Neuropsychological Assessment (Testing): An Overview (Part 1)
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A. General Issues

Rationale: Why is a neuropsychological assessment conducted?

Top 10 Assessment Referral Questions (Rabin et al, 2016, Table 7)
among 510 doctoral-level neuropsychologists

Question	%age of respondents
Determining Diagnosis	71.0
Rehabilitation/Treatment Planning	39.2
Educational Planning	33.7
Disability Determination	22.4
Establish baseline for subsequent testing	21.2
Assess capacity to work	20.0
Assess capacity for independent living	19.4
Forensic determination	19.2
Capacity assessment	16.1
Pre- and post-medical intervention	10.2

- *Diagnosis* (Labeling): Need to establish a diagnostic label for various legal, educational, insurance, and other reasons.

- *Strengths & weaknesses*: Need to provide employer or referral source with an extended description of the patient's strengths & weaknesses. What can they do best? Worst?

- *Educational/school psychological evaluation*: Need to detail student's strengths, weaknesses, and areas for remedial attention in academic/school planning; IEP (Individual Educational Program) purposes.

- *Rehabilitation or treatment planning*

- *Legal/forensic evaluation*: Need to establish loss of abilities due to injury for purposes of setting damages in a tort; need to evaluate responsibility for a criminal act.

- *Job/employment evaluation*

Where do clinical neuropsychologists work? (Rabin et al., 2016, Table 3)

Setting	%age of respondents
Private or group practice	59.8
Medical hospital	32.2
Rehabilitation facility	14.7
Other (e.g.., school, outpatient clinic/rehab facililty)	11.6
VA hospital	10.0
Psychiatric hospital	6.5
Community mental health center	2.9
College/university counseling center	2.2
State prison/correctional facility	2.2
Business/industry	0.8

Note: Percentage does not total to 100% since respondents had option to name multiple settings.

Typical Diagnostic Groups Encountered by Neuropsychologists (Rabin et al., 2016, Table 6)

Patient/Diagnostic Group Assessed	%age of respondents
Head injury	54.8
Dementia	48.6
ADHD	37.5
Learning disabilities	24.9
Mood disorders	18.7
Stroke/vascular disorders	17.7
Seizure disorders	13.5
Anxiety disorders	7.6
Neurological disorders	5.8
Autism spectrum disorders, multiple sclerosis, mild cognitive impairment CNS tumor, cerebral palsy/spina bifida, developmental disorder	3.0 to 4.0
Schizophrenia/psychosis, substance abuse, chronic pain, Parkinson's disease	2.0 to 2.9
General medical disorder, HIV, movement disorder, hearing disorder Conduct/behavioral disorder, fetal alcohol syndrome, prematurity Childhood/adolescents, genetic disorder, personality disorder, Inpatient care, toxic exposure	1.0 to 1.9

Diagnostic Conditions Serving as Bases for Neuropsychological Evaluation (Top 5 conditions, Sweet et al. 2021, Table 46, p. 56)

Year	Pediatric Only	Adult Only	Lifespan
2015	ADHD	Elderly dementias	CHI/TBI
	Seizure disorder	CHI/TBI	ADHD
	CHI/TBI	Stroke or CVA	Elderly dementias
	Brain tumor	Seizure disorder	Seizure disorder
	PDD/Other med/neuro	ADHD	Other med/neuro
2020	ADHD	Elderly dementias	CHI/TBI
	Seizure disorder	CHI/TBI	Elderly dementias
	Other med/neuro	Seizure disorder	ADHD
	CHI/TBI	Other med/neuro	PDD
	PDD/Learning dis- abilities	Stroke or CVA	Learning disabilities/seizures Other med/neuro conditions

PDD = Pervasive developmental disorder; CHI = closed head injury

**What Is Involved? What general things must the clinician think about?**

- Establish what the *referral question* is: Why is *this* assessment being carried out?
- *Patient history*: What is the patient/testee's medical, educational, work, social, and legal background or history
- *Patient current situation*: current mood, affect, social supports, environmental demands
- *Interviewing*: Will the patient/testee be interviewed using a structured, semi-structured, or open-ended set of questions?
- *Psychological/Neuropsychological Tests*: Choice & length. Who will pay?

See more below in Part B. The Patient's History

Issues in Testing (AERA, APA, & NCME, 2014)

Basic statistics: The neuropsychologist needs to know & use these statistical terms, concepts, & kinds of data: raw scores, mean, standard deviation, standard scores (such as z scores, T scores), percentiles, r/R, r^2/R^2 (variance), standard error of measurement, the difference between statistical significance vs. clinical significance

- Note: The square of a test's validity coefficient (r^2/R^2; see below) measures the percentage of variance of the trait, ability, etc. which can be accounted for on the basis of that test.
    - For example, if the Verbal IQ of the WAIS has a validity coefficient of 0.91, then we know that the test can account for roughly 83% of the underlying verbal ability measured by the test.
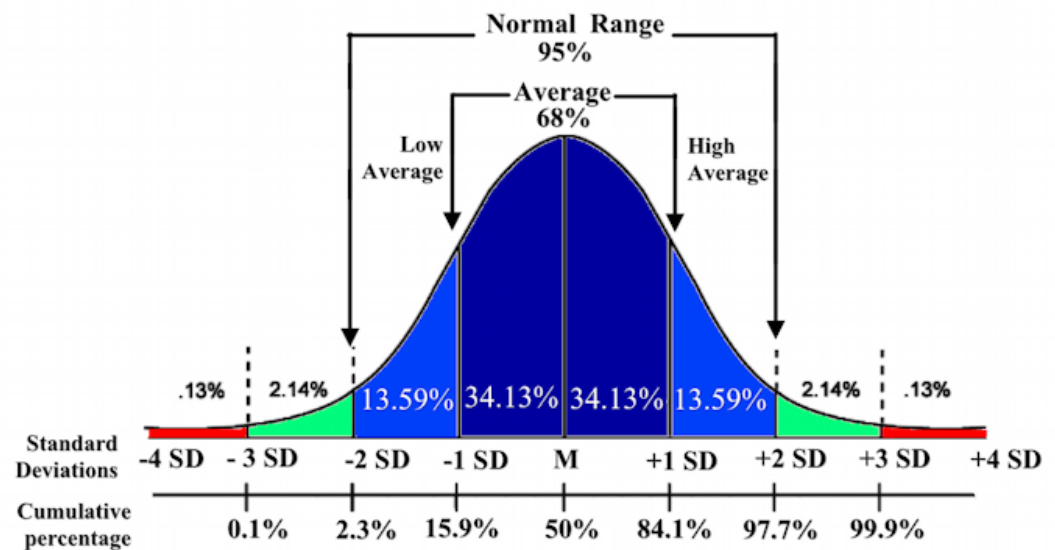
- ***Validity***: The question of ***meaning***. It answers the question, "How much/what do I learn about this person being tested when the assessment is concluded?" Is the test accurate? = validity. The 2014 AERA, APA, & NCEM standards for testing argues that "validity refers to the degree to which evidence and theory support the interpretation of test scores for proposed uses of tests" (p. 11).

    Further, there is no SINGLE measure of validity. Rather, there are multiple forms of evidence that, jointly, contribute to the judgment that a particular test is valid for a particular purpose. Some of these forms of evidence involve:

    - ❑ ***Concurrent validity***: What is the test measuring? ("The score on test X measures quality Y.)
    - ❑ ***Predictive validity***: What does the test forecast about future performance?
    - ❑ Guidelines: r (r^2) < 20 (< 4%) [not useful], 20-40 (4-9%) [minimally useful clinically], 40-50 (9-25%) [moderately useful clinically], > 50 (25%+) [highly useful clinically]

- ***Reliability/Precision***: The question of ***consistency***. It answers the question, "If this person is evaluated again, how likely is it that the person will achieve the same score or perform in the same way?" Would the scores of the person being evaluated change if they had been scored by someone else? If they had been tested at a different time? Had they been given other items or stimuli?

    - ❑ Across time (***test-retest reliability***)
    - ❑ Across examiners (***inter-rater reliability***)
    - ❑ Within the test (***content reliability***)
    - ❑ Guidelines: r < 60 (not useful), 60-70 (experimentally intriguing, but need to be cautious), 70-79 (marginally useful), > 80 (clinically quite useful)
    - ❑ Note that the reliability of a test represents the ceiling of the test's possible validity. Tests can't be more valid than they are reliable.

- ***Standardization***: The question of **norms**

  - ❑ ***Standardization Sample***: What is the comparison group used to generate the normative scores on the assessment instrument/test. Is it a national? Is it representative of the group my patient belongs to (e.g., of Americans, males, females, African-American, etc.) Does the comparison group consist of brain-injured or neurologically-impaired?

  - ❑ ***Standardization of Administration***: How is the test given? What are the procedures? There should be a standardized way (a single way) in which the test is given in order for results to be comparable across different testees. This standardization form of administration must be used when the standardization sample is itself tested.

Some Important Issues in Assessing Neuropsychological Patients

- The nature of the neuropsychological impairment may make testing difficult, e.g., fatigue, inattention, frustration
- Testing setting: Often less than optimal if in a hospital or clinic setting
- Motivation: Testers want persons to give their best effort & performance.
- Malingering: Might the subject fake performance in order to appear worse? This is especially relevant for forensic/legal testing in lawsuits, government disability certification, etc.

Quantitative vs. Qualitative ("Process") Approaches to Test Interpretation

Quantitative

- ***Use of normative comparisons***. Testee's performance is compared to the standardization sample. Where does that performance fall? Is it average? Below average? Significantly below average?

- ***Use of cut-off scores***. Testee's performance is compared to a group of brain-damaged or impaired individuals. Does the individual's performance fall below a certain threshold which puts them clearly in the range of how brain-injured testee's perform?

Qualitative

- Over and above the numerical score, how does the testee go about the test? More centrally, how did the errors occur and how was correct performance achieved? ***By looking at the WAY the testee made mistakes***, we may learn about the underlying problem he or she may have.

  - E.g., Edith Kaplan and the "Boston process approach": *Wechsler Tests as Neuropsychological Instruments* (WAIS-R-NI; WISC-R-NI)

B The Patient's History
(Lezak et al. 2004; Loring et al. 2021)

In a neuropsychological assessment of a patient, it is important that the clinician have a broad understanding of the patient's background, educational attainment, and medical history. The major elements which are important for evaluation include the following:

Demographics

What is the patient's race, ethnicity, sex, gender, marital status, reported parental educational attainment?

Educational Attainment and Employment History

When assessing younger clients, a complete history should be obtained from a parent which indicates both pre-school and school attainment (including difficulties and achievements). Are there any teacher/counselor observations or referrals that would help identify how this client has been behaving?

When assessing adult clients, a complete history of educational attainment (High school? College? Graduate school? Technical training?) needs to be assembled. If the client indicates any successes or difficulties during schooling, these should be made part of the history.

For adult clients, a full history of the individual's employment including job responsibilities, etc. should be obtained. This would also include any experiences such as service in the armed forces and the roles/responsibilities the client carried out in any of these setting.

Family, Social and Legal History

Clients should provide a broad understanding of their family and personal social histories, e.g., important aspects of parents, siblings, and other relatives regarding employment, social lives, and difficulties in across developmental stages. Have there been any significant legal issues in the client's life, e.g., has the client been involved in any criminal proceedings? Is/has the client been involved in any lawsuits or other legal proceedings to obtain benefits, compensation, or other advantages?

Medical History and Referral Question

A full medical history includes an overview of developmental milestones (or delays), significant physical or mental illnesses in the past, and current medical difficulties or diagnostic conditions.

Any forms of psychological treatment and the reasons for seeking such treatment need to be noted.

A complete overview of medications should be obtained to evaluate whether any drugs that affect the nervous system or behaviors are identified. Similarly, does the client have a history of substance use?

What is the precise nature of the referral question, that is, what is the neuropsychologist being asked to do and what aspects of the client's recent life (medical, legal, etc.) prompts the referral?

C. Synopsis of Clinical Neuropsychological Assessment Instruments

Foundational Instruments

Wechsler Adult Intelligence Scale® (WAIS®)

- Created by Dr. David Weschler (1896-1981, right), chief psychologist at Bellevue Hospital (NYC), as the *Wechsler-Bellevue* (*WB*) in 1939 and the *Wechsler-Bellevue II* (WB-II) in 1945. This was the first IQ test developed initially for adults rather than children.

Earlier Versions
- WAIS: 1955
- WAIS-R (Revised edition): 1981
- WAIS-III (3rd edition): 1997

Composite Scores: Mean = 100 points (SD = 15): FSIQ, VIQ (Verbal IQ), PIQ (Performance IQ)
Subtest scores: Mean = 10 points (SD = 3)

The WAIS-5 is currently under development and standardization. It was expected to be published in 2019 but it has still not been published or mentioned in 2021.

Wechsler Adult Intelligence Scale®-4th Edition (WAIS-IV, 2008)

- The WAIS-IV was standardized on a sample of 2,200 people in the United States ranging in age from 16 to 90. An extension of the standardization has been conducted with 688 Canadians in the same age range.

Verbal Comprehension Scale	Working Memory Scale	Perceptual Reasoning Scale	Processing Speed Scale
Similarities Vocabulary Information	Digit Span Arithmetic	Block Design Matrix Reasoning Visual Puzzles (N)	Symbol Search Coding
Comprehension (S)	Letter-Number Sequencing (S/16-69)	Picture Completion (S) Figure Weights (N, S/16-69)	Cancellation (N, S/167-69)

S = Supplemental subtest; N = New to WAIS-IV; 16-69 = used with 16-69 year old subjects only

Composite Scores (Mean of 100; SD of 15)

- FSIQ (Full-scale IQ) based on 10 core subjects

- VCI (Verbal Comprehension Index) based on 3 core subtests
- PRI (Perceptual Reasoning Index) based on 3 core subtests
- WMI (Working Memory Index) based on 2 core subtests
- PSI (Processing Speed Index) based on 2 core subtests
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- GAI (Global Ability Index) = VCI + PRI

WAIS®-IV Subtests

Verbal Comprehension (VC)

Similarities: Identify how two items belong to a superordinate category
- How are a tangerine & an orange alike? A telegram & a letter? Charity & faith?

Vocabulary: Define the meaning of words. A measure of verbal intelligence & established knowledge
- What do these words mean: Automobile? Dramatic? Incidental?

Information: Samples of an individual's general fund of knowledge.
- How many months are there in a year? Who wrote the play *Macbeth*? Who was Duke Ellington?

Comprehension (S): Questions about the rules of socially acceptable behavior, reasons for social law & customs, & interpretation of proverbs
- Why do we wash our hands before we eat? Why do we stop at Stop signs? What does this saying mean, "A stitch in time saves nine"?

Working Memory (WM)

Digit Span: Ask individual to repeat a string of numbers forwards; repeat a string of numbers backwards.
- 3 – 6 – 8 – 7 – 1 – 9 – 4 (forward/backwards)

Arithmetic: Ask individual to perform mental arithematical calculations
- How much is 6 times 7? If Janie has $2.00 and gives Billy one-quarter of her money, how much money does she have left?

Letter-Number Sequencing (S): Individual is orally presented with sequences of numbers & letters together. They must repeat them in numerical order and alphabetical order
- 2 B 4 F 7 M

Perceptual Reasoning (PR)

Block Design: Show individual a design on a card and ask them to reproduce the design using a set of individual blocks whose faces are either all white, all red, or half-white/half-red (example below on left).

Matrix Reasoning: Complete the missing portion of a picture matrix by choosing one of five options (example below on right).
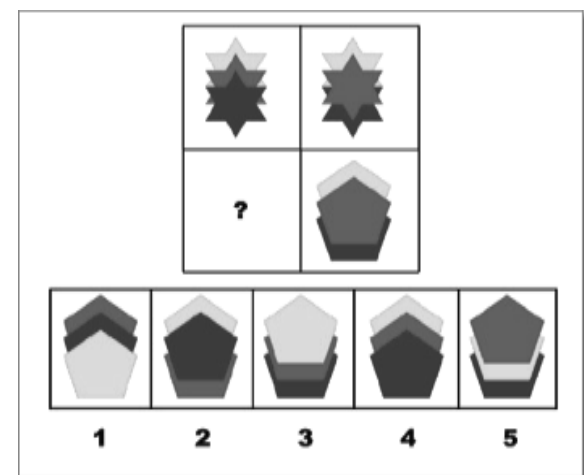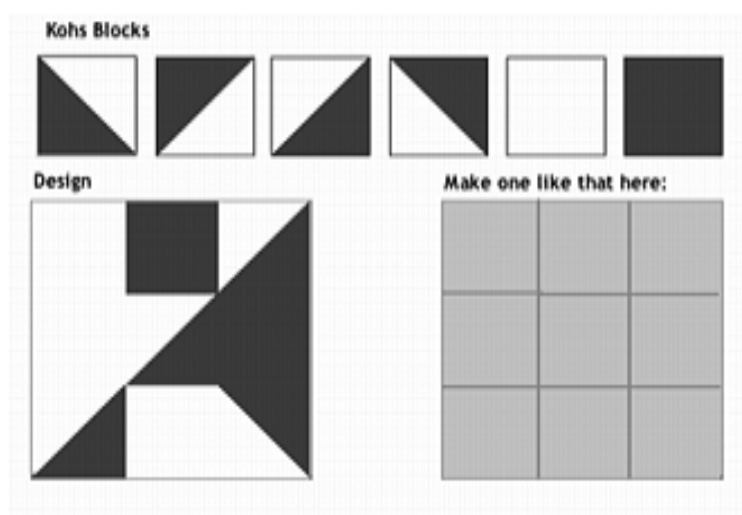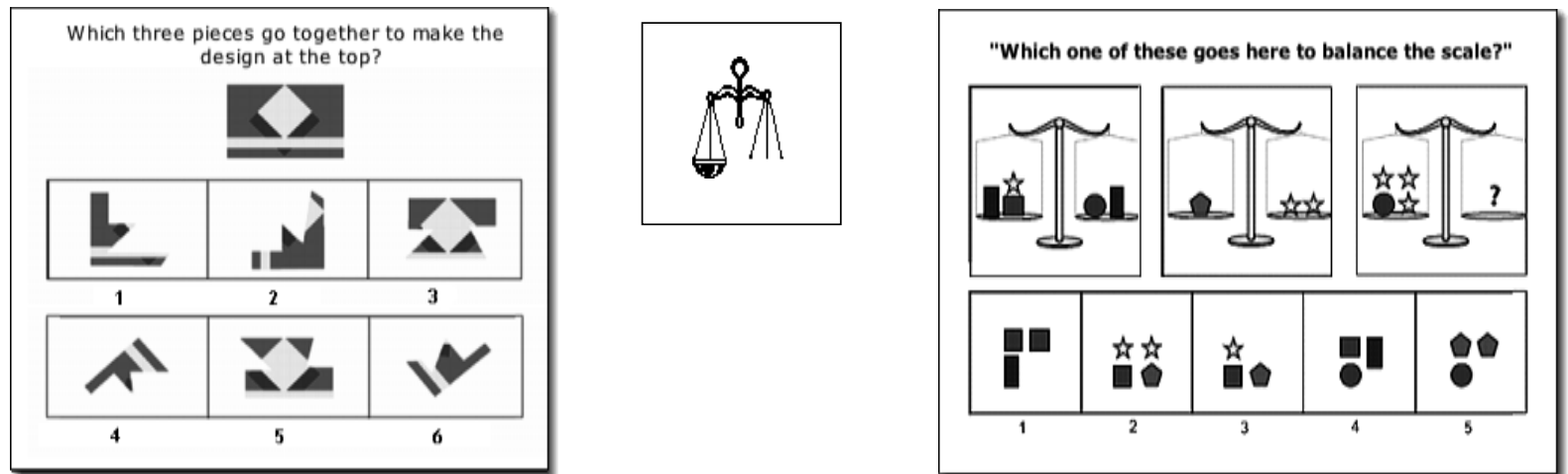

Visual Puzzles (N) – examining visual images to understand how they are put together (example beiow on left).

Picture Completion (S): Ask individual to perceive what is missing in a visual image and say/point to what is missing (example below in middle).

Figure Weights (S): Individual uses logic to determine various values to solve the puzzle (example below on right)


Which three pieces go together to make the design at the top?

"Which one of these goes here to balance the scale?"

Processing Speed (PS)

Symbol Search – Testee scans a row of symbols to identify whether a target symbol or set of symbols can be found within the row within a specified period of time.
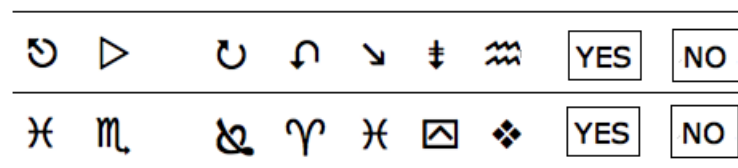
Coding – Testee must transcribe the appropriate coded symbol in bottom empty rows based on the guide at the top.
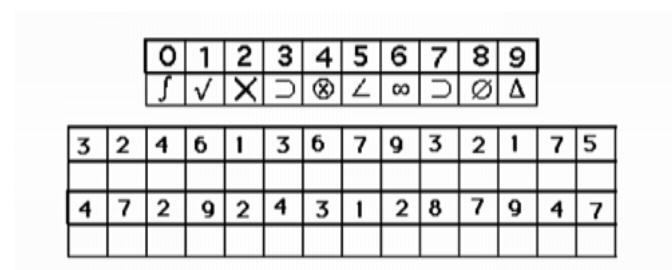
Cancellation (S) – Testee scans a set of differently colored shapes and puts a mark through target of a specific shape and color.

When I say go, draw a line through each black square and gray triangle.
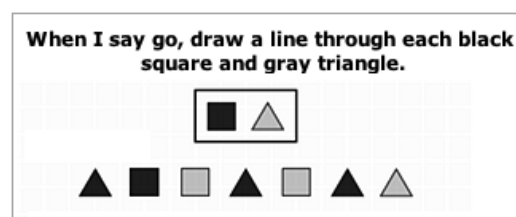
Wechsler Intelligence Scale for Children® (WISC)

- Created by Dr. David Wechsler as an extension to younger ages (children & adolescents) of his earlier intelligence test for adults.

Earlier Versions

- WISC: 1949
- WISC-R (Revised edition): 1974

Composite Scores on Scales above: Mean = 100 points (SD = 15): FSIQ (Full Scale IQ), VIQ (Verbal IQ), PIQ (Performance IQ) and subtest scores with mean = 10 points (SD = 3)

- WISC-III (3rd edition): 1991. Evidence for factors of (I) verbal comprehension, (II) perceptual organization, (III) freedom from distractibility and, perhaps, (IV) processing speed.
- WISC-IV (2003): Factor indexes = (1) Verbal Comprehension, (2) Working Memory, (3) Perceptual Reasoning, and (4) Processing Speed

Wechsler Intelligence Scale for Children-5th Edition® (WISC-V, 2014)

- The WISC-V was standardized on a sample of 2,200 individuals) in the United States ranging in age from 6 years 0 months to 16 years 11 months matched to US census data based on sex, race/ethnicity, parent education level, and geographic region for each age group.
- Additional data gathered for special need groups.

Full Scale				
Verbal Comprehension Index (VCI)	Visual Spatial Index (VSI)	Working Memory Index (WMI)	Fluid Reasoning Index (FRI)	Processing Speed Index (PSI)
Similarities **Vocabulary** *Information* *Comprehension*	**Block Design** **Visual Puzzles**	**Digit Span** ***Picture Span*** *Letter-Number Sequencing*	**Matrix Reasoning** **Figure Weights** *Picture Concepts* *Arithmetic*	**Coding** **Symbol Search** Cancellation
Primary index Scales subtests in boldface				
Ancillary Index Scales				
Quantitative Reasoning	Auditory Working Memory	Nonverbal	General Ability	Cognitive Proficiency
Figure Weights Arithmetic	Digit Span Letter-Number Sequencing	Block Design Visual Puzzles Matrix Reasoning Figure Weights Picture Span Coding	Similarities Vocabulary Block Design Matrix Reasoning Figure Weights	Digit Span Picture Span Coding Symbol Search

Composite Scores (Mean of 100; SD of 15)

- FSIQ (Full-scale IQ) based on 10 core subjects

- VCI (Verbal Comprehension Index) based on 2 core subtests
- VSI (Visual Spatial Index) based on 2 core subtests*
- WMI (Working Memory Index) based on 2 core subtests
- FRI (Fluid Reasoning Index) based on 2 core subtests*
- PSI (Processing Speed Index) based on 2 core subtests

On the WISC-IV, there was a factor called *Perceptual Reasoning*. In the WISC-V, this factor was separated into two new index scores: Visual Spatial and *Fluid Reasoning*

The Psychological Corporation: PsychCorp™

- Originally established in 1921 by psychologists James McKeen Cattell, Robert Sessions Woodworth, and Edward Lee Thorndike (all associated with Columbia University) to publish materials related to assessment and testing in psychology for use by schools, the government, and corporations.

- Original publisher in 1939 of the Wechsler-Bellevue Intelligence Scales (David Wechsler was himself a student of Woodworth at Columbia University)

- The Psychological Corporation was bought out by Harcourt Brace Jovanovich in 1970 and eventually was acquired in 2008 by Pearson Educational in a business unit called Pearson Assessments & Information <http://psychcorp.pearsonassessments.com/pai/ca/cahome.htm>

The Psychological Corporation
By J. McKeen Cattell

THE Psychological Corporation was granted a charter by the state of New York on April 28, 1921, its objects and powers being defined as the "advancement of psychology and the promotion of the useful applications of psychology." The certificate of incorporation provides that no dividend in excess of six dollars a share shall be paid during any calendar year and empowers the American Psychological Association to take over any or all of the stock on payment of one hundred dollars a share. The stock was subscribed for and is now held by about 170 psychologists active in the work of the Corporation. The thousand shares have no par value; they were allotted to psychologists at a valuation of ten dollars a share and each stockholder is expected to give without payment services to the Corporation that will make the ultimate value of the shares one hundred dollars. As the maximum dividend is 6 per cent on this valuation and as the Psychological Association can take over the stock, the owner can make no profit beyond interest on the money subscribed and payment for services rendered. All profit that accrues from the work of the Corporation must be used for psychological research.

OFFICERS AND DIRECTORS

The directors of the Psychological Corporation named in the act of incorporation were elected by the stockholders; there has been no change except to fill the vacancy caused by the death of Professor George Trumbull Ladd of Yale University. The directors are:

James R. Angell, Yale University.
W. V. Bingham, Carnegie Institute of Technology.
J. McKeen Cattell, The Psychological Corporation.
Raymond Dodge, Wesleyan University.
S. I. Franz, Government Hospital for the Insane.
G. Stanley Hall, Clark University.
H. L. Hollingworth, Barnard College, Columbia University.
Charles H. Judd, University of Chicago.
William McDougall, Harvard University.
W. B. Pillsbury, University of Michigan.
Walter Dill Scott, Northwestern University.
C. E. Seashore, University of Iowa.
Lewis M. Terman, Stanford University.
Edward L. Thorndike, Teachers College, Columbia University.
E. B. Titchener, Cornell University.
Howard C. Warren, Princeton University.
Margaret Floy Washburn, Vassar College.
John B. Watson, The J. Walter Thompson Company.
R. S. Woodworth, Columbia University.
R. M. Yerkes, The National Research Council.

At the first meeting of the directors on June 2, 1921, Dr. Cattell was elected president; Dr. Scott, first vice-president; Professor Terman, second vice-president; Professor Thorndike, chairman of the directors; Professor Dodge,

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- Clinical assessment materials like the Wechsler and other tests are only sold to individuals who are qualified by education and licensure.

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Note that these books are directed principally toward clinical professionals and graduate students.

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