MENTAL ABILITIES

1. Introduction to mental abilities
   • Differential psych: always individual differences, personality, cultural background, intelligence
   • Intelligence is:
     o Abstract thinking ability
     o Goal directed adaptive behaviour
     o Ability to learn from experience
     o Metacognition (understanding/ control of own thinking)
   • Tests 3 categories:
     o Achievement: gauge a person’s mastery of certain subjects, English, history
     o Intelligence: (general mental ability, previous learning),
     o Aptitude: (measures potential, specific types of ability, spelling, language)
     o Personality tests: motives, attitudes
   • Theoretical background: Galton 1885- quicker you can think more intelligent you were, coined the term nature vs nurture
   • Binet 1904- 1st person to construct a test, wanted to ID French kids that were struggling, teachers to describe typical students and looked at 30 different scales: perception, knowledge, memory
     o 1st person to come up with mental age- whether academic ability is at same level as peers
     o rejected Galton’s theory, but circularity in his study
   • Stern 1912- created term IQ (intelligent quotient) mental age / chronological age x100
   • Relates with academic achievement and professional careers and longer lived lives but not to income due to greater education and healthier choices
   • Terman 1916- Binet’s test to Californian students= Stanford Binet test
     o evaluate differences in natural endowment
     o basis of US army test for soldiers in WW1
     o version 5, widely used, normed on 4800 individuals, verbal, 45-90mins to complete
     o 15 scales to measure
       ▪ verbal reasoning
       ▪ quantitative reasoning
       ▪ abstract/ visual reasoning
       ▪ short term memory
   • Weschler 1939- published first high quality IQ test; non verbal scales + looked at normal distribution not IQ
   • Spearman early 20thC- factor analysis: correlates many variables to ID clusters
     o Overall general ability ‘g’ under this there are many factors
2. **Psychometric issues**

- **Standardisation:** uniform procedure for scoring, same instructions, same time limit, control differences that could affect outcome
  - Most tests mean - 100, SD 15, 68% of people have an IQ 85-115, 10 000+ different standardized tests
- **Norms:** info about where a score in psych test ranks in relation to other scores on the same test
  - Minorities are underrepresented
  - Turn raw score into a percentile, where you sit compared to others
- **Percentile score:** % of people who score at or below your score
- **Reliability:** consistency of a test, check by:
  - test-retest (same score at 2 different times, problem is most ppl do better on the 2nd test, to eliminate this do parallel tests),
  - split half reliability tests : correlation, halves are =
  - more items= greater reliability
  - Cronbach’s coefficient alpha: all split half reliabilities
- **Validity:** how well the test measures what its suppose to measure, how accurate it is
  - Content validity: how well test represents domain its supposed to (exam includes items not covered= poor content validity)
  - Criterion validity: correlate score on test with the score on another type of measure (get into medicine= test + interview)
  - Construct validity: evidence that the test measures a construct (most measure have a theory behind them)
  - Convergent validity: compare 2 tests trying to measure the same thing
  - Discriminate validity: compare 2 tests measuring different constructs (IQ with personality test)
- Tests are made for different populations, different formats (computer, paper, group), different goals (selection, assessment)
- High reliability but low validity: measuring something but not what we expect
- High validity low reliability: measure what we want but can’t find consistently

3. **Specific IQ tests**

- **Raven’s progressive matrixes,** (1941), measured to get a single factor of general intelligence (g), not influenced by cultural background as doesn’t rely on verbal, tests ability to discern patterns
  - Coloured progressive matrices 5-11 yo
  - Standard 6- adults
  - Advanced- superior intelligence
- FOUND: similar norms across societies with different norms of literacy= patterns is a cognitive ability
- **Wechsler adult intelligence scale (WAIS)-** developed in 1939, most widely used, current is WAIS IV (2008), less emphasis on language, global
(individual’s behaviour as a whole) + aggregate (qualitatively differentiable elements) comes up with overall IQ, WISC for children

- **WAIS III** 1hr to administer, same items for age between 16-89yo (differs from SB test), 14 subtests in 5 subscales

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<td>and rearrange</td>
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<td>pictures into a story</td>
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- 3 IQ scores: overall + 2 subscales (unlike SB)

**4. Models of intelligence**

- **Psychometric approach: Spearman and Boring**: test intelligence from analysis of tests

- **Spearmen 1904, 1927**: single factor, came up with factor analysis and g theory, overall general intelligence made up of single factors, +ve correlation between cognitive abilities testing
  - Total variance= g variance + s variance + error
  - Sees intelligence as overlapping coloured circles
  - Support from Carroll (1993) survey 146 tests found evidence for g
  - G= biological endowed capacity (speed of neural processing)
  - **Engle et al (1999)** g= ability to keep a mental representation active in face of distraction
  - **Sternberg 2000** g= collection of different elements: capacities, motivations, attitude, perseverance

- **Thurstone 1938**: g not a valid representation of mental abilities, 7 primary mental abilities (1930s) PMAs, add up to get a general g
  1. Verbal comprehension
  2. Inductive reasoning
  3. Numerical fluency
  4. Word fluency
  5. Spatial ability
6. Memory  
7. Perceptual speed

- **Cattell 1941:** modified Spearman’s theory, 2 combined measure intelligence, most widely accepted today
  1. **GF: fluid intelligence:** abstract reasoning; speed of processing, decreases over time, born with, natural, perception of patterns, inductive reasoning, critical thinking, not previously experienced, not learnt
     - Soon is to never, as near is to...
  2. **GC: Crystallised:** ability to acquire knowledge and skills, school and education, everything you have learnt, increases over time

5. **Group differences in intelligence: evidence and possible causes**
   - **Hunt 2011** – EU Nth American industrial and post industrial societies found 40-60% variation in intelligence scores is due to genetic variation
     - **Galton 1869**- eminent men came form a small n# of families
   - Differences extremes: intellectual disability (subnormal mental ability, before 18yo, IQ under 70, lack adaptive skills like clean, IQ under 25: constant care)
   - 85% of intellectual disabilities are mild, 10% moderate, 5% profound
   - giftedness: people who score around IQ 130
   - influences on intelligence: hereditary: look at twin studies, IQ is largely inherited, identical twins have similar intelligence correlation .8, fraternal twins: correlation .6, higher for identical even when raised apart, but results affected by education, environment
     - **Turcheimer et al 2003:** WISC for 7yr old twins divided by SES, lower SES 60% of IQ variance due to environment, but for higher SES due to genetics
     - PKU disease is a genetic condition solved by environment
   - adoption studies: compared adopted to biological parents and adoptee parents, more that chance similarity between biological parents and children
     - **Skodak and Skeels 1949**- babies from British working class mothers adopted by well educated families, IQ at 2yrs old was 117 (IQ of birth mother= 85)
   - environment deprivation: kids reared in orphanages have lower IQ scores, if you put them in upper class home there IQ will increase rapidly, enriching environment can have a huge difference
   - **reaction range:** heredity places limits on one’s intellectual potential and environment determines where one falls within the limits
   - **Flynn effect:** over generations IQ scores are getting higher, mean on test is always 100 but tests getting harder, due to environment advantages
     - IQ test scores have been rising by 3pts per decade
     - 1946-78 WAIS and SB scores had increased by 13.8 pts and Americans gained 25 IQ pts, 1987 5-26 pt increase in a generation over 14 countries
     - Increases driven by: heterosis- international mating rather than inbreeding due to urbanisation, better nutrition and health, longer schooling, more practice with testing, child rearing more attention paid to individual child + early start (Abecedarian + head start programs in
US), more visual spatial world (Greenfield 1998 children have better spatial skills than parents)
  o Flynn’s explanation: ability to adapt to modernity is better, manipulating abstract concepts being tested, wearing scientific spectacles, style of thinking has changed

• Occupational differences: Reynolds et al 1987 professionals had higher IQs (+22pt) to unskilled workers
• Cultural/ racial differences: Watson 2007 white Americans tend to better than African Americans, intelligence as genetic based
  o Lynn: IQs of sub Saharan immigrants to EU, Nth US increasing (African US rising 50% faster than other groups) but never to level of EU’s
  o Coleman et al 1966 IQs for EU American 12th graders > African Americans
  o Hernstein and Murray 1994 racial differences are inherent
  o Jensen 1969 white American have a 15pt advantage
  o Eyferth 1961 WISC for children with german mums and US dads and found no IQ difference in children with white or black dads but small sample

• but gap is shrinking, often bias questions on tests whites are more familiar with Qs
  o Socio economic disadvantage: most African Americans are poorer, not as good education, malnutrition
  o Stereotype effect: Steele and Aronson 1995: Stanford uni black Americas when told intelligence test they would perform worse than whites, but if told it was a problem solving test blacks would perform the same
  o Ambady et al 2001: asian girls given a maths test but primed identify before test: colour in a picture of a) asian with chopsitcks to prime ethinc ID or b) girl with doll to prime gender ID, when primed ethnic they performed above control and when primed gender they performed below control

6. Recent developments in understanding mental abilities
• IQ tests today subdivide g into 10-15 specific abilities
• Biological: parts of the brain and intelligence, MRI scans, more intelligence associated with greater grey and white matter
• studies to show IQ related to increased longevity: better health care, good genes, exercise, better job, more money, early retirement
• Sternberg 2005: cognitive perspective: how people use their intelligence: analytical intelligence: evaluation and judgement; creative int: coming up with new ideas, practical: everyday problem solving, tacit: work efficiently without being told to
• Gardner: multiple intelligences, 8 key things, looked at people with brain damage, special populations; 8= logical mathematical (maths and science), linguistics (sound and meaning of words), musical, spatial, bodily kinesthetic (coordination), interpersonal (relate to other ppl), interpersonal (strengths, self knowledge, naturalist (things in nature) = popular, people have different abilities, feedback does his study cover a variety or too broad
How do we test intelligence?

Lewis Terman
- In 1916 adapted Binet’s test to Californian children to create *Stanford Binet test*
  - Added some items, took off others
- Wanted to evaluate difference in what he saw as natural endowment (unlike Binet)
- Applied to adults (Terman & Merrill, 1937)
- Basis of US army test for soldiers in WW1
  - Army alpha test successfully tested 1,726,000 recruits
  - Determine roles, officers, who to reject
  - Av mental age of recruits 13

Stanford Binet test
- Still widely used, now version 5
- Stanford Binet 5 (2003) was normed on 4,800 individuals
- Adaptive, different items given based on earlier performance
- Largely verbal items (changing)
- Takes 45-90 minutes (one on one test)

*What’s on the SB test?*
- Now 15 scales to measure 4 areas
  - Verbal reasoning
    - Reflects acquired verbal knowledge and apply to new situations
  - Quantitative reasoning
    - Knowledge and skill in numerical concepts
  - Abstract/visual reasoning
    - Ability to solve problems through reasoning, to determine logic behind patterns
  - Short term memory
    - Skills in focusing, using STM, and understanding sequences

Standardization
- Normed test to fit to a normal distribution with a mean of 100 with standard deviation of 15
  - Therefore 68% of people 85-115 (normal distribution: bell curve)
- Lots of quantities have a normal distribution: height

*Why use a normal curve?*
- Early results suggest it, scores were made to fit
- Normal curve tends to fit to data without a single cause

*There are lots of tests*
- estimated that there are 10 000 different standardized tests of cognitive abilities available
- Why
  - Different populations: children, adults
  - Different formats: individual, group, computer
  - Different goals: selection, assessment
Different theoretical approaches to intelligence: single/ multiple factors
Different ideas about what is being measured: intelligence, aptitude, ability
Some tests are more often than others
  - Raven’s progressive matrices
  - The Wechsler Intelligence tests

Raven’s progressive matrices
  - Raven 1941 developed one of the most widely used psychometric tests available
    - Explicitly developed to measure a single factor of general intelligence (g)
  - 3 different instruments
    1. coloured progressive matrices (5-11 yrs)
    2. standard progressive matrices (6 yrs- adult)
    3. advanced progressive matrices (superior intellect)

Assessment
  - good reliability and validity
  - independent of language and culture
  - raven (2000) showed similar norms across societies with different norms of literacy
  - same norms for men and women
  - assumes that ability to find patterns is a cognitive ability equally important in all societies

Wechsler Adult intelligence scale (WAIS)
• first version 1939, latest version (WAIS-IV) 2008 (also a WISC for children)
• similar approach to Stanford Binet but less emphasis on language
“intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment (Wechsler 1974)
• global bc it characterises individual’s behaviour as a whole
• aggregate bc it is composed of elements or abilities that are qualitatively differentiable

WAIS III
• Individual administration
  o Duration: 60-80 min (depending on subsets, goal, examinee)
• Assessment of cognitive functioning in adults, aged 16-89 years
  o Differs from the SB tests in that subscales contain items that are identical across the age groups
  o A person at 20 will do the same items as the person at 70
• Scale composition: 14 subtests
• Items that have the same format are grouped together to form a subscale

Mental abilities measured in the WAIS III

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• Vocabulary: Meaning- bed
• Similarities- friend enemy, piano drum?
• Information- what is a thermometer?- general knowledge about the world
• Comprehension- why do people wash their clothes?- social knowledge

• Picture completion- what part is missing in 2\textsuperscript{nd} photo?
• Block design- replicate models of box design
• Matrix reasoning- choose missing part
• Picture arrangement- put pictures in order to make sense of story

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<th>Working memory- holding representations and manipulating them</th>
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<td>• Arithmetic: 4 +5? / average of numbers</td>
<td>• Digit symbol coding: put symbol in coded box (crack a code exercises)</td>
</tr>
<tr>
<td>• ability to hold numbers in mind and manipulate them</td>
<td>• Symbol search: symbol match symbol on right</td>
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<tr>
<td>• Digit span: memorize numbers</td>
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<td>• backwards- say numbers backwards,</td>
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reverse order
• Letter number sequencing: numbers and letters put in ascending order and alphabetical - recall and rearrange

* Object assembly: make into picture

WAIS III subtests for IQ scores
• 3 IQ scores: overall and 2 subscales (unlike Stanford Binet)

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Assessment
• Good reliability (consistent) and validity
• Good for assessment - different tasks and subscales
  o Like a structured interview

Models of intelligence
• Spearman and Boring – test to theory

Psychometric approach
• Try to understand intelligence from analysis of tests of mental abilities
  o Assumes there are common underlying factors
  o Based on sophisticated statistical analysis
• First ask what makes a good test
  o Consistent: reliability
  o Meaningful: validity
  o Low error

Reliability (hits the same place every time)
• If a test is measuring a consistent trait of a person then it should consistently produce the same answer
• Tests retest
  o Correlation between scores on same test at different time
  o But people often get better on retest
• Split half reliability
  o The correlation between test items from 2 halves of a test
  o Assumes halves are equivalent
• More items = greater reliability
  o Evens out random error
• Cronbach’s coefficient alpha - measure of reliability of test
  o Does all split half reliabilities

Validity
• Does the test measure what we think it does?
  o Established by examining the r’ship between test scores & other measures
• Convergent validity
  o Is the construct related to other theoretically similar constructs/ tests
• **Discriminant validity**
  o Is the construct independent of other psychological

Does reliability = validity
• Test with high reliability but low validity?
  o Measures something but not what we expect
• Low reliability but high validity?
  o Validity can’t > reliability
  o A test can’t correlate more highly with something else than it can with itself

Error: classical test theory
• CTT proposes that test scores are influenced by 2 factors
  o Factors contributing to consistency: the stable attributes that are being measured
  o Factors contributing to inconsistency: characteristics of the test, testing situation, individual that affect the test score
  o Measured score = true score + random error \(X = T + e_u\)
  o True score is constant for individual but never know what it is for certain

Error
• Try to minimize error, should be unrelated to true and measured scores
• Possibly: \(X = T + \text{systematic error and random error}\)
• A task may inadvertently and consistently be assessing an attribute other than the one of interest
• Possible sources:
  o Confounds
  o Uncontrolled factors
  o Bias
  o Sampling errors

Intelligence is a construct
• Theoretical concept can’t be directly observed, but give rise to measurable phenomena
  o Constructs aren’t discovered, but constructed from data
  o Basis for prediction of behaviour
• Defined by:
  o Empirical indicators
  o Relationships to other constructs
  o Network of constructs = theory
• Theory and measurement are inextricably linked in test development
  o One or multiple factors behind mental abilities?

How can we tell?
• See ability scores, but what underlies them?
• A single factor?
• Multiple factors?
• Each score separate?