Theories of Intelligence II: The Wechsler Scales

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1939: Wechsler vs. Binet

- Two years after the 1937 Binet revision, the first Wechsler test is published: the Wechsler-Bellevue Intelligence Scale.
- Criticisms of the 1937 Binet
  - Intelligence is multifaceted, the Binet produces a single IQ score.
  - The 1937 Binet was developed for children, yet purports to test adults.
  - The 1937 Binet has an overemphasis on speeded/timed tasks, which is more difficult for older adults.
  - Intelligence *can decline as one ages. The 1937 Binet does not* account for this.

Advantages of the 1939 Wechsler-Bellevue

- Age Scale versus Point Scale
- 1937 Binet used an Age Scale
  - Scores on a particular test are based on basal and ceiling levels.
  - Each Basal or Ceiling Level had a chronological age associated with items at that level.
  - So, a person who successfully completed 3 out of 4 items at the 6-year old level, would have a basal mental age of 6 years.

Advantages of the 1939 Wechsler-Bellevue

- 1937 Binet used an Age Scale
  - Content of items at each level of the age scale could vary tremendously
    - Vocabulary word, arithmetic problem, and digit repetition, for example, could all be asked sequentially at a given age level of the 1937 Binet.
- 1939 Wechsler-Bellevue used a Point Scale
  - Items in a scale answered correctly are each given a certain number of points.
  - Point Scales allow for homogeneous content.

Advantages of the 1939 Wechsler-Bellevue

- 1939 Wechsler-Bellevue used a Point Scale
  - Point Scales allow for homogeneous content.
  - As such, Wechsler could obtain scores for an individual in a wide range of content areas.
    - Vocabulary, Creative Thinking, Judgment, General Knowledge

Advantages of the 1939 Wechsler-Bellevue

- 1939 Wechsler-Bellevue included a Performance Scale
  - 1937 Binet was criticized for its over-reliance on verbal skills to measure IQ
  - 1939 Wechsler-Bellevue added a second entire scale of non-verbal measures.

Evolution of the 1939 Wechsler-Bellevue

- Normative sample for the 1939 Wechsler-Bellevue
  - 1081 whites from the eastern US (primarily New York)
- First revision: 1955
  - Wechsler Adult Intelligence Scale (WAIS)
- Second revision: 1981
  - Wechsler Adult Intelligence Scale - Revised (WAIS-R)
- Third Revision: 1997
  - Wechsler Adult Intelligence Scale - 3rd Edition (WAIS-III)
  - Standardization Sample based on 2450 adults in 13 age groups, stratified according to 1995 census data.

Evolution of the 1939 Wechsler-Bellevue

- Other Test Versions
  - **Wechsler Intelligence Scale for Children (WISC; ages 6-16 yrs)**
    - The WISC was originally developed as a downward extension of the Wechsler Adult Intelligence Scale in 1949.
    - A revised edition (WISC-R) in 1974 as the WISC-R, and the third edition, the WISC-III in 1991.
    - The current version is the WISC-IV (2003)

Evolution of the 1939 Wechsler-Bellevue

- Other Test Versions
  - **Wechsler Preschool and Primary Scale of Intelligence (WPPSI; 2.5 – 7.25 yrs)**
    - Originally Developed in 1967 as a descendent of the WAIS and the WISC
    - It has since been revised twice, in 1989 and 2002.
    - The current revision, WPPSI–III provides subtest and composite scores that represent intellectual functioning in verbal and performance cognitive domains, as well as providing a composite score that represents a child's general intellectual ability (i.e., Full Scale IQ).

Evolution of the 1939 Wechsler-Bellevue

- Other Test Versions
  - **Wechsler Abbreviated Scale of Intelligence (WASI)**
    - Was developed in 1997 along with the WAIS-III
    - A short, four-subtest version of the battery has recently been released, allowing clinicians to form a validated estimate of verbal, performance and full scale IQ in a shorter amount of time.
    - Uses vocabulary, similarities, block design and matrix reasoning subtests similar to those of the WAIS to provide an estimate of full scale IQ in about 30 minutes

The WAIS-III Verbal Scale

Subtests	Skills Tapped
Vocabulary	word knowledge
Similarities	abstract, divergent thinking
Arithmetic	concentration, working memory
Digit span	active working memory
Information	fund of knowledge
Comprehension	social/moral reasoning, judgment
Letter-number sequencing	concentration, working memory

The WAIS-III Performance Scale

Subtests	Skills Tapped
Picture Completion	alertness to details
Digit-Symbol (Coding)	visual-motor skills
Block Design	nonverbal reasoning
Matrix Reasoning	inductive, NV reasoning
Picture Arrangement	planning ability, social reasoning
Symbol Search	Speed of processing
Object Assembly	Part-whole knowledge

WAIS-III Verbal Subtests

- Vocabulary
  - Give a word, ask for a definition.
  - Taps knowledge of words and their meanings.
  - Good measure of "premorbid functioning" (intellectual capacity prior to trauma/illness)
    - as brain "damage" continues, vocabulary is one of the last test scores to be affected.
  - Very stable measure of intelligence

WAIS-III Verbal Subtests

- Similarities
  - Present two words, ask how they are alike.
  - Early items tap previously-learned associations.
    - How are a dog and a cat alike?
  - Later items require abstract thinking.
    - How are liberty and freedom alike?
  - Can also be used to find serious psychopathology
    - Idiosyncratic reasoning.

WAIS-III Verbal Subtests

- Arithmetic
  - Frequently thought to be a math test.
  - Little math involved.
  - More a test of active working memory
    - If envelopes are 25¢ a dozen and you buy 3 dozen envelopes, how much change should you get back from a dollar?
  - Subject to effects of anxiety, depression as well as cognitive deficits.

WAIS-III Verbal Subtests

- Digit Span
  - Numbers presented, one per second, to subject.
  - Subject asked to repeat digits forward (part I) and reversed (part II).
  - Separate scores are obtained for Digits Forward and Digits Reversed, but the scores generally combined for reporting.
  - Taps active working memory, concentration, short-term auditory memory.
  - Also subject to anxiety, depression, and other forms of psychopathology.

WAIS-III Verbal Subtests

- Information
  - Ask a question about general knowledge, subject gives an answer.
  - Taps general fund of knowledge, also curiosity, academic achievement, and the effects of an enriched environment.
    - "How many senators come from each state in the United States?"

WAIS-III Verbal Subtests

- Comprehension
  - Asks three different types of questions:
    - Appropriate responses to hypothetical situations
      - What is the thing to do if you see someone lying in the street?
    - Logical explanations for everyday actions
      - Why do we elect senators?
    - Proverb interpretations
      - What does, "a stitch in time saves nine" mean?
  - Taps social and moral reasoning, conventional knowledge.
  - Also provides an arena for idiosyncratic responses

WAIS-III Verbal Subtests

- Letter-Number Sequencing
  - Optional subtest (not required to compute Verbal IQ scores)
  - One of the newest WAIS subtests
  - Present a sequence of letters & numbers, subject has to sort them into sequential order:
    - Stimulus: Z, 3, B, 1, 2, A
    - Response: 1, 2, 3, A, B, Z
  - Taps active working memory, sequential processing
  - Also subject to psychopathology effects.

Scoring the WAIS-III Verbal Subtests

- Raw scores on each test are converted to scaled scores
  - Mean 10, SD 3
  - Two sets of scaled scores
    - Age-adjusted norms - ability compared to other individuals in the normative sample of the same age
      - Allows "peer" comparisons, but not cross-age contrasts
    - Reference-group norms - ability compared to a group of individuals in the normative sample between the ages of 20 and 34
      - Allows contrasts across ages

Scoring the WAIS-III Verbal Subtests

- Age adjusted scores are then summed (except for the optional subtests) and this sum is compared with the standardization sample for all age groups.
  - ANOVAs do not show significant age-effects on any IQ or index (more on these later)
- The resulting score is the Verbal IQ.
  - Mean 100, SD 15

WAIS-III Performance Subtests

- Picture Completion
  - Show a picture with an important detail missing
  - In 20sec, subject has to come up with the missing detail
  - Taps attention to detail, scanning
- Digit Symbol-Coding
  - Present an array of numbers with matched abstract symbols as a key; multiple empty boxes with numbers below.
  - Complete as many as possible numbered boxes with appropriate key in 120sec
  - Taps processing speed, attention to detail

WAIS-III Performance Subtests

- Block Design
  - Present array of blocks on a card, give 9 blocks to subject; they must reproduce the block array in as short a time as possible (timed test, shorter times = higher points)
  - Taps visual-motor skills, processing speed
  - Input is visual, output is motor
  - Best test of nonverbal concept formation, abstract thinking.

WAIS-III Performance Subtests

- Matrix Reasoning
  - New to the WAIS-III, but similar to the Binet matrix reasoning test
  - Present subject with a nonverbal, sequence of matrices.
  - Subject must produce the content of the missing cell
  - Taps nonverbal logical abstract reasoning, inductive reasoning skills, fluid intelligence

WAIS-III Performance Subtests

- Picture Arrangement
  - Present array of pictures, similar to a comic strip, but scrambled in order.
  - Subject is asked to arrange the pictures in an "order that makes sense" as quickly as possible (shorter times = higher points)
  - Taps social reasoning, nonverbal reasoning, sequential reasoning, & cause-and-effect relationships

WAIS-III Performance Subtests

- Object Assembly
  - Presents subject with a set of puzzle pieces (manipulatives)
  - Subject is to arrange (solve) the puzzle in as short a time as possible (shorter times = higher scores).
  - Taps knowledge of part-whole relationships, visual-motor reasoning skills.

WAIS-III Performance Subtests

- Symbol Search
  - New to the WAIS-III, appeared in the WISC-III earlier. Optional Subtest
  - Subject is shown two target abstract symbols and is asked to determine if either target symbol appears in a set of distractor symbols.
  - Do as many as possible in 120 seconds (shorter times, more correct = higher scores).
  - Taps visual discrimination, processing speed.

Scoring the WAIS-III Performance Subtests

- Age adjusted scores are then summed (not the optional subtests) and this sum is compared with the standardization sample for all age groups.
  - ANOVAs do not show significant age-effects on any IQ or index (more on these later)
- The resulting score is the Performance IQ.
  - Mean 100, SD 15

Scoring the WAIS-III Full-Scale IQ

- Age-corrected scaled scores for all nonoptional subtests are summed and this sum is used to produce the Full-Scale IQ.
  - Mean 100, SD 15

WAIS-III Index Scores

- Aside from the Verbal, Performance, and Full-Scale IQ, the WAIS-III provides for four additional measures of ability, made up of summed age-corrected subtest scores:
  - Verbal Comprehension
  - Perceptual Organization
  - Working Memory (Freedom from Distractibility)
  - Processing Speed

WAIS-III Index Scores

- Verbal Comprehension
  - Vocabulary + Similarities + Information
  - "Pure" measure of verbal abilities
    - no working memory component nor attention-related concerns
  - Measures crystallized intelligence
- Perceptual Organization
  - Picture Completion + Block Design + Matrix Reasoning
  - Measures fluid intelligence
  - Also loads on attention to details and visual-motor integration

WAIS-III Index Scores

- Working Memory
  - Arithmetic + Digit Span + Letter-Number Sequencing
  - On WISC-III (without Letter-Number Sequencing), same index score is called "Freedom from Distractibility"
  - Measures active working memory
- Processing Speed
  - Digit-Symbol-Coding + Symbol Search
  - Measures abilities to solve problems under the constraints of time.

Interpreting the WAIS-III

Wechsler Adult Intelligence Scale - 3rd Edition

Verbal Subtests		Performance Subtests	
Subtest	**Score**	**Subtest**	**Score**
Vocabulary	13	Picture Completion	12
Similarities	12	Digit Symbal-Coding	11
Arithmetic	12	Block Design	12
Digit Span	12	Matrix Reasoning	15
Information	8	Picture Arrangment	9
Comprehension	13	Symbol Search	9
Letter-Number Sequence	9	Object Assembly	14

Verbal IQ	**110**
Performance IQ	**111**
Full Scale IQ	**111**
Verbal Comprehension Index	105
Perceptual Organization Index	118
Working Memory Index	106
Processing Speed Index	99

Interpretation of the WAIS-III

- Step 1 - Interpret Full Scale IQ
- Step 2 - Interpret VIQ and PIQ and note any discrepancies.
- Step 3 - Interpret Index Scores
- Step 4 - Interpret Subtest Scaled Scores and note any discrepancies.
  - Analyses of patterns of WAIS scores have not produced reliable findings.
  - Better to use these discrepancies to generate hypotheses.

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Psychometrics of the WAIS-III

- Reliability
  - Split half coefficents (without speeded tasks)
    - Full Scale IQ = .98
    - Verbal IQ = .97
    - Performance IQ = .94
  - Test-Retest
    - Full Scale IQ = .95
    - Verbal IQ = .94
    - Performance IQ = .88

Psychometrics of the WAIS-III

- Recall that the Standard Error of Measurement can be calculated by:

$$s_{meas} = s\sqrt{1 - r_{xx}}$$

  - s is the standard deviation; r_{xx} is reliability
- As such, we can describe the 95% (≈ score ±2 * SEM) and 99% (≈ score ±3 * SEM) confidence intervals for each of the IQ scores.

Calculating WAIS-III Confidence Intervals

- Suppose someone is measured with the WAIS-III with a Full Scale IQ of 108.
- What is the 95% confidence interval for this test score?

$$s_{meas} = s\sqrt{1 - r_{xx}}$$
$$s_{meas} = 15\sqrt{1 - .98}$$
$$s_{meas} = 2.121$$
$$2 * s_{meas} \approx 95\%tile$$
$$2 * 2.121 = 4.242$$
$$95\%\ \text{confidence interval} = 108 \pm 2.424$$
$$95\%\ \text{confidence interval} = 105.58 \le \mu \le 110.42$$

WAIS-III Subtest Reliabilities

- … are generally too low to be psychometrically sound
  - Most are in the .70s and .80s with a few in the .60s.
  - As such, scores on the subtests are likely to "bounce around" more than scores on the IQ scales and index scores.
  - This makes profile analysis impossible, from a psychometric perspective.

WAIS-III Validity

- Generally assessed through correlations with the older WAIS-R and for a small group of subjects, the WISC-III.
- Validity coefficients
  - range between .50 to .90 for the subtests
  - Verbal IQ: .94 (WAIS-R), .88 (WISC-III)
  - Performance IQ: .86 (WAIS-R), .78 (WISC-III)
  - Full-Scale IQ: .93 (WAIS-R), .88 (WISC-III)

Evaluation of the WAIS-III

- Considers more than one type of intelligence but clearly not the kind of multiple intelligences of which Gardner speaks.
- IQ and Index Scores are highly reliable and valid although caution should be used in interpreting subtest scores.
- Strong correlation between WAIS-III and WAIS-R mixed blessing.