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# Testing and Individual Differences

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## I. THEORIES OF INTELLIGENCE

### A. WHAT IS INTELLIGENCE?

1. Psychologists have vigorously debated the nature of intelligence. For example, is intelligence a single general ability? Or is intelligence a cluster of different mental abilities?
2. Psychologist David Wechsler (1896–1981) formulated the following widely-accepted definition of intelligence: “The global capacity to think rationally, act purposefully, and deal effectively with the environment.”

### B. CHARLES SPEARMAN AND THE G FACTOR

1. During the 1920s, British psychologist Charles Spearman (1863–1945) observed that an individual’s scores on various tests of intellectual performance correlated with one another. That is, people who performed well on a test of one mental ability, such as mathematical reasoning, tended to also do well on verbal ability and other tests.
2. Based upon this observation, Spearman proposed that intelligence is a single underlying factor, which he termed general intelligence or the g factor.
3. Spearman concluded that the g factor could be expressed as a single number, such as an IQ score.

### C. RAYMOND CATTELL AND THE TWO SUBTYPES OF G

1. Raymond Cattell’s research studies led him to conclude that Spearman’s concept of general intelligence could be broken

down into two relatively independent components that he called fluid and crystallized intelligence.

2. Fluid intelligence (gf)
  - ▶ Fluid intelligence includes memory, speed of information processing, and reasoning abilities, such as forming new concepts, seeing underlying relationships, and quickly solving unfamiliar problems.
  - ▶ Cattell believed that fluid intelligence is innate and thus independent of education and experience.
  - ▶ Note that fluid intelligence, like other biological capacities, declines with age.
3. Crystallized intelligence (gc)
  - ▶ Crystallized intelligence refers to the store of knowledge and skills gained through experience and education.
  - ▶ Crystallized intelligence remains stable or increases slightly with age.



Make sure you know the difference between fluid intelligence and crystallized intelligence. Remember that “fluid” means to flow and fluid intelligence changes throughout life. In contrast, “crystallize” means to take a definite form. Crystallized intelligence takes a definite form and remains stable, or even increases slightly, as a person ages.

#### D. ROBERT STERNBERG AND THE TRIARCHIC THEORY OF INTELLIGENCE

1. Contemporary cognitive theorists now believe that intelligence is a collection of separate and different abilities.
2. Robert Sternberg’s (b. 1949) triarchic theory of intelligence identifies the following three aspects of intelligence:
  - ▶ Analytical intelligence—logical reasoning skills that include analysis, evaluation, and comparison.
  - ▶ Creative intelligence—imaginative skills that include developing new inventions and seeing new relationships.
  - ▶ Practical intelligence—practical “street smart” skills that include coping with people and events.

3. Sternberg believes that each of these three intelligences is learned, and therefore, can be developed and enhanced.

## E. HOWARD GARDNER AND MULTIPLE INTELLIGENCES

1. Howard Gardner (b. 1943) points out that different cultures recognize and value different abilities. For example, the Hapsburg rulers of Austria prized and rewarded musical skills. As a result, musical geniuses, such as Mozart and Beethoven, transformed Vienna into the music capital of Europe.
2. Gardner believes that musical intelligence is one of a number of “multiple intelligences” that are recognized and defined within the context of each culture. Gardner’s ever-growing list of intelligences ranges from the linguistic skills demonstrated by writers to the kinesthetic skills demonstrated by athletes.

## II. THE DEVELOPMENT OF INTELLIGENCE TESTS

### A. ALFRED BINET

1. During the early 1900s, French psychologist Alfred Binet (1857–1911) designed a series of tests to measure the mental abilities of school children. Binet focused on mental abilities such as memory and the ability to distinguish similarities and differences.
2. Binet soon discovered that brighter children performed like older children. For example, a bright 8-year-old might be able to answer the same number of questions as an average 10-year-old. This insight led Binet to make a distinction between a child’s mental age and a child’s chronological age.
3. Binet used his new test to compute an average score for each age level. He then compared each child’s performance against the average abilities of a given age group. For example, if a child’s score was the same as the average score for a group of 8-year-olds, the child was said to have the mental age (MA) of an 8-year-old, regardless of his or her chronological age (CA).

## B. LEWIS TERMAN AND THE STANFORD-BINET INTELLIGENCE TEST

1. Binet's pioneering work impressed Stanford University psychologist Lewis Terman (1877–1956). Within a short time, Terman developed a revised test that he called the *Stanford-Binet Intelligence Scale*.
2. Terman used the following formula to compute a child's intelligence quotient or IQ:  
$$\text{IQ} = \text{Mental Age (MA)} \div \text{Chronological Age (CA)} \times 100$$
3. For example, an 8-year-old child who correctly answered the same number of questions as a 10-year-old would have a mental age of 10. Using the Stanford-Binet IQ formula, the child would have an IQ of  $10/8 \times 100$  or 125.

## C. DAVID WECHSLER AND THE WECHSLER INTELLIGENCE SCALES

1. David Wechsler (1896–1981) strongly believed that intelligence involved a variety of mental abilities. First published in 1955, the *Wechsler Adult Intelligence Scale (WAIS)* yielded separate verbal and performance scores.
2. Like the Stanford-Binet test, Wechsler's test yielded a final single IQ score. However, Wechsler used a new approach to calculate the IQ score. Instead of using the Stanford-Binet's IQ formula, Wechsler determined how far a person's score deviates from the scores of others in the same group. The group scores formed a bell-shaped curve with a statistically fixed mean score of 100. This normal distribution means that 34 percent of individual scores are one standard deviation or 15 points below 100 and another 34 percent are one standard deviation or 15 points above 100. Thus, 68 percent of all individuals score between 85 and 100. Today, the Stanford-Binet and most other intelligence tests use this system.
3. In addition to his test for adults, Wechsler developed intelligence tests for preschool and school age children. The Wechsler tests are now the most widely-used measures of intelligence.

### III. PRINCIPLES OF TEST CONSTRUCTION

#### A. STANDARDIZATION

1. Suppose you correctly answered 40 of 50 questions on an intelligence test. Did you perform well or poorly?
2. In order to determine how well you performed, your score must be compared to a standard of performance. Standardization means that the test has been uniformly presented to a large, representative sample of people. The scores of this representative group set the norms or standards against which the performance of later test takers can be evaluated.
3. Standardized norms for the Stanford-Binet and the Wechsler tests all form a bell-shaped curve so that 68 percent of the scores occur within one standard deviation above or below the mean.

#### B. RELIABILITY

1. A trustworthy test must be reliable. Reliability means that a test must produce consistent results when it is administered on repeated occasions.
2. Reliability can be determined by the test-retest method in which researchers compare participants' scores on two separate administrations of the same test. The test demonstrates a strong reliability if there is a high positive correlation between the two test scores.
3. Reliability can also be determined by a procedure known as the split-half method. In this procedure, a test is divided into two equivalent parts. The researcher then determines the degree of similarity between scores on the two halves of the test. For example, there should be a very high correlation between the odd and even numbered questions on a test.

#### C. VALIDITY

1. A trustworthy test must also demonstrate validity. Validity is the ability of a test to measure what it was designed to measure.

2. Criterion validity is a key measure of test validity. Tests demonstrate criterion validity when test scores can be used to predict another relevant measure. For example, your AP Psychology exam is an achievement test designed to measure your knowledge of the material in a college-level introductory psychology course. The AP Psychology exam would demonstrate criterion validity if high scores on it are correlated with high scores in college psychology courses.



*The concepts of reliability and validity consistently generate a number of multiple-choice questions. In order to nail down the definition of reliability, you might mentally connect the “R” in reliability with the “R’s” in repeatable results. Remember that a test can be reliable without being valid. For example, a driver’s education course could have a written test that demonstrates reliability, but is not correlated with how well a student performs on an actual road test.*

## **IV. EXTREMES IN INTELLIGENCE: MENTAL RETARDATION AND GIFTEDNESS**

### **A. MENTAL RETARDATION**

1. The label “mentally retarded” is applied to individuals who score significantly below average in general intellectual functioning. Only about 1 to 3 percent of people are classified as mentally retarded.
2. Genetic abnormalities, such as Down syndrome, can cause retardation. Prenatal exposure to alcohol and other drugs can also cause mental retardation.

### **B. MENTAL GIFTEDNESS**

1. The label “mentally gifted” is applied to individuals who score significantly above average in general intellectual functioning. Only about 1 to 3 percent of people are classified as being mentally gifted.

2. Lewis Terman's study of gifted children
  - ▶ *Lewis Terman conducted the best-known and most extensive study of gifted children. Terman identified 1,528 California grade school children with IQs of 140 or higher. He then conducted a longitudinal study by tracking the children's progress through school and into adulthood.*
  - ▶ *Affectionately known as the "Termites," the gifted children went on to achieve a high level of academic and career success. Although most of the Termites led happy and fulfilling lives, their high IQ did not guarantee success. For example, the group's divorce rate nearly equaled the national average.*

## **V. TEST SCORES AND THE SELF-FULFILLING PROPHECY**

### **A. THE SELF-FULFILLING PROPHECY**

1. IQ and other test scores can be very powerful labels that affect how others see a person and how a person sees himself or herself.
2. A self-fulfilling prophecy occurs when a person's expectations of another person leads that person to behave in the expected way.

### **B. A STUDY**

1. Robert Rosenthal and Lenore Jacobson tested the effects of the self-fulfilling prophecy in an unidentified elementary school called "Oak School." The researchers informed elementary school teachers that about 20 percent of their students were academically gifted "spurters." In reality, Rosenthal and Jacobson randomly selected the "spurters."
2. At the end of the year, the teachers demonstrated a self-fulfilling prophecy when they reported that the "spurters" were more curious, happier, and better adjusted than the other students. The "spurters" academic performance proved to be consistent with their teacher's biased expectations. They achieved high grades and made substantial gains in IQ points.



*The concept of the self-fulfilling prophecy has played a particularly prominent role in the free-response questions of the AP Psychology exam. For example, in 1995, test writers asked students to explain how the self-fulfilling prophecy contributes to prejudice. In 2000, a free-response question asked how the self-fulfilling prophecy might affect student performance in a school without grades. It is very important to remember that a self-fulfilling prophecy can have both positive and negative effects.*

## **VI. THE IMPACT OF HEREDITY AND ENVIRONMENT ON INTELLIGENCE**

### **A. HEREDITY**

1. Studies of identical twins support the hypothesis that intelligence is, in part, inherited. For example, the IQ correlation for pairs of identical twins is greater than for pairs of fraternal twins.
2. Studies of adopted children show that their IQs are more strongly correlated with their biological mother's IQ than with their adoptive mother's IQ.

### **B. ENVIRONMENT**

1. Studies of identical twins reared separately support the hypothesis that environment plays an important role in determining IQ. For example, the correlation between the IQ scores of identical twins reared separately is lower than those of identical twins reared together.
2. Studies also find that early enrichment programs can have a positive impact on children's IQ scores.