Ch. 9: Intelligence

- The problem of defining “Intelligence”
- Binet’s Principles of Test Construction
  - Age differentiation
  - General mental ability
- General Mental Ability
  - g
  - gf - gc theory
- Multiple intelligences
- Stanford-Binet and WAIS IQ tests

What is “Intelligence”

- Everyone knows but nobody (laypersons or scientists) agrees
- Historically, limitations in theory and technique (stats) have been paramount
- Statistical advances often came before theoretical ones
- Mistake the IQ test score for the thing it measures (intelligence)
- Extremely controversial subject -- wealth, race, gender, class, genetics, freedom, destiny...

definitions 1

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

APA (1995)

Individuals differ from one another in their ability to *understand* complex ideas, to *adapt* effectively to the environment, to *learn* from experience, to *engage* in various forms of reasoning, to *overcome* obstacles by taking thought. Although these individual differences can be substantial, they are never entirely consistent: a given person’s intellectual performance will vary on different occasions, in different domains, as judged by different criteria. Concepts of "intelligence" are attempts to clarify and organize this complex set of phenomena.

brief history

- Formal testing started in 1904 in France.
- Commission formed with goal of identifying intellectually limited individuals for special educational treatment
- Foremost problem was that of defining Intelligence

Man of Irony

- IQ tests designed to help the lower class / poor, uneducated, sick
- IQ tests show lower performance
- Used to *justify* unequal treatment

Binet's principles 1

- Principle 1: Age Differentiation
  - Kids get smarter as they get older
  - Test items designed to be answerable by
    - 67% to 75% at the target age
    - higher % at older
    - lower % for younger
    - (e.g. an item characteristic curve)
  - Mental Age corresponds to level of average performance for a given age

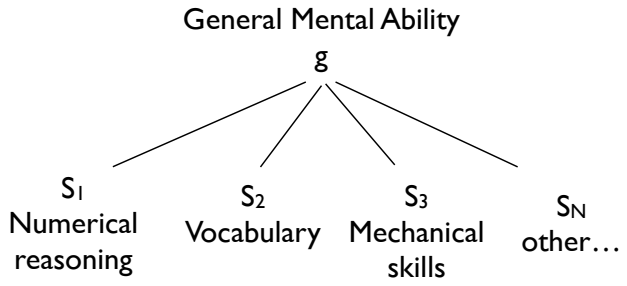
Binet's principles 2

- Principle 2: General Mental Ability
  - Instead of trying to measure the parts that make up the whole, decided to just measure the whole
  - Solved a lot of theoretical and practical questions
  - Is this a circular argument or design?

Spearman's g

- Intelligence composed of
  - General Factor (g)
  - Specific Factors (S_1, S_2, S_3, … S_n)
- Observation: All measures of intelligence, even on seemingly unrelated subjects, have a positive correlation. No items that "smarter" people do worse on. (what about over-studying?)
- Factor Analysis : From a large number of items (Xs) deduce a smaller number of Factors (Fs) which share variance
  - Shared variance = g = about 50%

Spearman's model



improving on g

- Although factory analysis does show a large "g" factor, there is more than one way to divide the variance.
- Two-factor model is a more modern approach
  - gf - "fluid"
    - reasoning ability, mental flexibility, executive functioning, problem solving, ability to learn
  - gc - "crystallized"
    - facts, figures, information, acquired knowledge that has been learned

Limitations of g

- Did the test methodology and techniques used to collect data overly influence the theory?
- Early tests were primarily of language, facts, figures, calculations and manipulation of objects
- Many areas not tested:
  - kinesthetic
  - social
  - musical
  - non-verbal thought
  - etc

Gardner's Research

- Do we learn more about the design and structure of a system when it is working normally, or functioning unusually? Often, best information comes from odd cases.
- Gardner considered
  - neurological evidence (brain damage patterns)
  - prodigies, virtuosos, savants, prodigies, autists
  - evolution
  - psychometrics
  - existence of symbolic notation

Autism / Savantism

- Autism
  - spectrum of disorders characterized by impaired social interaction, restricted interests, obsessions, and repetitive behavior
  - Prevalence 1-2 out of 1000
- Savant Syndrome
  - One or more areas of mental brilliance or excellence.
  - About 50% are autistic, about 50% have developmental disorder, mental retardation, brain injury or disease
  - Very rare: perhaps 100 worldwide

Stephen Wiltshire

- Diagnosed autistic
  - mute until age 3
  - first words "paper" and "pencil"
  - full language developed by age 9
- Video
- Panorama

incredible brain video

- Features several savants, some with autism
- incredible brain video

Kim Peek

- Diagnosed severely retarded
- Movie "Rain Man" based on him
- Amazing memory for fact and figures
- Severe physical and social disabilities
- Reads 8-10 books/day, retains 98% of the information, can read two pages at once (one with each eye)

Twins Flo & Kay

- Identical twin autistic / savant twins
- Flo & Kay on You Tube

Alonzo

- Severe brain damage as child
- Can not read, write, or calculate.
- Speech very limited.

Review

- Intelligence : How many factors?
- IQ : does it measure Intelligence?
- Heritable?
- Mutable?

- Theory / Methods
  - top-down
  - bottom-up
  - "normals" vs. extremes
    - autism, savantism

Gardner's 8 Intelligences

- logical-mathematical (*)
- verbal-linguistic (*)
- spatial (*)
- musical
- bodily-kinesthetic
- naturalist
- interpersonal
- intrapersonal

Sternberg's Intelligences

- analytic (*)
- creative
- practical

of Factors

Researcher	# of Factors	Comment
Binet	multiple	for practical reasons, only measured 1
Spearman	g	acknowledged other smaller factors (S
Thurstone (et. al)	g	fluid vs. crystallized
Sternberg	3	analytic, creative, practical
Gardner	8	"multiple intelligences" (MI) theory

Criticisms of MI

- Philosophical : rejection of single intelligence factor
- Political : egalitarianism / PC : everyone is equally intelligent just in different ways
  - misunderstanding / misstatement of the MI theory?
- Practical : gives weight to skills that are not valued by society.
- Theoretical : is MI just another way of describing personality styles?
- Research : little empirical support

Alfred Binet (MMOM Ch 5)

- Director of the Sorbonne Psychology Laboratory
- Originally believer in Cranial Volume (Craniometry)
- Ran his own experiments
  - Results were statistically significant (smarter students had bigger heads)
  - Smarter students were also taller.
  - Difference in skull sizes (the effect size) was trivial
- Decided to measure behavior instead

Binet's Metacognition

- "I feared that in making measurements on heads with the intention of finding a difference in volume […] I would be led to increase, unconsciously and in good faith, the cephalic volume of intelligent heads and to decrease that of un-intelligent heads"

Binet's Pragmatism

- "It matters very little what the tests are, so long as they are numerous"
- Chose practical "everyday" tasks

Binet on Ranking

- "The [IQ] scale, properly speaking, does not permit the measure of the intelligence, because intellectual qualities are not superposable, and therefore cannot be measured as linear surfaces are measured"

Binet on Determinism

- (After finding that retarded students scored better after special classwork)
- "[…]in the practical sense[…] the intelligence of these children has been increased. We have increased what constitutes the intelligence of a pupil: the capacity to learn and assimilate instruction"

Binet's Principles

- 1. IQ scores are practical - they have no theoretical basis - they do not measure "intelligence"
- 2. IQ scores are for identifying mildly retarded and learning-disabled children
- 3. Low IQ scores can be improved with special training.

Stanford Binet Early

- Binet developed first modern IQ test
- Goal - identify developmentally disabled students for special education
- Major revisions have made it into a modern test:
  - 1905 First version : 30 questions, Age Scale format
    - "Idiot", "Imbecile", "Moron"
  - 1908 Revision:
    - Mental Age

Stanford Binet 1916-1986

- 1916 Revision: Stanford-Binet
  - IQ = MA/CA
- 1937 Revision:
  - Improved standardization sample (but still mainly urban-dwelling USA Caucasians)
  - Good psychometrics (though less reliable for younger ages and higher IQs)
- 1960 Revision
  - Deviation IQ with mean of 100 and SD of 16
- 1986 Revision -- some changes (later backtracked)

Stanford Binet 5

Stanford Binet 5 (2003)

- 5 Factors / 10 verbal/nonverbal subtests: Fluid Reasoning, Knowledge, Quantitative Reasoning, Visual/Spatial Reasoning, Working Memory.
- Full-Scale IQ (FSIQ) r = .97
  - Verbal IQ (VIQ) r =.96
  - Non-Verbal IQ (NVIQ) r = .95
- Finally uses SD = 15 (instead of 16)
- Excellent normative sample (n=4800 gender, ethnicity, region, education level, plus 3000 from subpopulations: gifted, ADHD, etc.)