

Chapter 9

Introduction to Intelligence

What is Intelligence?

- **Intelligence**
 - ability to learn from experience, solve problems, and use knowledge to adapt to new situations

What is Intelligence?

- Aptitude (how to test?)
 - An ability to learn from experience or practice
 - Predict a person's achievement or performance at some future time
 - Potential
- Achievement (how to predict)
 - Successfully accomplishing a task or activity
 - Actual
- Human beings have a variety of aptitudes
 - Physical
 - Emotional
 - Cognitive
 - Social

What is Intelligence?

Factor Analysis

- 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)**
 - factor that Spearman and others believed underlies specific mental abilities
 - measured by every task on an intelligence test

What is Intelligence?

- Search for factors underlying intelligence
 - Charles Spearman
 - Observed that people who are good at one type of thinking or cognition tend to do well in other types as well
 - G factor
 - Spearman's term for a general intellectual ability that underlies all mental operations to some degree
 - Some of the correlations between subtests are much higher than others
 - These other abilities Spearman named "s factors" for specific abilities

What is Intelligence?

- Search for factors underlying intelligence
 - Louis L. Thurstone
 - Rejected Spearman's notion of a general intellectual ability
 - Thurstone identified seven primary mental abilities
 - verbal comprehension
 - numerical ability
 - spatial relations
 - perceptual speed
 - word fluency
 - memory
 - reasoning

Origins of Intelligence Testing



- **Intelligence Test**
 - a method of assessing an individual's mental aptitudes and comparing them to those of others, using numerical scores

Reliability

- **Reliability:** A measure should give the same score each time the same person takes it
 - **Test-Retest:** Give test to a large group, then give exactly the same test to same group later
 - **Split-Half:** Making sure scores on one-half of a test match the scores on the other half

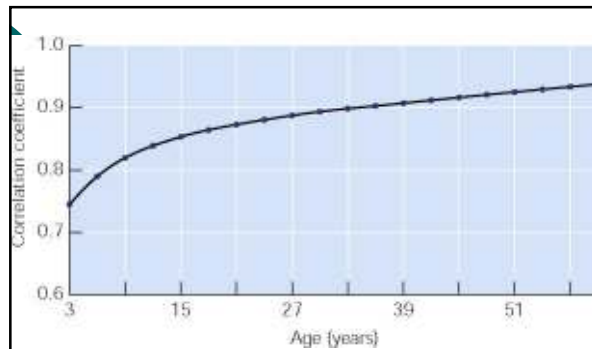


Fig.11.4 The stability or reliability of IQ scores increases rapidly in early childhood. Scores are very consistent from early adulthood to later middle age. (Source: Schuerger & Witt, 1989.)

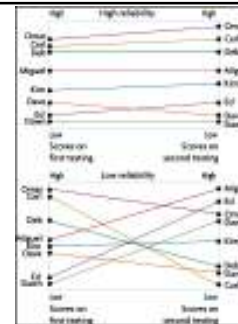


Figure 9.2 Test-retest reliability. Subjects' scores on the first administration of an assertiveness test are represented on the left, and their scores on a second administration of the same test a few weeks later are shown on the right. If subjects obtain similar scores on both administrations, as in the left graph, the test measures assertiveness consistently and has high test-retest reliability. If they get very different scores on the second administration, as in the right graph, the test has low reliability.

Standardization & Validity

- **Standardization**
 - Establishing norms for comparing the scores of people who will take a test in the future
- **Validity (3-TYPES: Content, Criterion, and Construct)**
 - The ability of a test to measure what it is intended to measure
 - Test items that are valid in one cultural context may lose their validity in a different context
 - Intelligence tests must undergo continuous revision to maintain their validity

Validity (3 Types!!!!)

- **Validity:** Ability of a test to measure what it is purported to measure
 - 1. **Criterion Validity (aka Predictive Validity)**
 - Comparing test scores to actual performance
 - Comparing SAT to college grades

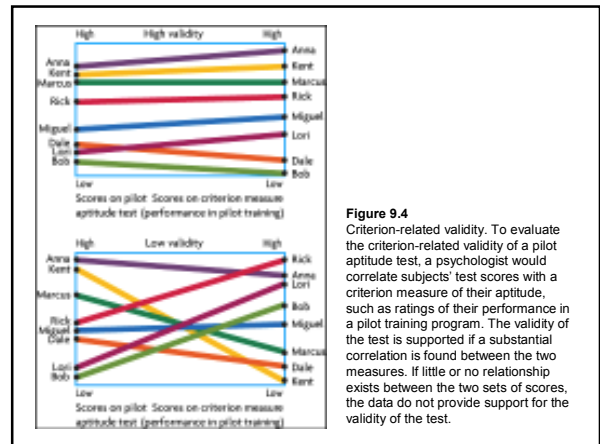
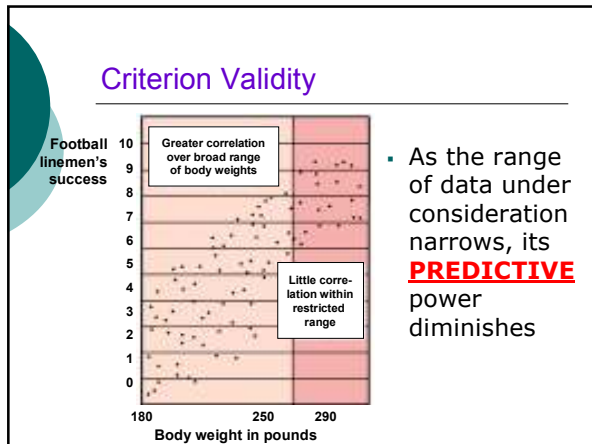
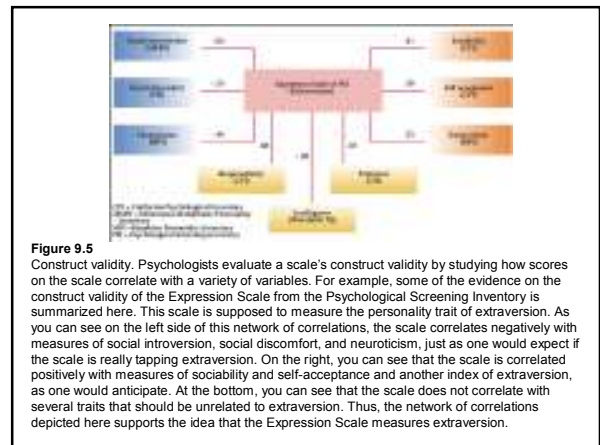


Figure 9.4 Criterion-related validity. To evaluate the criterion-related validity of a pilot aptitude test, a psychologist would correlate subjects' test scores with a criterion measure of their aptitude, such as ratings of their performance in a pilot training program. The validity of the test is supported if a substantial correlation is found between the two measures. If little or no relationship exists between the two sets of scores, the data do not provide support for the validity of the test.

Assessing Intelligence

2. Content Validity
 - the extent to which a test samples the behavior that is of interest
 - Psychology terms on a psychology test
 - driving test that samples driving tasks
3. Construct Validity:
 - The extent to which a test measures a particular CONSTRUCT! Ex: extroversion



Measuring Intelligence

- Franz Gall
 - Proposed that measurements of the size and shape of an individual's skull could be used to estimate an individual's intelligence; this proposal failed
- Sir Francis Galton
 - Measured intelligence through reaction times
 - Initiated the debate over measure of intelligence and whether it is predominantly the result of heredity or the environment

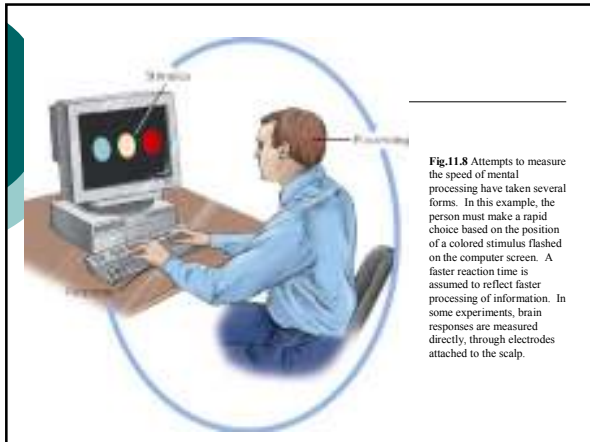
Measuring Intelligence

People who can perceive the stimulus very quickly tend to score somewhat higher on intelligence tests

Stimulus

Mask

Question: Long side on left or right?



Measuring Intelligence

- Alfred Binet and Theodore Simon
 - Tested schoolchildren in Paris in 1904 for intelligence levels
 - Published their intelligence scale in 1905 and revised it in 1908 and again in 1911
 - The Binet-Simon Intelligence Scale was an immediate success

Stanford Binet: Intelligence Testing

- **Intelligence Quotient (IQ)**
 - defined originally the ratio of mental age (ma) to chronological age (ca) multiplied by 100
 - $IQ = ma/ca \times 100$
 - on contemporary tests, the average performance for a given age is assigned a score of 100

Measuring Intelligence

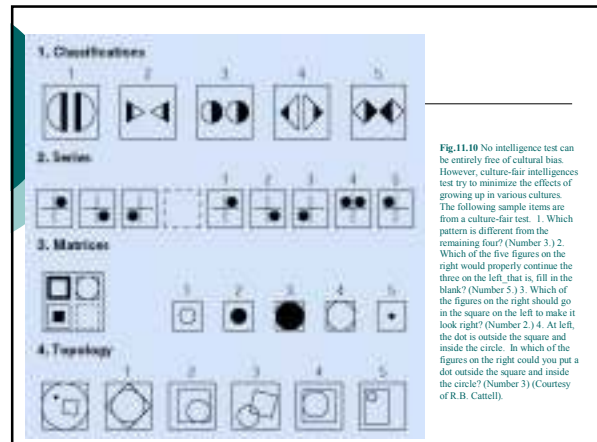
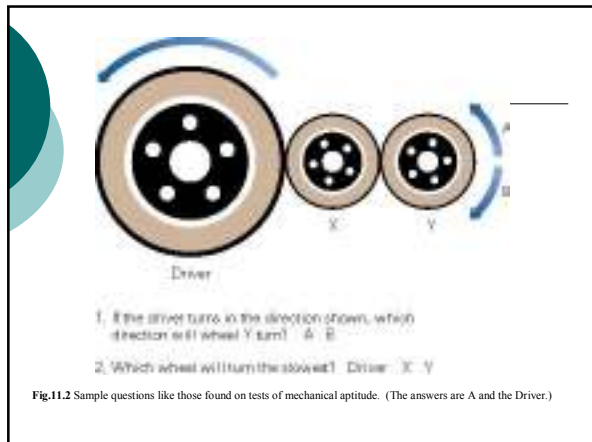
- **Wechsler Adult Intelligence Scale (WAIS)**. Said I.Q. put too much emphasis on verbal skills
 - most widely used intelligence test
 - subtests
 - **VERBAL**
 - **PERFORMANCE** (nonverbal)

Measuring Intelligence (WAIS)

- Intelligence testing in the United States
 - Wechsler intelligence tests
 - David Wechsler
 - Developed the first successful individual intelligence test for adults
 - Wechsler Adult Intelligence Scale
 - » An individual intelligence test for adults that yields separate verbal and performance IQ scores as well as an overall IQ score

Example: WISC Subscales

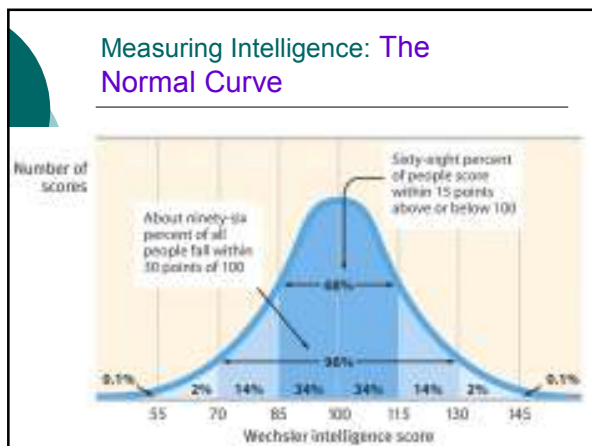
<p>Verbal Subtests</p> <p>Information: General factual knowledge, long term memory</p> <p>Similarities: Abstract reasoning, categories, relationships</p> <p>Arithmetic: Attention, concentration, numerical reasoning</p> <p>Vocabulary: Word knowledge, verbal fluency</p> <p>Comprehension: Social judgment, common sense reasoning</p> <p>Digit Span: Short term auditory memory, concentration</p>	<p>Performance Subtests</p> <p>Picture Completion: Alertness to essential detail</p> <p>Coding: Visual motor coordination, speed, concentration</p> <p>Picture Arrangement: Sequential, logical thinking</p> <p>Block Design: Spatial, abstract visual problem solving</p> <p>Object Assembly: Visual analysis, construction of objects</p> <p>Symbol Search: Speed of processing novel information</p> <p>Mazes: Fine motor coordination, planning, following directions</p>
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Measuring Intelligence (scoring)

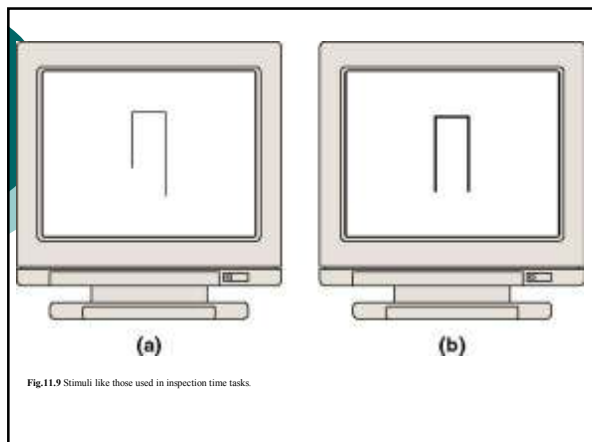
Standardization (Norm-referenced)

- 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
 - most scores fall near the average, and fewer and fewer scores lie near the extremes



Range of Intelligence

- Intelligence and neural processing
 - Some scientists once AGAIN (remember Sir Francis Galton) believe that biochemical differences may explain variations in normal intelligence
 - Some researchers have found that processing speed is related to intelligence and that processing speed accelerates as children get older



New Ways of Viewing Intelligence

- Neural Intelligence: Speed and efficiency of the nervous system; innate
- Experiential Intelligence: Specialized knowledge and skills acquired over time
- Reflective Intelligence: Ability to become aware of one's own thinking habits
- **Metacognitive Skills**: Ability to manage one's own thinking and problem solving efforts

STERNBERG'S Triarchic Theory of Intelligence

- There are three types of intelligence
 - **Componential**: focus on analytical processes
 - **Experiential**: focus on creative processes
 - **Contextual**: focus on practical processes

Sternberg's Triarchic Theory of Intelligence

Figure 9.23
Sternberg's triarchic theory of intelligence. Sternberg's model of intelligence consists of three parts: the contextual subtheory, the experiential subtheory, and the componential subtheory. Much of Sternberg's research has been devoted to the componential subtheory, as he has attempted to identify the cognitive processes that contribute to intelligence. He believes that these processes fall into three groups: metacomponents, performance components, and knowledge-acquisition components.

Are There Multiple Intelligences?

Savant Syndrome

- condition in which a person otherwise limited in mental ability has an exceptional specific skill
 - computation
 - drawing

Gardner's Theory of Intelligence: Some Concepts

- Multiple Intelligences: Theory posed by Howard Gardner that states we have several specialized types of intellectual ability
- Denies the existence of a *g* factor
- First developed his theory by studying patients with different types of brain damage that affect some forms of intelligence but leave others intact

Gardner's Theory of Eight Multiple Intelligences

1. Language: Used for thinking by lawyers, writers, comedians
2. Logic and Math: Used by scientists, accountants, programmers
3. Visual and Spatial Thinking: Used by engineers, inventors, aviators
4. Music: Used by composers, musicians, music critics

Gardner's Theory of Eight Multiple Intelligences

5. Bodily-Kinesthetic Skills: Used by dancers, athletes, surgeons
6. Intrapersonal Skills (Self-Knowledge): Used by poets, actors, ministers
7. Interpersonal Skills (Social Abilities): Used by psychologists, teachers, politicians
8. Naturalistic Skills (Ability to Understand Natural Environment): Used by biologists, organic farmers

Are There Still OTHER Multiple Intelligences?

- **Social Intelligence**
 - the know-how involved in comprehending social situations and managing oneself successfully
- **Emotional Intelligence (E.Q. instead of I.Q.)**
 - ability to perceive, express, understand, and regulate emotions

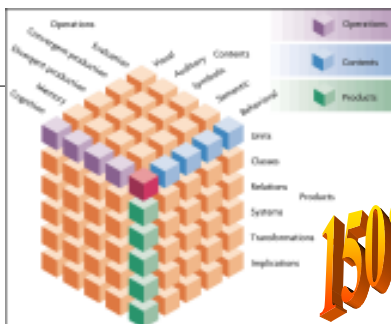


Figure 9.20
Guilford's model of mental abilities. In contrast to Spearman (see Figure 9.19), J. P. Guilford concluded that intelligence is made up of many separate abilities. According to his analysis, people may have as many as 150 distinct mental abilities that can be characterized in terms of the operations, contents, and products of intellectual activity.

Creative Personality

- There is a weak correlation b/w smart people and higher levels of creative
- Creative people usually have a greater than average range of knowledge and interests
- Creative people have openness to experience

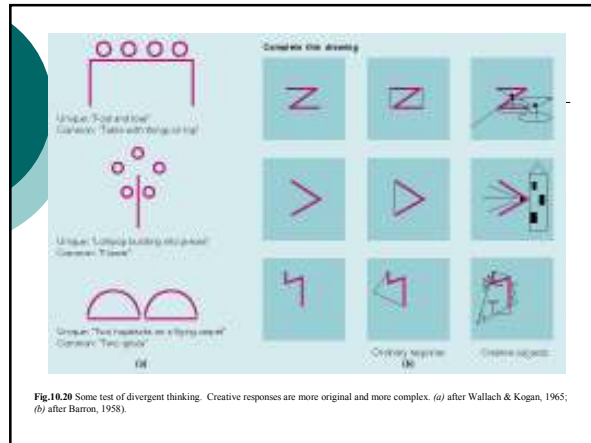
Intelligence and Creativity

Creativity

- the ability to produce novel and valuable ideas
 - expertise
 - imaginative thinking skills
 - venturesome personality
 - intrinsic motivation
 - creative environment

How to “Rate” Creative Thoughts

- Fluency: Total number of suggestions you can make
- Flexibility: Number of times you shift from one class of possible uses to another
- Originality: How novel or unusual your suggestions are
- Convergent Thinking: Lines of thought converge on an answer; conventional thinking
- Divergent Thinking: Many possibilities developing from one starting point

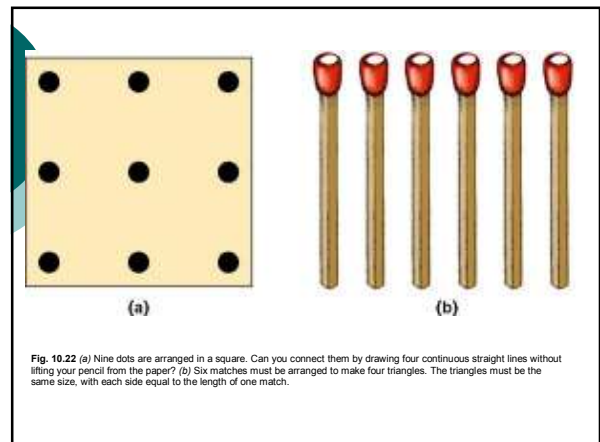


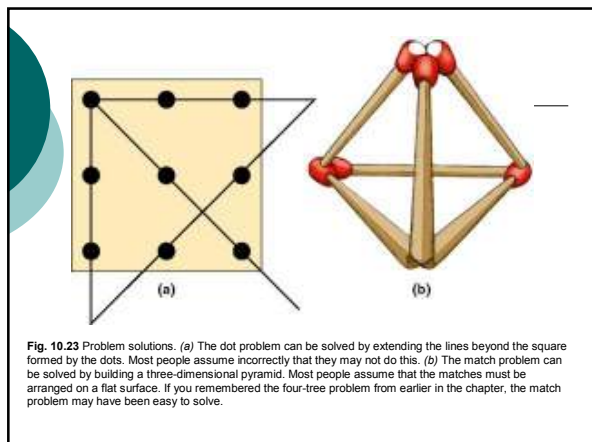
Tests of Creativity

- Unusual Uses Test: Find as many uses for an object as possible (Tell me all the things you can do with this pencil.)
- Consequences Test: List all the consequences that would follow if a basic change were made in the world (What would happen if we were able to read everyone's thoughts?)
- Anagrams Test: Make as many new words as possible from the letters in a given word
 - Often seen on puzzle pages in newspapers.

Insight

- Definition: Sudden mental reorganization of a problem that makes solution obvious
- Involves three abilities
 - Selective Encoding: Selecting information that is relevant to a problem while ignoring distractions
 - Selective Combination: Connecting seemingly unrelated bits of useful information
 - Selective Comparison: Comparing new problems with old information or with problems already solved (Sternberg & Davidson, 1982)





How to Enhance Creativity

- Break mental sets and challenge assumptions
 - Mental Set: Predisposition to perceive or respond in a certain way that blinds us to possible solutions
- Define problems broadly
- Restate the problem in different ways
- Allow time for incubation
- Take sensible risks
- Look for analogies
- Seek varied input
- Brainstorm

Group Tests

- These tests can be given to a large group of people with little supervision; usually contain multiple-choice items
 - Army Alpha was the first group intelligence test; developed for those entering World War I in the USA
- Normal (Bell-Shaped) Curve: Most scores fall close to the average, and very few are found at the extremes

IQ Research

- Men and women do not appear to differ in overall intelligence
- A strong correlation (about .50) exists between IQ and school grades
- Terminal Decline: Abrupt decline in measured IQ about 5 years before death

Giftedness

- Giftedness
- Having a high IQ (usually above 130) or special talents or abilities (playing Mozart at age 5)
 - Top 2% to 5% of population
 - Lewis Terman
 - Launched a longitudinal study, now a classic, in which 1,528 students with “genius” IQs were measured at different ages throughout their lives
 - Concluded that the “Gifted” are more than likely to be well liked, athletic, and above “normal” destroys “Nerd” stereotype.

The Dynamics of Intelligence

TABLE 11.5
DEGREES OF MENTAL RETARDATION

Level	Typical Intelligence Scores	Percentage of Persons with Retardation	Adaptation to Demands of Life
Mild	50–70	85%	May learn academic skills up to sixth-grade level. Adults may, with assistance, acquire self-supporting vocational and recreational skills.
Moderate	35–50	10%	May progress to second-grade level academically. Adults may contribute to their own support by laboring in sheltered workshops.
Severe	20–35	3–4%	May learn to talk and to perform simple work tasks under close supervision but are generally unable to profit from vocational training.
Profound	Below 20	1–2%	Require constant aid and supervision.

Source: Reprinted with permission from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Copyright 1994 American Psychiatric Association.

The Dynamics of Intelligence

Mental Retardation

- a condition of limited mental ability
- indicated by an intelligence score below 70
- produces difficulty in adapting to the demands of life
- varies from mild to profound
- **Down Syndrome**
 - retardation and associated physical disorders caused by an extra chromosome in one's genetic makeup

Organic Causes of Mental Retardation

- Related to physical disorders
- Birth Injuries: Lack of oxygen during delivery
- Fetal Damage: Congenital problem; prenatal damage from disease, infection, or drug use by the mother
- Metabolic Disorders: Disorder in metabolism; affects energy use and production in the body
- Genetic Abnormalities: Abnormality in the genes, such as missing genes, extra genes, or defective genes

Types of Organic Causes

- Phenylketonuria (PKU): Genetic disease in which the child lacks an important enzyme. Allows phenylpyruvic acid to accumulate in the body
 - If untreated, severe retardation may occur by age 3
 - Routine medical tests at birth can detect PKU
 - Treat with phenylalanine-free diet (found, for example, in Aspartame, known as Nutrasweet)

More Organic Causes of Mental Retardation

- Microcephaly: Head and brain are abnormally small; brain is forced to develop in a limited space
- Hydrocephaly: Buildup of cerebrospinal fluid within the ventricles (brain cavities); pressure can enlarge the head and damage the brain
- Cretinism: Stunted growth and retardation caused by insufficient supply of thyroid hormone
 - May also be caused by lack of iodine
 - Easily detected in infancy

Fragile X Syndrome

- Fragile X Syndrome: Genetic form of retardation caused by defect in X chromosome
 - Runs in families
 - Sex-linked; mainly affects boys
 - Most suffer from hyperactivity and attention disorders
 - Become more severely retarded as adults

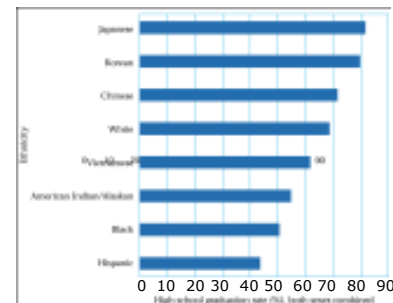


Figure 9.18

Asian Americans' academic success. On various measures of educational success, such as the high school graduation rates shown here, the performance of Asian American students tends to exceed that of other ethnic groups in the United States. More research is needed on the matter, but most theorists believe that cultural factors are responsible for Asian Americans' academic prowess. (Data from Sue & Okazaki, 1990)

Heredity and Environment

- Eugenics: Selective Breeding for desirable characteristics
- Fraternal Twins: Twins conceived from two separate eggs
- Identical twins: Twins who develop from a single egg and have identical genes
- Many researchers believe that intelligence is a combination of heredity (genes) and environment (upbringing); contributing percentage of each is not known yet

The IQ Controversy

- Uses of intelligence tests
 - IQ scores are fairly good predictors of academic performance
 - Neisser and others
 - "Successful school learning depends on many personal characteristics other than intelligence, such as persistence, interest in school, and willingness to study"

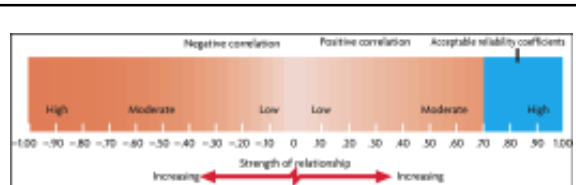


Figure 9.3

Correlation and reliability. As explained in Chapter 2, a positive correlation means that two variables covary in the same direction; a negative correlation means that two variables covary in the opposite direction. The closer the correlation coefficient gets to either -1.00 or $+1.00$, the stronger the relationship. At a minimum, reliability estimates for psychological tests must be moderately high positive correlations. Most reliability coefficients fall between $.70$ and $.95$.

The IQ Controversy

- Heritability of intelligence
 - Nature-nurture controversy
 - The debate over whether intelligence and other traits are primarily the result of heredity or environment
 - Heritability
 - An index of the degree to which a characteristic is estimated to be influenced by heredity
 - Thomas Bouchard
 - Reports that various types of twin studies have consistently yielded heritability estimates of $.60$ to $.70$ for intelligence

History of Behavioural Genetics

Nurture: The behaviourists

- "Give me a dozen healthy infants, well-formed, and my own special world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select - doctor, lawyer, merchant-chief and, yes, even beggar-man thief - regardless of his talent, penchants, tendencies, abilities, vocation and race of his ancestors."

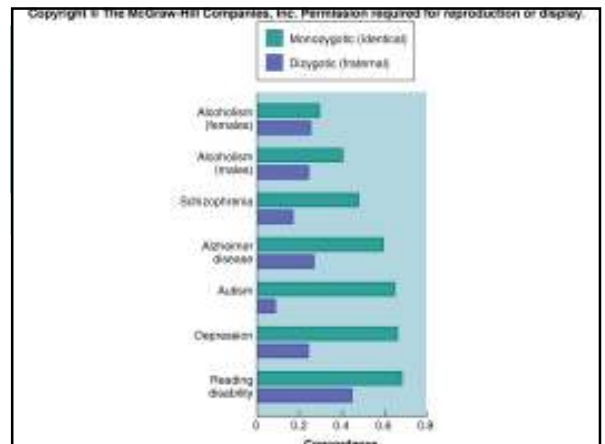
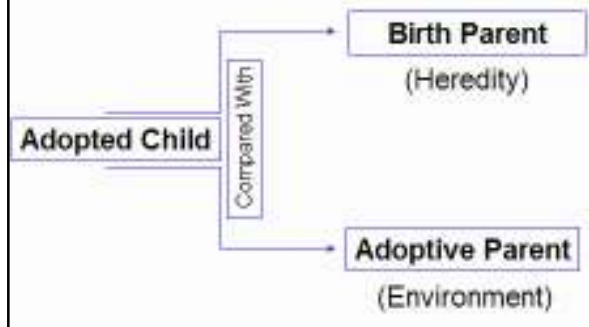
- Watson (1925)

History of Behavioural Genetics

Nature: Francis Galton:

- Found 100 men of 'genius' who possessed "the reputation of a leader of opinion, or an originator, of a man to whom the world deliberately acknowledges itself largely indebted".
- They could all be traced to 300 families, and Galton concluded that "there is no escape from the conclusion that nature prevails enormously over nurture"

Adopted child:
direct comparison of heredity with environment



Correlations for IQs within families

Relationship	Correlation
Same individual in two attempts	0.87
MZ twin	0.87
DZ twin	0.62
Siblings	0.41
Parent-child (in-home)	0.35
Parent-child (separated)	0.31
Foster parent - adopted child	0.16
Spouses	0.29

- Nature/Nurture IQ ?
- o IQ Score Correlations
 - o IT's reared together - 0.85
 - o IT's "" apart - 0.72
 - o FT's "" together - 0.60
 - o FT's "" apart - 0.50
 - o Sibs "" together- 0.45
 - o Sibs "" apart- 0.25

- The IQ Controversy
- o Abuses of intelligence tests
 - Abuses occur when scores on intelligence or aptitude tests are used for social or cultural groups for which the scores do not demonstrate high levels of predictive validity
 - o Culture-fair intelligence test
 - An intelligence test that uses questions that will not penalize those whose culture differs from that of the middle or upper classes

- The IQ Controversy
- o Race and IQ (**Blaming The Victim**)
 - Arthur Jensen
 - o Published an article in which he attributed the IQ gap to genetic differences between the races
 - o Claimed that the genetic influence on intelligence is so strong that the environment cannot make a significant difference
 - o Claimed that Blacks and Whites possess qualitatively different kinds of intelligence

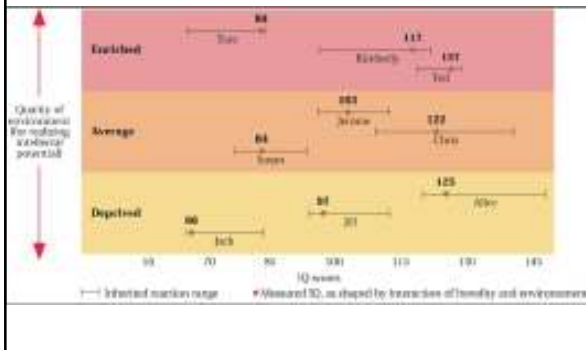
The IQ Controversy

- Race and IQ (**Blaming The Victim**)
 - Richard Herrnstein and Charles Murray
 - Published their book called *The Bell Curve*
 - Argued that IQ differences among people and between groups explain how those at the top in U.S. society got there and why those at the lower rungs of society's ladder remain there

The IQ Controversy

- Intelligence: fixed or changeable?
 - Ken Vincent: Changes in standard of living
 - Presents data suggesting that the Black-White IQ gap is smaller among younger children than older children and adults
 - Environmental changes in economic and educational opportunity are the cause of the rapid mean gains

Reaction Ranges As much as + or - 15 pts



The IQ Controversy

- Intelligence: fixed or changeable?
 - James Flynn: Changes in standard of living
 - Analyzed 73 studies involving some 7,500 participants ranging in age from 12 to 48 and found that "every Binet and Wechsler sample from 1932 to 1978 has performed better than its predecessor"
 - The consistent improvement in IQ scores over time that accompanies changes in standards of living is known as the *Flynn effect*

Getting Smarter?

