

Theories of Intelligence I: The Binet Scales

Psy 427
Cal State Northridge
Andrew Ainsworth PhD

Defining Intelligence

- Like any concept in psychology one of the principal challenges is defining intelligence
- In the face of this challenge there are many working definitions of intelligence proposed

Cal State Northridge - Psy 427

2

Defining Intelligence

- Binet
 - “the tendency to take and maintain a definite direction; the capacity to make adaptations for the purpose of attaining a desired end, and the power of autocriticism”
- Spearman
 - The ability to educe either relations or correlates
- Gardner
 - The ability “to resolve genuine problems or difficulties as they are encountered”

Cal State Northridge - Psy 427

3

Defining Intelligence

- There are many definitions and each tends to portray a general theory followed by the researcher
- Three independent research traditions in the study of intelligence
 - Psychometric – test structure (this and next chapter)
 - Information processing – learning and problem solving (Chapter 15)
 - Cognitive Approaches – adaptation to real-world demands (Chapter 15)

Cal State Northridge - Psy 427

4

Instigating Intelligence Testing

- In France at the end of the 19th century
 - French minister made a controversial decision to try and identify intellectually limited children in order to remove them from regular classes
 - Supposedly, so they could receive specialized training to help bring them up to the intellect of their same-aged counterparts
 - 1904 the minister appoints a committee to recommend a procedure for identifying intellectually limited children

Cal State Northridge - Psy 427

5

Two Early Principles

- Age differentiation
 - one can differentiate older children from younger children based upon their mental capacities
 - older children have greater skills than younger children
 - Mental age – knowledge and task ability of a specific age group
 - These abilities were assess and each respondent compared in the past
 - Today IRT is used to calculate the ability levels

Cal State Northridge - Psy 427

6

Two Early Principles

- General Mental Ability
 - intelligence *may be composed of several* individual factors, but
 - Binet was interested in measuring the sum total of them all
 - Considered *general intelligence*

Cal State Northridge - Psy 427 7

General Mental Ability

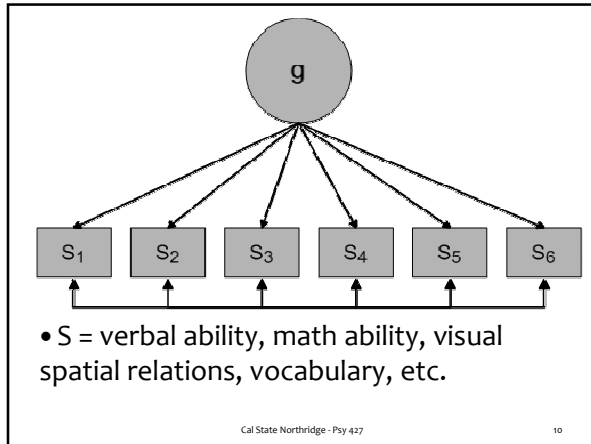
- First proposed by Galton (*Hereditary Genius*)
- Also independently proposed by Charles Spearman
 - Intelligence consists of one general factor (g) plus a large number of specific factors

Cal State Northridge - Psy 427 8

Spearman's g

- g acts like a single general factor
- The higher some scores on g the higher they are on the specific intelligences
- Approximately 50% of the variance in a set of diverse mental tests is represented by the g factor
 - Spearman developed factor analysis because he noticed that most, seemingly unrelated, abilities were positively correlated; this is known as *positive manifold*

Cal State Northridge - Psy 427 9



Other Theories of Intelligence

- Howard Gardner – Multiple Intelligences
 - Eight different kinds of intelligence
 - Linguistic: the ability to use with clarity the core operations of language
 - politicians
 - Logical-Mathematical: logical, mathematical, and scientific ability
 - scientists
 - Intrapersonal: the ability to form an accurate model of oneself and to use that model to operate effectively in life
 - therapists, novelists

Other Theories of Intelligence

- Howard Gardner – Multiple Intelligences
 - Eight different kinds of intelligence
 - Interpersonal: the ability to notice and make distinctions among other individuals' moods, temperaments, motivations
 - politicians, religious leaders, therapists
 - Musical: the ability to use the core set of musical elements (pitch, rhythm, timbre)
 - musicians, singers, composers
 - Spatial: the capacity to perceive the world accurately and to recreate one's visual experience
 - sailors, engineers, sculptors, painters

Other Theories of Intelligence

- Howard Gardner – Multiple Intelligences
 - Eight different kinds of intelligence
 - Bodily-kinesthetic: control of one’s bodily motions and the ability to handle objects skillfully
 - actors, dancers, acrobats, athletes
 - Naturalistic: the ability to comprehend, classify and understand things encountered in the world of nature
 - farmers, ranchers, animal handlers, zoo keepers

Cal State Northridge - Psy 427

13

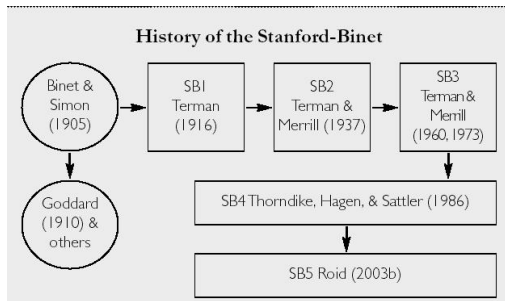
Other Theories of Intelligence

- Horn & Noll (1977): gf-gc
 - gf: fluid intelligence
 - those abilities that allow us to reason, think, and acquire new knowledge
 - allows us to learn new things
 - gc: crystallized intelligence
 - knowledge and understanding that we have acquired
 - “combined wisdom”

Cal State Northridge - Psy 427

14

Binet Scales: History



Cal State Northridge - Psy 427

15

Binet's Beginnings

- Binet begins with a unitary g model, one intelligence, in 1905.
 - 30 items, age scale
 - 3 levels of intellectual deficiency
 - Idiot – most severe impairment
 - Imbecile – moderate impairment
 - Moron – mild impairment
 - Problems
 - Question of unit
 - Small normative sample (50 children)
 - Limited Validity

Cal State Northridge - Psy 427

16

Binet's Beginnings

- 1908: age scale continues
 - Introduction of the term “mental age”
 - Described the level which an individual could reach on the 1908 scale
 - If you can perform tasks (e.g. answer questions) that can be performed by 2/3 to 3/4 of average 10 year olds, then you get a mental age of 10
 - Still, problems with single score & heavy verbal requirement

Cal State Northridge - Psy 427

17

Binet's Beginnings

- 1916: Binet's test comes to the United States (via Louis Terman of Stanford)
 - Increased standardization sample (although all children in sample were white, native-californians)
 - Retained the notion of age differentiation (used an age scale)
 - Retained the notion of mental age

Cal State Northridge - Psy 427

18

Binet's Beginnings

- 1916: Binet's test comes to the United States (via Louis Terman of Stanford)
 - combined mental age with chronological age to produce first intelligence quotient

$$IQ = \frac{\text{Mental Age}}{\text{Chronological Age}} \times 100$$

Cal State Northridge - Psy 427

19

Binet's Beginnings

- 1916: Binet's test comes to the United States (via Louis Terman of Stanford)
 - Problems
 - Test topped out at a mental age of 19.5; everybody older than that would produce some kind of mental retardation (MA < CA)
 - So typically any mental age above 16 would be set at 16 (there was a belief at that time that Mental Age maxed at age 16)

Cal State Northridge - Psy 427

20

Binet's Beginnings

- 1937: Larger standardization sample
 - 11 states in standardization sample
 - More urban subjects than rural
 - Only whites included in standardization sample
 - Alternate forms constructed: L and M
 - Problems:
 - Different sd's at each age for the standardization sample.
 - Sd at age 6 = 12.5; SD at age 12 = 20.0
 - IQ's at different ages were not comparable

Cal State Northridge - Psy 427

21

Binet's Beginnings

- 1960: Both forms of 1937 test combined to produce the Stanford Binet L-M
 - introduced the concept of a deviation IQ
 - mean 100; SD 16; deviation IQ determined by how far above/below the mean a person scored within a particular age band
 - 1960 norms better, still all white
 - 1972 - re-normed, included nonwhite standardization subjects for the first time

Cal State Northridge - Psy 427

22

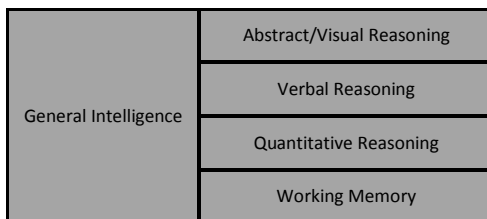
The Modern Binet Scales

- 1986/2003: Stanford Binet Intelligence Scale: Fourth and Fifth editions
 - Drastically revised items, and structure (hierarchical).
 - No longer dependent upon a unitary intelligence construct; theoretically-linked to the gf-gc and multiple intelligence model
 - Thurstone's Multidimensional Model: intelligence is made up of primary mental abilities and these abilities in turn are driven by g.

Cal State Northridge - Psy 427

23

Hierarchical Structure of SB4



Cal State Northridge - Psy 427

24

The SB4 Intelligence Model: The Subtests

- Routing Subtests used for “adaptive” testing
 - 1986
 - Used to test knowledge of words and their meaning
 - Highest level attained on vocabulary test indicates starting point for remainder of tests
 - This is used to gauge “age group” for test
 - “Vocabulary loads highly on g”
 - 2003
 - Added an additional non-verbal routing subtest

Cal State Northridge - Psy 427

25

The SB4 Intelligence Model: The Subtests

- Routing Subtests used for “adaptive” testing
 - Once an age range is established using the routing subtest(s)
 - This helped to choose the level of the remaining items; *start point*
 - *Basal* – level at which a minimum number of correct responses is obtained
 - *Ceiling* – number of incorrect responses that indicate that the items are too difficult

Cal State Northridge - Psy 427

26

The SB4: 15 Subtests

- Bead Memory
 - Two levels
 - Single & Double Bead displays for younger children
 - Sequential displays for older individuals
 - Used to test visual short-term memory
- Quantitative
 - Items presented visually, subject responds verbally
 - Scrap paper is permitted
 - Used to test quantitative skills (mathematics)

Cal State Northridge - Psy 427

27

The SB4: 15 Subtests

- Memory for Sentences
 - Tests auditory short-term memory
 - Sentences are presented verbally, must be repeated verbally
- Pattern Analysis
 - Tests visual-spatial and motor skills
 - Arrays of blocks presented visually, blocks must be assembled by hand to match patterns

Cal State Northridge - Psy 427 28

The SB4: 15 Subtests

- Comprehension
 - NOT a test of reading comprehension, but a test of social and moral reasoning
 - Items are presented verbally, must be answered verbally
- Absurdities
 - Another test of social, logical reasoning
 - Items are presented visually, must be answered verbally

Cal State Northridge - Psy 427 29

The SB4: 15 Subtests

- Memory for Digits
 - Two subtests
 - digits forward
 - digits backward
 - BUT, both scores are combined for the subtest score
 - Taps short-term auditory memory and active working memory

Cal State Northridge - Psy 427 30

The SB4: 15 Subtests

- Copying
 - Two levels
 - Copying blocks for younger children
 - Paper and pencil for older children
 - Tests visual-motor integration and visual spatial skills
- Memory for Objects
 - Tests sequential, visual, short-term memory
- Matrices
 - Tests non-verbal, logical-deductive reasoning

Cal State Northridge - Psy 427 31

The SB4: 15 Subtests

- Number Series
 - Tests quantitative and logical-deductive reasoning
 - Scratch paper is allowed
- Paper Folding and cutting
 - Tests visual-spatial reasoning
 - No actual cutting occurs in actual test items, only for sample items
- Verbal Relations
 - Tests verbal, logical reasoning

Cal State Northridge - Psy 427 32

The SB4: 15 Subtests

- Equation Building
 - Tests quantitative, logical, deductive reasoning skills and active working memory

Cal State Northridge - Psy 427 33

SB4 Scoring Subtests

- Items in each subtest are administered to obtain basal and ceiling measures.
- Highest number item administered minus number of failed items = Raw Score
- Raw scores are converted into Standard Age Scores (Mean 50, SD of 8)
- Subtests are then combined to produce Area Scores

Cal State Northridge - Psy 427

34

The Four SB4 Scales

- Verbal Reasoning Area
 - Vocabulary, Comprehension, Absurdities, Verbal relations
- Abstract/Visual Reasoning Area
 - Pattern Analysis, Copying, Matrices, Paper Folding & Cutting
- Quantitative Reasoning Area
 - Quantitative, Number Series, Equation Building
- Short-Term Memory Area
 - Bead Memory, Memory for Sentences, Memory for Digits, Memory for Objects

Cal State Northridge - Psy 427

35

SB4 Scales and Scores

- Four Scales each produce their own Area Scores
- Four Area Scores are combined to produce a “Test Composite”
 - Mean 100, SD 16

Cal State Northridge - Psy 427

36

Advantages of the SB4

- Based on modern theories of intelligence
 - gf-gc foundation
 - Tests wide range of intelligences
- Tests wide range of ages with single instrument
 - Can test as young as 2 and as old as adulthood
- Strong reliability & validity
- More sensitive in higher end of abilities
 - Better to use for discrimination among gifted individuals
- Tests short-term memory explicitly

Cal State Northridge - Psy 427 37

Disadvantages of the SB4

- Eliminated Age Scale for a point scale
- “Cumbersome” test
 - Taps many areas, requires tester to be facile with all 15 scales
 - *DOES NOT* require tester to obtain basal and ceiling measures on all 15 tests
- Possible ethnic/socio-economic biases
- Older norms than other child-based tests (at present)

Cal State Northridge - Psy 427 38

Hierarchical Structure of SB5

General Intelligence	Fluid Reasoning (FR)	Nonverbal
		Verbal
	Knowledge (KN)	Nonverbal
		Verbal
	Quantitative Reasoning (QR)	Nonverbal
		Verbal
	Visual/Spatial Reasoning (VS)	Nonverbal
		Verbal
	Working Memory (WM)	Nonverbal
		Verbal

Cal State Northridge - Psy 427 39

Scoring of the SB5

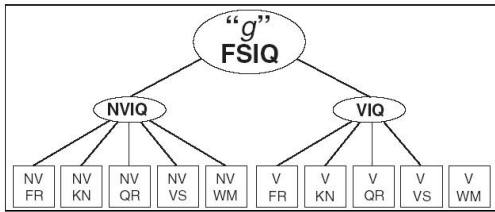


Figure 1.1 The Hierarchical Structure of the SB5 Scoring System

Notes: FSIQ = Full Scale IQ; g = general ability; NVIQ = Nonverbal IQ; VIQ = Verbal IQ; FR = Fluid Reasoning; KN = Knowledge; QR = Quantitative Reasoning; VS = Visual-Spatial Processing; WM = Working Memory.

Cal State Northridge - Psy 427

40

The SB5 Intelligence Model: The Subtests

- Routing Subtests used for “adaptive” testing
 - 2003
 - Added non-verbal routing subtest (i.e. Matrices) as an addition to the vocabulary test

Cal State Northridge - Psy 427

41

The SB5: 10 Subtests

- Contains many of the subtests of SB4 but they have been altered/combined
- Represents abilities assessed by all former versions of the test
- The Fifth Edition reintroduces the age-scale format for the body of the test
 - Presenting a variety of items at each level of the test.
 - Intended to provide a variety of content to
 - keep examinees involved in the testing experience
 - and to allow for the introduction of developmentally distinct items across levels
 - The points system was also retained

Cal State Northridge - Psy 427

42

The SB5: 10 Subtests

- The short-term memory was shifted over to a working memory model
- The other subscales remained essentially the same except
 - The addition of Visual/Spatial Reasoning
 - And a few changes to the names of the subscales

Cal State Northridge - Psy 427 43

Changes from SB4 to SB5

Abstract/Visual Reasoning	→	Fluid Reasoning (FR)
Verbal Reasoning		Knowledge (KN)
Quantitative Reasoning (QR)		Quantitative Reasoning (QR)
		Visual/Spatial Reasoning (VS)
Short-Term Memory		Working Memory (WM)

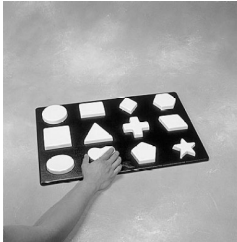
Cal State Northridge - Psy 427 44

The SB5: 10 Subtests

Fluid Reasoning (FR)	Nonverbal	Matrices Tasks
	Verbal	Analogies
Knowledge (KN)	Nonverbal	Recognize Absurdities in Pictures
	Verbal	Vocabulary
Quantitative Reasoning (QR)	Nonverbal	Quantitative Reasoning
	Verbal	Verbal Quantitative Reasoning
Visual/Spatial Reasoning (VS)	Nonverbal	Form Board
	Verbal	Positions and Directions
Working Memory (WM)	Nonverbal	Block Pattern Memory
	Verbal	Sentence Memory

Cal State Northridge - Psy 427 45

Form Boards



Cal State Northridge - Psy 427

46

SB5 Information

- Changed to using an SD of 15 instead of 16
- Much more game oriented (e.g. toys, brightly colored)
- Tapped into extremes in intelligence (2 – 85+ years)
- Standardized by stratified sample of 4800 respondents

Cal State Northridge - Psy 427

47

SB5 Information

- Full-scale IQ reliability is .97 - .98 for each of age ranges
- Average reliabilities for the 3 IQs are .98 (full-scale), .95 (non-verbal), and .96 (verbal)
- Five factors range from .90 - .92
- Test-retest range from the .7s to the .9s
- Manual touts support for validity as well

Cal State Northridge - Psy 427

48
