs to improve daily living.

Savants

Savants are a prime example of the fact that intelligence is not a simple continuum from genius to mentally retarded. **Savants** have IQs below 70 but display extraordinary abilities in one area of competence: musical, memory, or math. Savant syndrome is often associated with *autism*, a psychological disorder first seen in childhood that is marked by social and language impairment and repetitive behavior such as rocking or swaying.

In the movie *Rain Man* (1988) Dustin Hoffman plays Raymond Babbit, an autistic savant who doesn’t have a clue how to count money or survive in the world outside the institution he was placed in as a child. But tell him your birthday and he will tell you the day of the week you were born on. Ask him to multiply huge numbers and he can calculate them in his head.

The existence of savants means that at least in some circumstances, mental skills can be surprisingly independent and not controlled or limited to the person’s general intelligence.

CRITICAL THINKING



Should IQ Tests Be Used by Society?

Are IQ tests useful tools or should they be discarded? Consider what they're good for. Then read about the issues and decide.

THE ISSUES

At one time in our society, IQ tests were considered so important that every child took them. Now they are rarely given.

Some psychologists argue that despite the controversy surrounding them, IQ test scores predict academic performance and future life, including careers. They measure very well the general mental ability necessary to reason, plan, solve problems, learn quickly, and understand complex ideas. IQ tests can identify children who need extra attention at both ends of the spectrum—the mentally retarded and gifted.

Other psychologists believe that IQ tests are culturally biased and that reliance on them to make decisions about children's education can harm rather than help them. They also argue that IQ tests don't measure creativity and other abilities or talents that are important to success in life. An individual's intellectual worth shouldn't be reduced to one test score.

Are IQ tests useful in our society, or should they be discarded?

THE PROCESS

- 1 Restate the question.** In your own words, state the nature of the disagreement.
- 2 Provide evidence.** From your own experience, and from the information presented in this chapter, list evidence that *supports* the usefulness of IQ tests.
- 3 Give opposing arguments.** List information that is *critical* of IQ tests.
- 4 Look for more information.** What else do you want to know about IQ tests? Make a list of questions and search the Internet, an encyclopedia, or the psychology section of the library.

- 5 Evaluate the information.** Make a chart with two columns:

IQ Tests as Tools of Society	
<u>Use Tests</u>	<u>Discard Tests</u>

Record the evidence and give each item a number from 1 to 5. Number 1 is most important.

- 6 Draw conclusions.** Write one paragraph supporting your answer to the question "How Useful Are IQ Tests?" Be sure to provide evidence for your opinion.

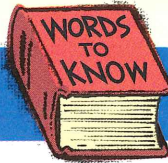
Chapter 10 Wrap-up

INTELLIGENCE

Intelligence is a palette of colors we're born with, learn to use, and add to. Intelligence colors our lives. Our survival—but more than that, our enjoyment of life—depends on it.

Individual differences in intelligence can be measured through tests. IQ tests are powerful, but perhaps limited, barometers of intelligence. Some psychologists believe that there are other kinds of intelligences and that our value to society should not be reduced to one number, the IQ. Psychologists don't agree, and perhaps never will, on exactly what intelligence is. It is much more complicated than simply whether one is "smart" or not.

Psychology



convergent thinking—thought process that leads to one logical choice from among several. *p. 167*

creativity—ability to develop original ideas or products that are valued and useful. *p. 166*

cultural bias—favoring of one culture group over others. *p. 158*

divergent thinking—thought process that results in many original or different solutions or ideas. *p. 167*

factor analysis—statistical technique that isolates what exactly a test is measuring. *p. 161*

G—Spearman's one measurable factor of general intelligence, shared by all mental processes. *p. 161*

genetic inheritability—way of plotting how much a trait such as intelligence is due to inherited genes. *p. 158*

giftedness—high intelligence; also includes high performance in visual and performing arts, creativity, leadership, and physical dexterity. *p. 165*

intelligence—ability to learn and to adapt to the environment. *p. 154*

intelligence quotient (IQ)—measure of intelligence level relative to others of the same age. *p. 155*

mental age—age Binet established as normal for a certain level of performance on his test. *p. 155*

mentally retarded—condition of having an IQ below 70–75 and significant limitations in the skills necessary to daily life. *p. 168*

psychometrics—field of psychology that develops and uses tests to measure psychological characteristics such as intelligence. *p. 154*

reliable—test condition characterized by achieving similar results from the same people. *p. 157*

savants—people whose IQs are below 70 but who have extraordinary abilities in one area of competence. *p. 168*

valid—test condition in which the test measures what it is supposed to be measuring. *p. 157*