

We all take many standardized tests and receive scores that tell us how we perform. Given the world in which we have grown up, it is almost unimaginable that there ever could have been a time during which people’s mental abilities were not measured and tested. **Francis Galton** was a pioneer in the study of human intelligence and testing, who initiated the use of surveys for collecting data and developed and applied statistics toward its analysis. In this chapter, we will review **what makes for a good test, how to interpret your scores on such tests, and what different kinds of tests exist.** Then we will focus on one of the most tested characteristics of all, intelligence.

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

If you learn only 5 things about Intelligence...

1. **Binet** created the first intelligence test and developed the concept of mental age, but **Terman's** revision, the **Stanford-Binet**, created a way to compute an IQ score.
2. **Aptitude tests** predict future success and **achievement tests** assess what individuals already know.
3. When designing tests, psychometricians focus on **standardization, reliability, validity, and culture fairness.**
4. **Normal distributions are bell-shaped curves** in which most scores fall near the average and the percentage of scores between **standard deviations** is fixed by a formula.
5. **Reliability** refers to a test being repeatable and validity refers to a test being accurate.

Learning Targets:

- ★ Explain the **theories** that have been created for **understanding intelligence**
- ★ Compare the different **modes of intelligence testing**
- ★ Explain how the **range of mental abilities**, from creativity and giftedness to cognitive dysfunction (formerly known as mental retardation), can be identified, explained, and understood.

Terms to know:

intelligence: mental quality consisting of the ability to learn from experience, solve problems, and use knowledge to adapt to new situations

factor analysis: a statistical procedure that identifies clusters of related items (called factors) on a test; used to identify different dimensions of performance that underlie one's total score

general intelligence (g): a general intelligence factor that according to Spearman and others underlies specific mental abilities and is therefore measured by every task on an intelligence test

savant syndrome: a condition in which a person otherwise limited in mental ability has an exceptional specific skill, such as in computation or drawing

Sternberg's triarchic: intelligence theory that our intelligence is best classified into 3 areas that predict our real-world success: analytical, creative, and practical

analytical (academic problem-solving) intelligence: according to Sternberg, a type of intelligence that is assessed by intelligence tests, which present well-defined problems having a single right answer

creative intelligence: according to Sternberg, a type of intelligence that is demonstrated in reacting adaptively to novel situations and generating novel ideas

practical intelligence: according to Sternberg, a type of intelligence that is often required for everyday tasks, which are frequently ill-defined, with multiple solutions

Thurstone's primary mental abilities: intelligence theory that our intelligence may be broken down into 7 factors: word fluency, verbal comprehension, spatial ability, perceptual speed, numerical ability, inductive reasoning, and memory

Gardner's multiple intelligences: intelligence theory that our abilities are best classified into 8 independent intelligences, which include a broad range of skills beyond traditional school smarts

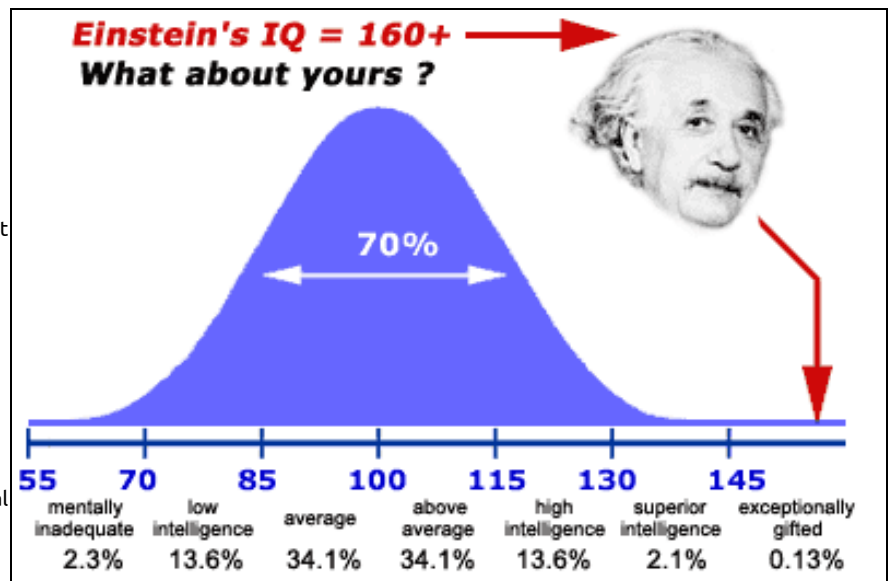
emotional intelligence: the ability to perceive, understand, manage, and use emotions

intelligence test: a method of assessing an individual's mental aptitudes and comparing them with those of others, using numerical scores

mental age: a measure of intelligence test performance devised by Binet; the chronological age that most typically corresponds to a given level of performance

Stanford-Binet: the widely used American revision of Binet's original intelligence test

intelligence quotient (IQ): defined originally as the ratio of mental age (ma) to chronological age (ca) multiplied by 100; on contemporary



intelligence tests, the average performance for a given age is assigned a score of 100

aptitude test: a test designed to predict a person's future performance

achievement test: a test designed to assess what a person has learned

WAIS (Wechsler Adult Intelligence Scale): the most widely used intelligence test; contains verbal and performance subtests

standardization: defining meaningful scores by comparison with the performance of a pretested standardization group

normal curve: the symmetrical bell-shaped curve that describes the distribution of many physical and psychological attributes

reliability: the extent to which a test yields consistent results, as assessed by the consistency of scores on two halves of the test, on alternate forms of the test, or on retesting

validity: the extent to which a test measures or predicts what it is supposed to

content validity: the extent to which a test samples the behavior that is of interest (such as a driving test that samples driving tasks)

predictive validity: the success with which a test predicts the behavior it is designed to predict; it is assessed by computing the correlation between test scores and criterion behavior

cognitive dysfunction (also known as: mental retardation): a condition of limited mental ability, indicated by an intelligence score of 70 or below and difficulty in adapting to the demands of life; varies from mild to profound

Down syndrome: a condition of retardation and associated physical disorders caused by an extra chromosome in one's genetic makeup

stereotype threat: a self-confirming concern that one will be evaluated based on a negative stereotype

People to know: Alfred Binet, Francis Galton, Howard Gardner, Sandra Sarr, Charles Spearman, Claude Steele, Robert Sternberg, Lewis Terman, David Wechsler, Ellen Winner.

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. **Debate continues in psychology over the meaning of intelligence, but a generally accepted definition is the mental capacity to solve problems and adapt to the environment.**

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. Francis Galton, who originally coined the phrase ***nature versus nurture***, **researched the hereditary basis of intelligence by studying twins**. He **developed the field of psycho-metrics** by applying key **statistical concepts** including ***correlation & percentile rank*** to studies on human intelligence and other factors.

Binet-Simon Scale created by **Alfred Binet**, was designed for French schools to identify students who would benefit from additional support.

Binet also developed the **concepts of mental age**, which indicated an individual was capable of reasoning at the level of a typical person at that chronological age.

Lewis Terman (1916) **revised and expanded Binet's test** for use in the US and renamed it the **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. It is an **individual test**, which means that a trained psychologist gives the test one-on-one to each test-taker.

Stanford-Binet scores in 4 areas of cognitive ability:

Verbal reasoning (understanding words and their use),

Abstract/Visual Reasoning (forming mental pictures),

Quantitative Reasoning (using numbers and measurements),

Short-Term Memory (remembering things just taught).

Intelligence Quotient (IQ), developed by **William Stern**, and allowed for testing of adults.

IQ = dividing mental age by chronological age and multiplying the results by 100. Provides a method for comparing individuals.

David Wechsler (1896-1981) suggested **IQ tests were limited** because they **measured intelligence only verbally**; he devised a test that included both verbal and performance components to compute a total IQ score. Wechsler developed separate intelligence tests for **adults (WAIS)** and **children (WISC)** and used a **scoring system based on normal distribution**.

Rather than one final score, the Wechsler gives 3 scores:

1. **Verbal Scale** (language, reasoning, and memory skills as are found in Binet),
2. **Nonverbal Performance Scale** (spatial relations, such as putting puzzle pieces together, sequencing, and problem solving),
3. **Full score**, adding the two scores together.

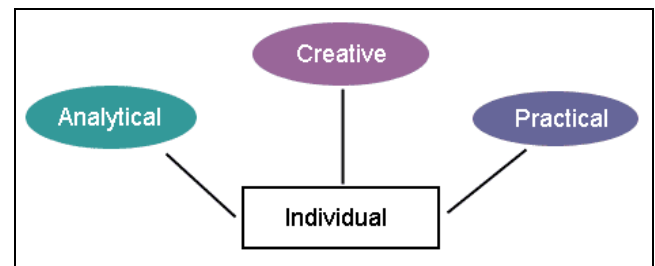
Unlike Stanford-Binet, which used a ratio IQ (mental age divided by chronological age), the **Wechsler tests based their score on a standard deviation IQ**. This means that a person's mental ability is **scored in comparison with the average person of his or her age**.

- ★ *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 related to creativity and artistic or athletic abilities?*

THEORIES OF INTELLIGENCE. **Charles Spearman** presented a **2-factor theory of intelligence** separating general and specific mental abilities. Utilizing the statistical method of **factor analysis**, which identifies groups of associated ideas by combining like items, Spearman discovered that most cognitive skills are related to a single essential trait he called **General Mental Ability** or **G Factor Intelligence**. The g factor or general intelligence is **the ability of individuals to solve complex problems**, and **Specific Mental Abilities** or **S Factor** is what he called the ability of an individual to **utilize math or verbal skills**.

Triarchic Theory of Intelligence: Robert Sternberg- intelligence divided into **3 aspects** (P.A.C.):

Practical, the ability to adapt to changes in the environment;
Analytical, the reasoning and problem solving that is evaluated by most intelligence tests; and
Creative, the capacity to create new ideas and unique solutions to problems.

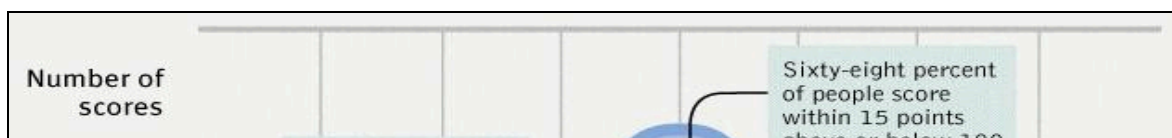
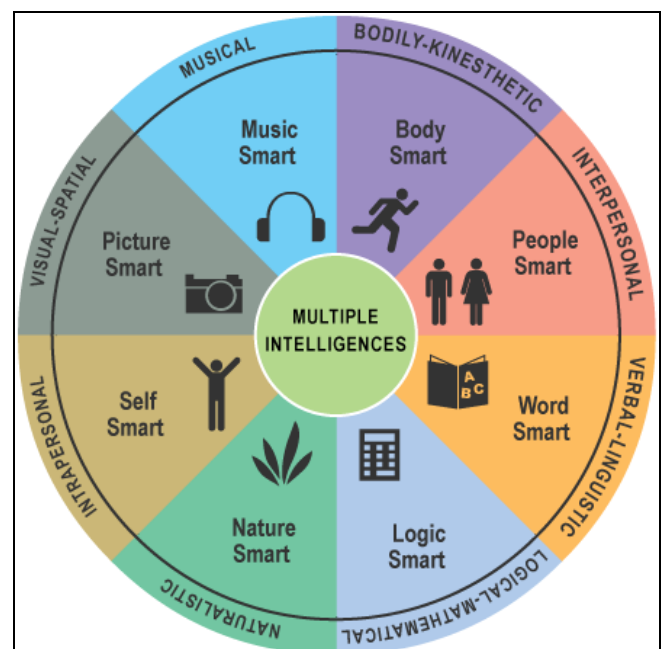


Gardner's Multiple Intelligences: Intelligence is **not fixed** & all individuals possess at least **8 different types of intelligences**.

Test Construction using 3 major aspects of psychometrics:

Standardization, Reliability, and Validity.

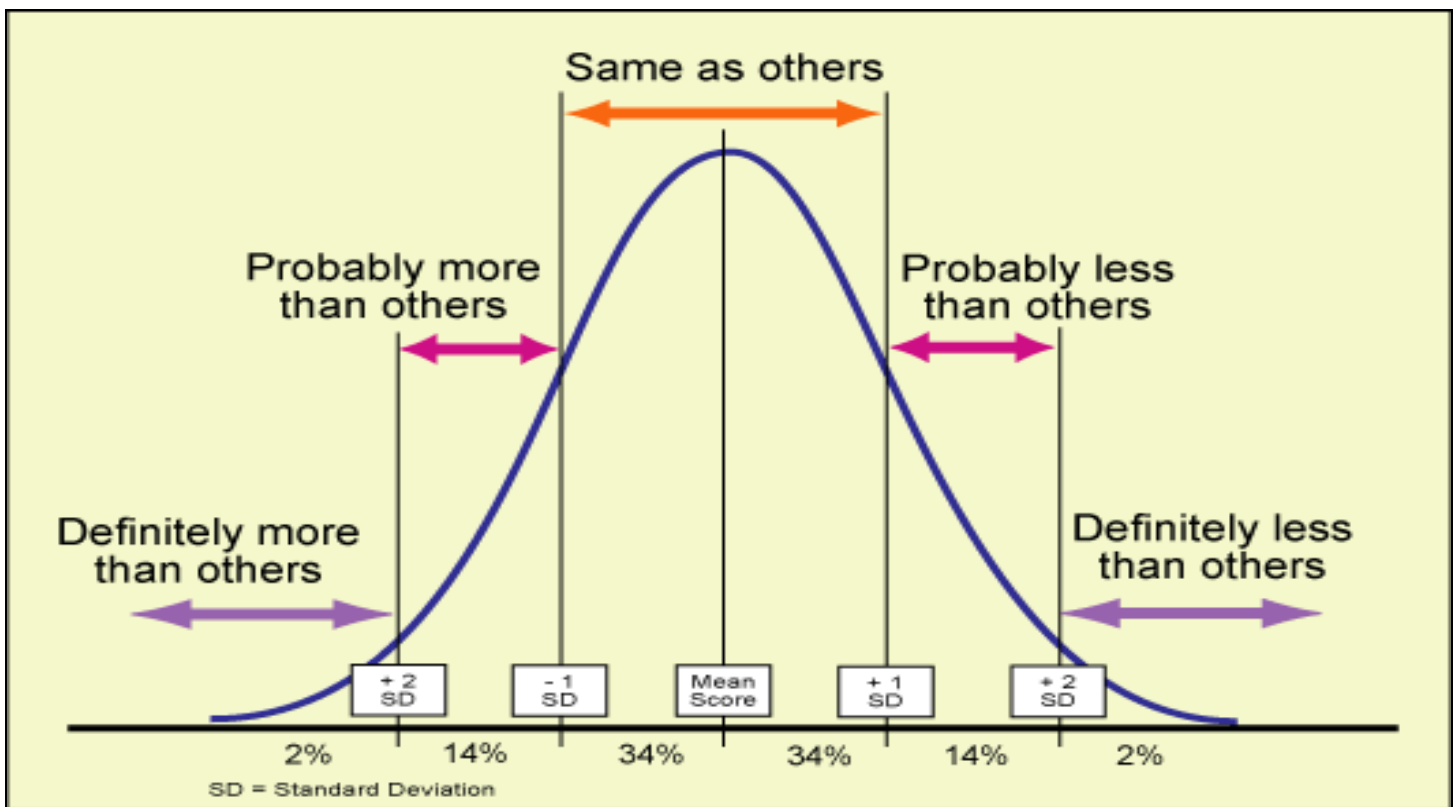
Standardization involves utilizing scores from a **representative sample** to determine how well an individual did on the test relative to other test takers, and creating **similar testing conditions** for all individuals taking the exam to prevent any potentially confounding variables. Intelligence tests originally indicated a ratio between a person's mental age and chronological age, but **modern tests are based on normal distribution created through standardization**.



Normal distributions of scores form **symmetrical bell-shaped curves** in which the **mean, median, and mode** are equal and located in the center of the distribution and the percentages of scores falling between **standard deviations** are fixed by a formula.

68% of scores fall within one standard deviation,
95% within two standard deviations, and
98% within three standard deviations of the mean in either direction.

Because percentages in normal distribution are fixed, it is possible to compute a **percentile rank**, or the percentage of scores in a distribution below the score you are considering. *For example, an individual with a score of 68, which is greater than 90% of scores of all people taking the test, is in the 90th percentile.*



Standardization & Norms:

When we say that a test is **standardized**, we mean that the test items have been piloted on a similar population of people as those who are meant to take the test and that achievement **norms** have been calculated. For instance, consider the scholastic aptitude test (SAT), a test with which many of you are probably all too familiar. When you take the SAT, you take an experimental section, a group of questions on which you will not be evaluated. In this case, you are helping the Educational Testing Service (ETS) to standardize its future examinations. The group that is taking the test

that day is called the **standardization sample** (they are fairly representative of the population).

The purpose of tests is to distinguish between people. Therefore, test questions that virtually everyone answers correctly as well as questions that almost no one can answer are discarded. Such items do not provide information that differentiates between the people taking the test.

Reliability is the degree to which a psychological test such as an IQ test is **consistent or dependable**. In order to determine if a test is reliable, psychologists utilize three main methods.

1. **Test-retest reliability** is computed by having the **same individuals take the same test at two different times**.
2. **Alternate form reliability (or equivalent form reliability)** involves testing the **same individuals twice** but **giving a different version on the retake date**.
3. **Split-half reliability** involves **checking for consistency between the scores on two halves of the same test**, which can mean comparing the first half to the second half of the test or even questions to odd.

Validity is the degree to which a particular psychological test is **accurate** and inferences drawn from the results are correct.

1. **Content validity** evaluates how well a test measures the total meaning of the concept and if its a reasonably **representative of the material it is evaluating**.
2. **Construct validity** refers to **whether a test is really evaluating an abstract psychological or theoretical idea**. Constructs are difficult to measure and define operationally and include ideas such as extroversion or intelligence.
3. **Criterion or predictive validity** refers to **how well test results relate to another measure of what you are evaluating** or how well they predict success in the future.

******TIP: Reliability refers to a test's consistency. Validity refers to a test's accuracy.******

EXTREMES IN INTELLIGENCE. The average IQ score is 100 and scores below 70 signify **mental retardation**. The term mental retardation has received much criticism and will **likely be replaced with the term cognitively disabled**. Generally, anyone with an IQ below 70 can be considered mentally retarded; however, psychologists do not use IQ exclusively to determine mental retardation and now utilize additional social factors when making a diagnosis. IQ scores range between 50 and 70 are considered mild mental retardation, which makes up the largest percentage of individuals with cognitive deficits. These scores between 35 and 49 are considered moderate, scores between 20 and 34 are considered severe, and scores below 20 are classified as profoundly mentally retarded. Known causes of mental retardation include **Down syndrome**, in which individuals are born with all or part of an extra chromosome, or other genetic problems such as **phenylketonuria (PKU)** and **fragile X syndrome (both genetically inherited)**. Mental retardation can also have external causes related to problems during pregnancy such as malnutrition, exposure to toxins, fetal alcohol syndrome (the #1 cause of mental retardation in the US), and injuries during birth.

Psychologists also investigate individuals with extremely high IQ scores who are often referred to as **gifted**. One of the most well-known studies of gifted individuals was **Lewis Terman's longitudinal study** of a group of **gifted students** whom he called "**Terman's Termites**." Individuals from the study scored higher than average in terms of family income, physical and mental health, and reported happiness. Terman's research disproved a popular misconception that gifted individuals were not well adjusted or successful socially.

Mental age divided by chronological age x 100 was the **initial method** used to determine an **IQ score**.

For example, an eight-year old child who scores as well as a typical ten-year-old would have an IQ of 125.

Currently, if you take an IQ test, **your total score is compared with those of others your same age to determine where you fall in the normal distribution**.

IMPACT OF SOCIOCULTURAL FACTORS ON INTELLIGENCE. Although intelligence tests are widely used in the US and other Western cultures, they are not utilized worldwide. In addition, tests standardized on Western samples do not accurately measure intelligence in other parts of the world. When creating intelligence tests for other cultures, it is important that the tests are designed with the values and experiences of the people in that culture in mind.

Differences related to **ethnicity, culture, and gender** exist within Western societies can affect performance on intelligence tests, and critics argue that **culture-fair tests** must include examples relevant to the experiences of the individuals taking the test.

The reason for the disparities in scores among groups is a subject of debate in which most psychologists believe that **both genetics and environment influence an individual's IQ**. A heritable or genetic component to intelligence has been established with **twin and adoption studies**, but research also indicates that **socioeconomic status has an impact on IQ**.

The Flynn effect is the finding that ***IQ scores have been steadily improving across generations***. The reason for the Flynn effect has not been identified, but it is **generally considered to have an environmental basis** such as better education and nutrition, since 100 years is not long enough to create an evolutionary change.

Another potential cause for the gap in intelligence scores among groups may be stereotype threat. **Stereotype threat** results when individuals are ***reminded of a negative stereotype about a group they belong to prior to a test, which results in their scoring lower***. Psychologists today work to create culture-fair tests that eliminate racial, ethnic, socioeconomic, and gender bias.

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 brainwaves 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***.

Much other work on the biological basis of intelligence points to the 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***.

20 Questions to know (use the target sheet or your book to help you with the answers):

- 1. The person who revised the first IQ test to include test items for adults and the use of the IQ formula was ____.**
Galton, Binet, Simon, Spearman, Terman
- 2. The statistical process that reveals common aspects among large groups of variables is known as ____.**
the Flynn Effect, factor analysis, stereotype threat, construct validity, content validity
- 3. The SAT is designed to predict success in college, which makes the SAT a(n) ____.**
emotional intelligence test, culture-biased test, aptitude test, interpersonal test
- 4. Psychologists creating an assessment tool to determine if individuals would be well suited to a career in air traffic control first administer the exam to a representative sample to serve as a source of comparison and make certain that all individuals take the test under the same testing conditions. The psychologists are focused on establishing ____.**
standardization, content validity, construct validity, test-retest validity, test-retest reliability, inter-rater reliability
- 5. Charles Spearman referred to the ability of individuals to solve complex problems as ____.**
performance scales, creative intelligence, practical intelligence, g factor intelligence, s factor intelligence
- 6. Principal Campbell created a math readiness test to give to eighth graders prior to entering high school. He chose a representative group of students to give the test to and compared each student's scores on odd versus even questions. He found a strong positive correlation between the odd and even scores, which gave him evidence that the test he made had ____.**
content validity, construct validity, inter-rater reliability, test-retest reliability, split-half reliability
- 7. Which intelligence test includes separate verbal and performance sections and also provides an overall intelligence score?**
WAIS, Simon-Binet, Stanford-Binet, Sternberg-Binet, Gardner
- 8. Because IQ tests are based on a normal distribution in which 100 is the average and the standard deviation is 15, about ____ percentage of IQ scores fall between 70 and 115.**
possible choices: 13, 34, 68, 81.5, 85
- 9. Comparing average IQ scores from the original Stanford-Binet test to the scores of individuals taking the current version provides support for ____.**
multiple intelligences, standardization, the stereotype threat, the Flynn effect, factor analysis
- 10. All of the following are aspects of Howard Gardner's multiple intelligence theory EXCEPT ____**
practical, visual-spatial, logical-mathematical, interpersonal, body-kinesthetic) intelligence
- 11. The psychologist famous for a landmark longitudinal study of gifted individuals was ____.**
Howard Gardner, Lewis Terman, David Wechsler, Charles Spearman, Robert Sternberg
- 12. Mr. Duez asks other psychology teachers he knows on the Internet to look over the final exam that he created for his AP Psychology class to ensure that the test fairly represents the material covered during the semester. Mr. Duez is having others assist him in evaluating his exam for ____.**

split-half reliability, alternate form reliability, test-retest validity, content validity, criterion validity

13. The original formula for determining IQ scores utilized by Terman was ____ age divided by ____ age x 100.

chronological age divided by mental age x percentile rank

mental age divided by chronological age x 100

mental age divided by chronological age x 'z score' x 100

chronological age divided by mental age x 100

14. Women in studies have been found to score lower on math tests when they are tested in the same location as men if they are reminded of the belief that males typically outscore females in math. This highlights the concept of ____.

stereotype threat, standardization, practical intelligence, the Flynn effect, creative intelligence

15. All of the following are environmental causes of mental retardation EXCEPT ____.

fetal alcohol syndrome, phenylketonuria, malnutrition, exposure to lead, physical injuries during birth

16. Alfred Binet worked for the French Government to create an intelligence test that would help identify students that could benefit from ____.

avoid all cultural biases while measuring intelligence,

evaluate analytical and creative intelligence on verbal measures,

evaluate abilities of public school teachers,

determine which students would benefit the most from extra services

17. After taking the ACT and receiving a 29, Ryan decides to retake it the following month. Although he is given a different version of the test, he ends up with a score of 30. One reason his two scores are so close is that the ACT has strong ____ form reliability.

test-retest reliability, alternate form reliability, split-half reliability, construct validity, face validity

18. Individuals who are considered to be mildly mentally retarded are capable of reaching the level of a sixth-grade education and can often live independently. The IQ range of an individual with mild mental retardation is ____.

5 to 20, 20 to 35, 35 to 50, 50 to 70, 75 to 90

19. The aspect of Sternberg's triarchic theory of intelligence that is typically measured by traditional IQ tests is ____ intelligence.

verbal-linguistic intelligence, creative intelligence, emotional intelligence, practical intelligence, analytical intelligence

20. The psychologist who pioneered psychometrics by creating concepts like percentile rank and correlation was ____.

William Stern, Charles Spearman, Alfred Binet, Sir Francis Galton, David Wechsler