WISC–IV Technical Report #1
Theoretical Model and Test Blueprint

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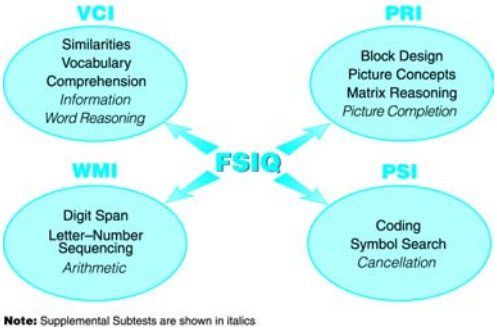
Overview

This technical report is the first in a series intended to introduce the Wechsler Intelligence Scale for Children—Fourth Edition (WISC–IV). Technical Report #1 presents the theoretical structure and test blueprint for the WISC–IV, as well as subtest changes from Wechsler Intelligence Scale for Children—Third Edition (WISC–III); Technical Report #2 presents the psychometric properties of WISC–IV; Technical Report #3 addresses the instrument's clinical validity.

Neurocognitive models of information processing provide the basis for the new structure of the WISC–IV, which replaces the traditional Verbal IQ (VIQ)/Performance IQ (PIQ) dichotomy. The index scores that were supplemental in WISC–III are now primary, and each has been enhanced according to contemporary research. The names of two indices have been updated in order to more accurately reflect the content measured by subtests introduced in this revision. Detailed information is provided in the WISC–IV Technical and Interpretive Manual.

WISC–IV Development and Structure

During a five-year period that encompassed the pilot, tryout, and standardization phases of development, the items that compose the WISC–IV were administered to thousands of children. The results of each phase were reviewed and analyzed by the staff at The Psychological Corporation (TPC), as well as outside experts, and those determined to be the most effective were included in subsequent research phases. Items were also reviewed for potential bias by a panel of outside experts and through statistical analysis; those items identified as potentially biased, based on cultural, socioeconomic, and/or regional concerns were either eliminated or modified to reduce potential bias.



Note: Supplemental Subtests are shown in italics

After the standardization phase, the best items were refined to craft an instrument that was clinically sound both in content and utility, with an enhanced sensitivity to cognitive functions related to learning disabilities, attention disorders, and executive function.

Five new subtests grounded in the new theoretical modal of the WISC–IV were developed. Four new subtests, Picture Concepts, Letter-Number Sequencing, Matrix Reasoning, and Word Reasoning, were adapted from other Wechsler intelligence scales and were modified specifically for use with school-age children. One new subtest, Cancellation, was developed specifically as a measure of visual selective attention and as a measure of processing speed.

The item content, administration procedures, and scoring procedures for the ten subtests retained from the WISC–III were revised for the WISC–IV. These subtest are Block Design, Similarities, Digit Span, Coding, Vocabulary, Comprehension, Symbol Search, Picture Completion, Information, and Arithmetic.

The four indices of the WISC–IV derive from ten core and five supplemental subtests. The indices and subtests are:

- **Verbal Comprehension Index**—Similarities, Vocabulary, and Comprehension (Supplemental: Information, Word Reasoning)
- **Perceptual Reasoning Index**—Block Design, Picture Concepts, and Matrix Reasoning (Supplemental: Picture Completion)
- **Working Memory Index**—Digit Span and Letter–Number Sequencing (Supplemental: Arithmetic)
- **Processing Speed Index**—Coding and Symbol Search (Supplemental: Cancellation)

WISC–IV Full Scale IQ

The Full Scale IQ (FSIQ) score derives from the ten core subtests included in the four indices. This change means that the FSIQ is no longer simply the sum of verbal and performance composites; in keeping with contemporary intelligence research, the FSIQ now includes greater contributions from working memory and information processing speed.

Verbal Comprehension Index

The familiar Verbal IQ (VIQ)and Performance IQ (PIQ) scales were renamed the Verbal Comprehension Index (VCI) and Perceptual Reasoning Index (PRI); these should be substituted for the VIQ and PIQ when making clinical decisions and in other situations where VIQ and PIQ were previously required.

The clinical interpretation is focused on the four index scores, which reflect different abilities important in the expression of intelligent behavior in the classroom and the world at large. The profile of these four abilities represent key clinical indicators of the cognitive strengths and weakness considered important to the assessment of learning disabilities, executive functions, attentional disorders, traumatic brain injuries, mental retardation, lead poisoning, giftedness, and various other medical and neurological concerns. The VCI derives from those subtests that assess verbal reasoning and comprehension. The Information subtest was removed as a core subtest in this composite. The Word Reasoning subtest was developed as a supplemental task to measure higher order verbal reasoning.

Perceptual Reasoning Index

The Perceptual Organization Index in WISC–III became the Perceptual Reasoning Index in WISC–IV and reflects the increased emphasis on fluid reasoning abilities as measured by the new Matrix Reasoning subtest and Picture Concepts subtest. To reduce the impact of speeded performance and motor skill on the performance factor, three traditional performance subtests, Picture Arrangement, Object Assembly, and Mazes, were not included in the WISC–IV. The emphasis these subtests placed on completion time when assessing perceptual organizational skills and motor skills, with bonus points based on the timed performance, did not fit the new theoretical model. Only Block Design retains time bonuses; otherwise, they have been removed from items frequently administered to younger children. Block Design also includes a new process score that does not include time bonus.

The restructuring of the Perceptual Reasoning Index greatly reduces the dependency on time bonuses outside of the Processing Speed Index. Picture Arrangement, though a fair measure of *g*, was dropped to reduce administration time and because of questions raised about its use as a measure of social judgment (Beebe, Pfiffner, & McBurnett, 2000; Lipsitz, Dworkin, & Erlenmeyer-Kimling, 1993). Picture Completion was removed from the core to accommodate the new measures of higher order reasoning. In WISC–III, the performance composite was primarily a measure of perceptual organization, with some elements of fluid reasoning inherent in the tasks. This composite was remade into a measure of fluid reasoning in the perceptual domain for WISC–IV.

Working Memory Index

The Freedom from Distractibility Index in WISC–III was renamed Working Memory Index (WMI) to more accurately reflect the nature of the construct measured. Working memory is the ability to hold information in mind temporarily, to perform some operation or manipulation with the information, and produce a correct result. Contemporary research has shown that working memory is an essential component of fluid reasoning and other higher order cognitive processes and is closely related to achievement and learning (Fry & Hale, 1996; Perlow, Jattuso, & Moore, 1997; Swanson, 1996)

WAIS–III's Letter–Number Sequencing subtest was adapted for use in WISC–IV as an improved measure of working memory. The Arithmetic subtest was removed as a core subtest for the WMI because of its dependence on arithmetic knowledge; however, it remains an excellent supplemental measure of working memory for children for whom arithmetic knowledge is not a constraint.

Processing Speed Index

The Processing Speed Index in WISC–III was retained and now includes Cancellation, as new supplemental subtest. Contemporary research has shown that speed of information processing is dynamically related to mental capacity (Kail & Salthouse, 1994), reading performance and development (Kail & Hall, 1994), and reasoning by the conservation of cognitive resources and the efficient use of working memory space used for higher order fluid tasks (Fry & Hale, 1996; Kail, 2000).

The removal of Picture Arrangement and Object Assembly reduced the size of the kit, making it lighter and more portable, and reduced testing time within the core subtests by removing the subtests that were more complicated to administer.

Subtest Description and Rationale

Verbal Comprehension Subtests

Similarities

The Similarities subtest is a core Verbal Comprehension subtest. It is designed to measure verbal reasoning and concept formation. The Similarities subtest has 23 items; 12 items were retained from the WISC–III with the same content. Scoring criteria for all items were revised through a series of scoring studies. The sample item has been revised to require a creditable response from the child before beginning the subtest. This interactive sample replaces the corrective feedback provided on the first item awarding 2 points. The number of items scoring only 1 point was also reduced from five to two, and separate age start points were introduced.

Vocabulary

The Vocabulary subtest is a core Verbal Comprehension subtest. Vocabulary has 36 items, including four picture items and 32 verbal items. Picture items are new and are designed to extend the floor of the subtest; the child names pictures that are displayed in the Stimulus Book for these items. Twenty-seven verbal items were retained from the WISC–III and five new verbal items were added. Scoring criteria were revised for all verbal items.

Comprehension

Comprehension is a core Verbal Comprehension subtest. The Comprehension subtest has 21 items; all items require the child to answer questions based on his or her understanding of general principles and social situations. Eleven new items were added and 10 items were retained from the WISC–III with little or no change in wording. Scoring criteria for all items were revised.

Information

The Information subtest is a supplemental Verbal Comprehension subtest. The Information subtest has 33 items; 22 verbal items from the WISC–III were retained with little or no change in wording, although many scoring criteria have been modified, and eleven new items were added. For each item, the child answers questions that address a broad range of general knowledge topics.

Word Reasoning

Word Reasoning is a new subtest in the WISC–IV and is a supplemental Verbal Comprehension subtest. It is related to tasks that measure verbal reasoning, such as the Word Context subtest of the *Delis–Kaplan Executive Function System* (D–KEFS; Delis, Kaplan, & Kramer, 2001), the Riddles subtest of the K–ABC, and cloze tasks (e.g., tasks requiring the child to complete missing portions of a paragraph). These tasks have been shown to measure verbal comprehension; analogic and general reasoning ability; the ability to integrate and synthesize different types of information; verbal abstraction; domain knowledge; and the ability to generate alternative concepts (Ackerman, Beier, & Bowen, 2000; Alexander & Kulikowich, 1991; Delis et al., 2001; DeSanti, 1989; McKenna & Layton, 1990; Newstead, Thompson, & Handley, 2002; Ridgeway, 1995). Word Reasoning has 24 items in which the child is asked to identify the common concept being described in a series of clues.

Item	Clue	Response
A.	I. This is an animal that goes "woof."	
B.	I. This has a long handle . . .	
	II. and is used with water to clean the floor.	

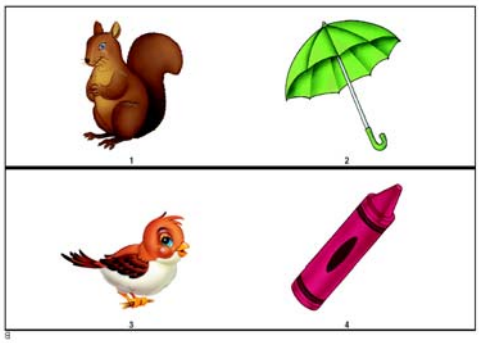
Perceptual Reasoning Subtests

Block Design

Block Design is a core Perceptual Reasoning subtest and has 14 items. Instructions have been shortened to reduce testing time and increase user-friendliness. The discontinue rule has been increased to ensure an appropriate discontinue and to be consistent with other Wechsler scales. All items require the child to view a constructed model or a picture in a Stimulus Book and use red and white blocks to re-create the design within a specified time limit. Ten items from the WISC–III have been retained; four new items were created to improve the floor, ceiling, and item difficulty gradient of the subtest. Although the use of time bonuses is retained on the WISC–IV, the number of items utilizing time bonuses has been reduced. In addition, a process score is available without time bonuses. This process score allows for a comparison of a child's performance without the influence of processing and motor speed. The process score cannot be used as a substitute for Block Design in deriving the PRI or the FSIQ.

Picture Concepts

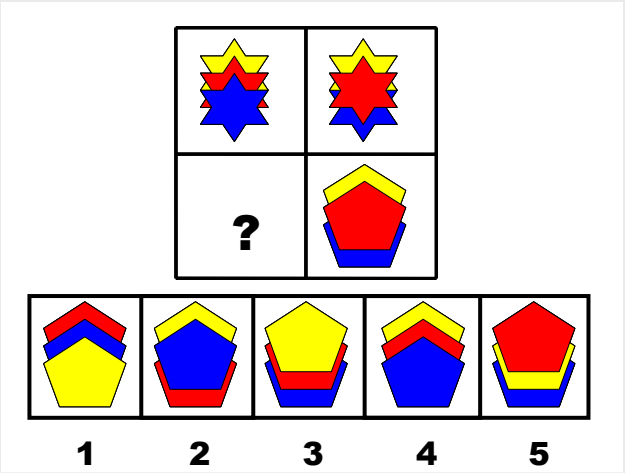
Picture Concepts is a core Perceptual Reasoning subtest. It is a new subtest designed to measure fluid reasoning and abstract categorical reasoning ability. Items are developmentally sequenced to reflect increasing demands on abstract reasoning ability (Deak & Maratsos, 1998; Flavell, 1985; Shulman, Yirmiya, & Greenbaum, 1995). The solutions to easier items are generally attained by reasoning based on concrete representations (e.g., color, shape, and appearance), whereas the solutions to more difficult items are obtained by reasoning based on more abstract representations (e.g., function of an object).



The Picture Concepts subtest has 28 items; the child is presented with two or three rows of pictures and chooses one picture from each row to form a group with a common characteristic. The addition of this subtest provide continuity with the new WPPSI–III.

Matrix Reasoning

Matrix Reasoning is a core Perceptual Reasoning subtest. Matrix analogy tasks have long been recognized as good measures of fluid reasoning and reliable estimates of general intellectual ability (Brody, 1992; Raven, Raven, & Court, 1998). Studies have shown a high correlation between matrix analogy tests and the PIQ and FSIQ scores of the Wechsler scales (Desai, 1955; Hall, 1957; Levine & Iscoe, 1954; Watson & Klett, 1974; Wechsler, 1997). Matrix reasoning tasks are also relatively culture-fair and language-free and require no hand manipulation.



Four types of items were designed to provide a reliable measure of visual information processing and abstract reasoning skills. These four types of matrices are continuous and discrete pattern completion, classification, analogical reasoning, and serial reasoning. They are commonly seen in existing matrix analogy tasks such as Raven's Progressive Matrices (Raven, Raven, & Court, 1998) and the Matrix Reasoning subtest of the WAIS–III.

The Matrix Reasoning subtest has 35 items; the child looks at an incomplete matrix and selects the missing portion from five response options.

Picture Completion

The Picture Completion subtest is a supplemental Perceptual Reasoning subtest. Scoring criteria were reviewed to determine whether or not children were being penalized for poorly verbalized responses or limited vocabulary when they had, in fact, been able to correctly identify the missing part. To assist the examiner in distinguishing between a poorly verbalized and a spoiled response, examples of these types of responses have been added to the *WISC–IV Administration and Scoring Manual*. Revisions to the scoring criteria also distinguish between those verbal responses that require pointing and those that should be awarded credit without pointing. The Picture Completion subtest has 38 items; all artwork for this subtest has been redrawn and 13 new items were added. All items require the child to view a picture and then point to or name the important part missing.

Working Memory Subtests

Digit Span

Digit Span is a core Working Memory subtest composed of two parts: Digits Forward and Digits Backward. The shift from the Digits Forward task to the Digits Backward task requires cognitive flexibility and mental alertness. Reynolds (1997) suggests the clinical interpretation of performance on the Digit Span subtest be divided based on performance on the Digits Forward and Digits Backward tasks due to the different abilities measured by the separate tasks.

Digits Forward and Digits Backward each comprise two trials and eight items. Fifteen trials from the WISC–III were retained in Digits Forward, and 12 were retained in Digits Backward. One new trial was developed for Digits Forward and six new items were developed for Digits Backward. An additional 2-digit item was added to Digits Backward to provide the child adequate set formation before increasing span length.

Two process scores and additional base rate information have been provided for Digit Span to increase clinical sensitivity. The process scores are Digit Span Forward and Digit Span Backward. Additionally, base rate information on the difference between Digit Span Forward and Digit Span Backward is available as well as for span lengths obtained in Digits Forward and Digits Backward and the difference between the span lengths.

Letter–Number Sequencing

Letter–Number Sequencing is a core Working Memory subtest based in part on the work of Gold, Carpenter, Randolph, Goldberg, and Weinberger (1997), who developed a similar task assessing working memory in individuals with schizophrenia. The task involves sequencing, mental manipulation, attention, short-term auditory memory, visual-spatial imaging, and processing speed (Crowe, 2000; Sattler, 2001).

Item	Trial			
9.	1.	T–4–L–5–Z–2–H	2–4–5–H–L–T–Z	H–L–T–Z–2–4–5
	2.	6–R–9–J–1–S–5	1–5–6–9–J–R–S	J–R–S–1–5–6–9
	3.	M–1–K–5–R–2–H	1–2–5–H–K–M–R	H–K–M–R–1–2–5

Letter–Number Sequencing consists of ten items of three trials each. The child is read a sequence of numbers and letters and is asked to recall the numbers in ascending order and then the letters in alphabetical order.

Arithmetic

Arithmetic is a supplemental Working Memory subtest and consists of 34 items, 11 of which were retained from the WISC–III with the same mathematical computation, although text may have been revised. Twenty-six new items were developed to improve the floor, ceiling, and item difficulty gradient of the subtest. Items designed to increase the working memory load while reducing the mathematical skills required to complete the problem were also developed. The child mentally solves a series of orally presented arithmetic problems within a specified time limit. Time bonuses were not retained on the Arithmetic subtest.

Processing Speed Subtests

Coding

The Coding subtest is a core Processing Speed subtest; the two forms of Coding were retained from the WISC–III. The verbatim instructions to the child on both Coding A and Coding B have been shortened to be more age appropriate and reduce verbiage.

Symbol Search

The Symbol Search subtest is a core Processing Speed subtest; the two forms of Symbol Search were retained from the WISC–III. Fifteen items were added to Symbol Search B to improve the ceiling for older children. The instructions for both Symbol Search A and Symbol Search B were shortened to reduce administration time.

Cancellation

The Cancellation subtest is a supplemental Processing Speed subtest. It was developed to measure visual selective attention and as a straightforward measure of processing speed. It is very similar to letter cancellation tasks (e.g., Geldmacher, 1996) and cancellation tasks utilized by Wojciulik, Husain, Clarke, and Driver (2001) that measure vigilance, processing speed, visual selective attention, and visual neglect (Bate, Mathias, & Crawford, 2001; Geldmacher, 1996). Cancellation consists of two items, one organized randomly and one organized in columns and rows. The child scans a structured and unstructured arrangement of pictures and marks target pictures in each arrangement within a specified time limit. Separate process scores are available for each item.

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