
[20073873].

Leiter International Performance Scale—Third Edition.

Purpose: Designed to "measure nonverbal intelligence and abilities as well as attention and memory functioning."

Population: Ages 3 to 75 years and older.

Publication Dates: 1936–2013.

Acronym: Leiter-3.

Scores, 19: 11 subtest scores: Figure Ground, Form Completion, Classification/Analogies, Sequential Order, Visual Patterns (Optional), Attention Sustained, Forward Memory, Reverse Memory, Nonverbal Stroop Incongruent Correct, Nonverbal Stroop Congruent Correct, Nonverbal Stroop Effect; 3 composite scores: Nonverbal IQ, Nonverbal Memory, Processing Speed; 5 supplemental scores: Attention Sustained Errors, Attention Divided Correct, Attention Divided Incorrect, Nonverbal Stroop Congruent Incorrect, Nonverbal Stroop Incongruent Incorrect.

Administration: Individual.

Price Data, 2014: \$1,095 per complete kit including all manipulatives (frame, blocks, foam shapes, stimulus cards, attention divided bowls), easel book, stimulus book, scoring keys, administration gestures laminate, record forms, response booklets, manual, timer, and purple marker in a rolling backpack; \$95 per manual (2013, 312 pages); \$73 per 20 record forms; \$84 per 20 response booklets; \$225 per scoring software.

Time: (30–45) minutes for cognitive battery; (30) minutes for attention/memory battery.

Authors: Gale H. Roid, Lucy J. Miller, Mark Pomplun, and Chris Koch.

Publisher: Stoelting Co.

Cross References: For reviews by Gary L. Marco and Terry A. Stinnett of the revised edition, see 14:211; see also T5:1485 (64 references), T4:1446 (33 references), T3:1319 (16 references), and T2:505 (18 references); for a review by Emmy E. Werner of the original version, see 6:526 (10 references); see also 5:408 (17 references); for a review by Gwen F. Arnold and an excerpted review by Laurance F. Shaffer, see 4:349 (25 references).

a) EXAMINER RATING SCALE.

Purpose: "Developed to provide information about ... behavioral characteristics that can impact reasoning, visualization, memory, and attention."

Scores, 10: Cognitive/Social (Attention, Organization/Impulse Control, Activity Level, Sociability, Total), Emotions/Regulations (Energy and Feelings, Regulation, Anxiety, Sensory Reaction, Total).

Review of the Leiter International Performance Scale—Third Edition by SANDRA WARD, Professor of Education, The College of William & Mary, Williamsburg, VA:

DESCRIPTION. The Leiter International Performance Scale—Third Edition (Leiter-3) is a norm-referenced instrument developed to assess nonverbal intelligence, memory, and attention in individuals between the ages of 3 and 75 years. The test authors claim that it can be used to provide a comprehensive measure of nonverbal strengths and limitations needed for assessment and program planning. It is intended for use with individuals who would benefit from a nonverbal measure of cognitive ability, including those with autism, communication disorders, cognitive delay, English as a second language, hearing impairment, and traumatic brain injury. The Cognitive Battery includes four core subtests and one supplemental subtest that measure fluid reasoning and visualization. The Attention/Memory (A/M) Battery consists of five subtests: two measure nonverbal attention; two measure memory; and one measures cognitive interference (nonverbal Stroop test). The A/M Battery can be administered with the Cognitive Battery or separately. The Cognitive Battery can be administered in approximately 45 minutes, and the A/M Battery takes approximately 30 minutes to administer. The Leiter-3 also includes an examiner rating scale (ERS) to evaluate test session

behaviors in the areas of Attention, Organization/Impulse Control, Activity Level, Sociability, Energy and Feelings, Regulation, Anxiety, and Sensory Reaction.

The Leiter-3 is a completely nonverbal instrument, so the administration requires the use of pantomimed instructions that consist of combinations of hand and head movements, facial expressions, and demonstrations. A laminated sheet is included that adequately describes and displays the standardized gestures; however, examiners are encouraged to be creative and flexible during pantomime of initial instructions for each subtest. Both the record form and test manual include start points, stop rules, materials needed for the subtest, and scoring directions. Specific administration directions are found in the manual as well as in the easel book and stimulus book. Administration of the Leiter-3 is labor intensive for the examiner who is required to efficiently coordinate the stimulus book, stimulus materials (cards, blocks, shapes), nonverbal gestures, and timing on select subtests. Instructions in the manual are vague, especially for anyone who is not familiar with the earlier versions of Leiter scales. The training DVD is helpful, allowing examiners to view correct administration procedures. It will take several practice sessions to achieve competency in administration of the Leiter-3, and this reviewer recommends that first-time users of the Leiter-3 obtain

supervision by an experienced examiner. The test manual authors include an informative chapter on adaptations for administering the measure to special populations.

The scoring of the Leiter-3 is straightforward and facilitated by the scoring software. Raw scores for the 10 subtests and four of the ERS subscales are converted to scaled scores with a mean of 10 and standard deviation of 3. The sum of scaled scores from the four core subtests of the Cognitive Battery is converted to a Nonverbal IQ with a mean of 100 and standard deviation of 15. The A/M Battery subtests are combined to produce a Nonverbal Memory composite and a Processing Speed composite, also with a mean of 100 and standard deviation of 15. The examiner can obtain confidence intervals and percentile ranks for composite scores. Additionally, Rasch-based ability estimates are available that can be used to reflect growth in skills. The ERS is scored in a similar manner. The Cognitive/Social composite includes Attention, Organization/Impulse Control, Activity Level, and Sociability. The Emotions/Regulations composite includes Energy and Feelings, Regulation, Anxiety, and Sensory Reaction. Four of the subscales—Attention, Organization/Impulse Control, Energy and Feelings, and Anxiety—and the two composites generate scaled scores. It should be noted that the scaled-score range for the subscales is only from 1 to 12, because it is designed to

measure within the "clinical" range of behavior frequency. The scaled scores for the two ERS composites have a mean of 100 and a standard deviation of 15. The test authors explain a hierarchical model of interpretation for the Leiter-3 that is consistent with best practice and supplement this information with useful case studies. The test authors accurately acknowledge the inherent limits of using a nonverbal measure as the sole indicator of cognitive functioning.

DEVELOPMENT. The development of the Leiter-3 was based on the goal of providing "full range" subtests for the ages of 3 to 75 years. The Cattell-Horn-Carroll (CHC) theory (Flanagan & Harrison, 2012) provided the theoretical basis for the instrument and guided the selection of domains, including fluid reasoning, visual processing, memory, and attention and interference (processing speed). The Leiter-3 differs from other measures of cognitive ability in that IQ is based only on fluid reasoning and visual processing subtests. Attention, memory, and speed are used as clinical indicators.

The test manual provides a summary of the development and technical merits of the original Leiter and Leiter-Revised (Leiter-R) that served as the foundation for the Leiter-3. Many of the items from the Leiter-R were included in the Leiter-3, and 10 of the 23 subtests of the Leiter-R were retained in the Leiter-3. The authors of the Leiter-3 reviewed the literature on

the Leiter scales and nonverbal assessment, interviewed subject-matter experts, and surveyed users to obtain information about the strengths and weaknesses of the Leiter-R. Based on input from users, the Leiter-3 returned to the "block and frame" (manual, p. 105) design of item administration. The authors contend that pilot studies with the Leiter-3 showed this format to be effective and well received, but specific data are not provided. The national standardization sample of the Leiter-R provided the data on items and range of scores that were used to delete items, combine scales, and create new items and subscales for the Leiter-3. Results from factor analyses, Rasch scaling, and reliability analyses were used appropriately to make such decisions. Two new subtests were developed and added to the Leiter-3, Nonverbal Stroop and Attention Divided. The authors claim that the results of pilot studies supported the inclusion of these subtests, but a rationale and specific data regarding their inclusion are not provided in the test manual. A subsample of 1,167 cases of the Leiter-3 standardization sample was used for the final selection of items, to verify reliabilities of proposed versions of subtests, and to finalize the scoring system. This subsample was selected to model the desired Census proportions. Analyses included item discrimination, Rasch fit statistics, and correlations with criterion variables.

The ERS in the Leiter-3 is identical in content and presentation to that included in the Leiter-R. Its development was based on the input of expert consultants, research on behavior rating scales, and descriptors of childhood psychopathology in the literature. The authors of the Leiter-R identified items that differentiated between children with attention disorders and those with emotional or conduct disorders. Items with "theoretical and clinical validity" (manual, p. 126) were grouped into subtests for the tryout and final editions of the Leiter-R and Leiter-3. Item analyses resulted in further refinement of the scales.

TECHNICAL. The standardization sample for the Leiter-3, including the ERS, consisted of 1,603 individuals between the ages of 3 and 75 years from four regions of the United States. The sample was stratified to match the 2008 U.S. Census update for gender, race/ethnicity, educational level (parent or adult individual), and geographic region. The overall percentages of males and females were 49.8 and 50.2, respectively, which match the U.S. Census data. Considerably more females were included in the age bands for individuals over 30 years of age. Although the test authors claim that the larger number of females in the older age ranges reflects their expected longevity, the number of females included in the age bands of 30–39, 40–49, and 50–59 approximates 75% more than the number of males, which is an

overrepresentation based on Census data. Also, the number of females in age ranges 3 to 4 and 5 to 6 is considerably lower than the number of males. The data presented in the test manual indicate that the standardization sample closely matched the 2008 U.S. Census update for ethnicity, years of education, and geographic region. Special cases comprise 10.7% of the sample. This value is under the general estimate of 14 to 16 percent. A continuous norming method was used to develop the Leiter-3 normative tables. This is consistent with the research on extended norms for large age ranges.

The internal consistency reliability coefficients reported in the test manual are sufficient for the intended purpose of the Leiter-3. Alpha coefficient for Nonverbal IQ ranged from .94 to .98 for five age groupings. Alpha coefficients for the Processing Speed and Nonverbal Memory composites ranged from .94 to .95 and .82 to .93, respectively. Median reliability coefficients for the Cognitive Battery subtests ranged from .78 to .95 across age levels. The reliability coefficients for the A/M subtests ranged from .61 to .90 with 63% of the subtest coefficients falling below .80. The lower reliability for subtests suggests that interpretation should be based on composite scores, especially for the A/M composite.

Test-retest reliability coefficients were computed for 149 cases with an average test-retest interval of seven days. The

test-retest sample is not representative of geographic region and has a large percentage (21.7) of individuals with conditions requiring special education services. Most of the Cognitive subtests yielded reliability coefficients below .80. The A/M subtests demonstrated generally higher reliability coefficients, but the coefficient for the Nonverbal Stroop Effect score was below .50. Although the low reliability is explainable by practice effects, the coefficients are still low even with the authors' estimate of .60. Both classical and IRT standard errors were calculated. The latter is a great benefit if the Growth Scores are used.

Internal consistency reliability coefficients for the ERS also support its intended use. For the Cognitive/Social and the Emotional/Feelings composites, alpha coefficients ranged from .89 to .97 and .85 to .96, respectively, across age groups. Reliability coefficients for the subscales ranged from .71 to .96 across age groups, with only five coefficients falling below .80.

The test authors provide considerable evidence for the validity of the Leiter-3 that mostly supports its use. Separate sections are provided on content, criterion, concurrent, and construct evidence of validity. Each section is closely tied to both classical validation and the intended use of the instrument. It is clear from the evidence that considerable work

went into the construction of scales that are congruent and cover a large age range. Classification accuracy, special group studies, and correlations with other measures support the use of the Leiter-3. However, many of the studies were conducted with small samples. The construct evidence of validity includes both exploratory and confirmatory factor analyses. Although the test authors claim that the results show support for the structure of the Leiter-3, there is no indication of the amount of variability that was accounted for in the analyses; subtests load very differently at different ages (e.g. Stroop loads on Memory .012 at ages 3 to 6 and .977 at ages 7 to 11). Also, in several instances, subtests load on multiple factors. These findings suggest an unstable factor structure over age. Additionally, the fit measures from the confirmatory factor analyses are in the moderate range for most of the age groups examined. The fairness analysis was positive, with the examination of differential item functioning between ethnic groups showing little variability.

COMMENTARY. The Leiter-3 is an inclusive, completely nonverbal measure of cognitive ability, memory, and attention. It is an extremely valuable instrument for detecting strengths and needs in individuals whose abilities cannot be adequately assessed with traditional verbal measures. However, due to its nonverbal nature, IQ is based only on fluid reasoning and visual

processing subtests. Attention, memory, and speed are used as clinical indicators. The ERS is a useful tool for evaluating test session behaviors in several domains. The test authors used a sound theoretical model and applied accepted standards in the instrument's development. Administering the Leiter-3 is challenging because of vague instructions in the test manual; however, the training DVD is helpful. Scoring is straightforward and facilitated by scoring software. In general, the Leiter-3 was well standardized, but females were underrepresented in the lower age ranges and overrepresented in the upper age ranges. The internal consistency reliability of the instrument's composite scores is robust. However, lower test-retest reliabilities indicate variability in scores across time. Evidence for content, criterion, and concurrent validity supports the intended use of the Leiter-3. However, the results of factor analyses suggest an unstable factor structure of the instrument over age.

SUMMARY. The Leiter-3 was developed to be a completely nonverbal measure of cognitive ability, memory, and attention in individuals between the ages of 3 and 75 years. The technical adequacy of the instrument, including standardization and reliability, is robust. However, data suggest variability in performance over time. In general, the validity data to support the instrument is adequate. Although fit measures from the

confirmatory factor analyses are in the moderate range for most age groups, results from exploratory factor analyses suggest an unstable factor structure over age. The Leiter-3 represents a helpful nonverbal tool for measuring intelligence in the areas fluid reasoning and visual processing in individuals whose abilities cannot be adequately assessed with traditional verbal measures.

REVIEWER'S REFERENCE

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Review of the Leiter International Performance Scale—Third Edition by MARTIN WIESE, Psychologist, Lincoln Public Schools, Lincoln, NE:

DESCRIPTION. The Leiter International Performance Scale—Third Edition (Leiter-3) is an individually administered nonverbal measure of global intelligence, nonverbal memory, attention, and cognitive interference. This is the third edition of the Leiter International Performance Scale, which was introduced in a doctoral dissertation (Leiter, 1938), then later published in 1979, and revised in 1997 (Roid & Miller, 1997). The test authors state that this measure will be useful to professionals interested in assessing nonverbal intellectual abilities of individuals with severe communication disorders,

dominance in languages other than English, hearing impairments, and others whose limitations result in difficulty responding verbally to traditional norm-referenced intelligence tests. These nonverbal abilities are assessed with the use of pictures, figural illustrations, and symbols. Administration of the test items is completely nonverbal, and the examiner uses only gestures and pantomime to present items.

The test authors define nonverbal intelligence operationally rather than theoretically, but they claim the subtests primarily measure fluid reasoning, visualization, short-term and working memory, and processing speed. There is one form of the test, which now extends its age range up to adults ages 75 years and older. The number of subtests has been reduced from 20 on the Leiter-R to 10 on the Leiter-3, reducing administration time to less than 45 minutes for the core Cognitive Battery and 30 minutes for the Attention/Memory Battery.

The Nonverbal IQ composite is obtained after administering four core cognitive subtests. A supplementary fifth subtest is included to use as a substitute in case one of the other core subtests is spoiled. The memory and attention subtests do not contribute to the composite nonverbal intelligence score, but are used to calculate a Nonverbal Memory index and a Processing Speed score. These two composites comprise two subtests each. A

nonverbal neuropsychological screener (Nonverbal Stroop test) is also a separate subtest.

User feedback influenced the redesign of the Leiter-3 and brought back the block and slotted frame design of the original Leiter. Although the frame and box of 152 blocks are intimidating to the novice examiner at first glance, the administration procedures are clear and easy to follow, especially after one views the training DVD, which contains video clips of sample administrations and information about procedures and scoring. The first two subtests, Figure Ground and Form Completion, are presented in traditional easel format in combination with picture cards. The remaining cognitive subtests (Classification/Analogies, Sequential Order, and Visual Patterns) use the frame to hold the easel book and provide slots in which examinees place their foam response blocks. Use of the frame with the easel book allows the examiner easy access to item numbers, administration procedures, correct responses to watch for, and suggested gestures to use during administration of the subtests.

All subtests begin with teaching items. Examiners are permitted up to three repeated trials to demonstrate the task and communicate what is expected of the examinee. Once the examinee understands the task requirements, the teaching item is then repeated and scored based upon the individual's

performance. Recording scores for each trial is quick and easy with the provided record form. Starting points, discontinuation rules, and training items are clearly marked on the record form. In addition to space provided for examiner's notes and observations, the record form includes an examiner rating scale with which the examiner rates the examinee's test-taking behaviors including variables such as attention, impulse control, activity level, mood, and regulation of emotions.

Subtest raw scores are converted to scaled scores broken down by age groups (3 years to 70+ years) for the Cognitive Battery and the Attention/Memory Battery. Tables are used to convert sums of scaled scores into the Nonverbal IQ, the Nonverbal Memory composite, and the Processing Speed composite. The examiner rating scale provides a Cognitive/Social composite and an Emotions/Regulations composite. Tables for 95% confidence intervals and percentile ranks are also provided for the IQ and composite scores. In June 2014, the test publisher provided an adjusted table from the primary author (Roid, 2014) for use in converting the Cognitive subtest scaled scores into the Nonverbal IQ equivalents. It appears the unadjusted table "did not adequately estimate the score distribution for the lower IQ range" and overestimated nonverbal ability by up to 21 points at the lower end of the distribution.

DEVELOPMENT. In developing the Leiter-3, the authors wanted to construct a reliable and valid nonverbal measure of intellectual ability, memory, and attention suitable for use with children and adults who could not be assessed with traditional intelligence tests. The authors provide an extensive review of the progression of the development from the original Leiter scale with its technical inadequacies through the more rigorous revision of the Leiter-R to the current Leiter-3. Several pages in the test manual are devoted to the development and standardization of the Leiter-R before the authors address development of new items and subtests for the Leiter-3 and a rationale for eliminating some items. New or redesigned subtests include a nonverbal Stroop task and a divided attention task. Results of pilot studies are presented to support inclusion of the new subtests in the standardization edition. Also, because of requests by examiners for more "hands-on" materials, the Leiter-3 implements a modified block and frame format with foam manipulatives. Overall, the authors provide great detail about the development of the Leiter-3.

TECHNICAL. The authors also provide extensive information about the technical characteristics of the Leiter-3. The standardization sample for the Leiter-3 consisted of 1,603 individuals stratified by age, gender, race/ethnicity, educational level, and geographic region based on the 2008 U.S.

Census update. Criteria for inclusion in the sample included a history of typical development. Most participants reported no physical, mental, or emotional impairments. Of the total standardization sample, 10.7% had special or exceptional group status, including special education, English as a Second Language (ESL), emerging-language learners (ELL), and enrollment in a gifted program.

Internal consistency reliability coefficients for the Cognitive Battery subtests are acceptable; medians range from a low of .78 on Visual Patterns to a high of .95 on Sequential Order. As expected, the composite scores demonstrate higher internal consistency. Alpha coefficients for the composite Nonverbal IQ range from .94 to .98. The Processing Speed composite also displays excellent internal consistency with reliability coefficients ranging from .94 to .95. The Nonverbal Memory composite displays adequate reliability at the early ages (3–11), but coefficients drops below .90 at older ages (12+).

A test-retest sample (average delay of seven days) of 149 individuals yielded acceptable reliability coefficients ranging from .74 to .86 on the Cognitive subtests. On the Attention/Memory subtests, coefficients ranged from .42 to .93. The lowest test-retest reliability coefficient of .42 occurred when evaluating the difference score on the Nonverbal Stroop

subtest, which is not used in calculating the Nonverbal Memory composite or the Processing Speed composite.

The test manual reports content-related, criterion-related, concurrent, and construct-related evidence of validity. Content-related evidence of validity was established by experts reviewing, analyzing, and categorizing items from the original Leiter; pilot testing of newly developed items; and using item response theory to calibrate item difficulty. Criterion-related evidence of validity was established by examining the classification accuracy of the Leiter-3. Use of the Leiter-3 Nonverbal IQ correctly classified more than 95% of individuals in a sample that included 53 people identified as having an intellectual deficiency and 500 people with no such diagnosis.

To examine concurrent evidence of validity, a sample of 60 individuals was administered both the Leiter-3 and the Leiter-R Visual/Reasoning Battery. The correlation between the Leiter-3 Nonverbal IQ scores and the Leiter-R Brief IQ scores was .78. The means of the two IQ scales differed by 5.7 points with the latest version of the test resulting in higher scores. A table is provided in the test manual for converting Leiter-R Brief IQ scores into Leiter-3 Nonverbal IQ scores, but the test publisher released an adjusted table in June, 2014 (Roid, 2014). Other concurrent validation studies compared Leiter-3 subtest scores with results from selected subtests of the Stanford-Binet

Intelligence Scales, Fifth Edition (SB5; T8:2538; Roid, 2003), the Woodcock-Johnson Tests of Cognitive Abilities (WJ-III; T8:2952; Woodcock, McGrew, & Mather, 2001), the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; T8:2903; Wechsler, 2003), and the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV; T8:2899; Wechsler, 2008). The Nonverbal IQ scores from the SB5 and the Leiter-3 demonstrated a correlation coefficient of .77, with the mean Leiter-3 score about 5 points higher than the mean from the SB5. Correlations between the Leiter-3 Nonverbal IQ and the WJ-III Tests of Cognitive Abilities subtests ranged from .38 (Picture Recognition) to .74 (Fluid Reasoning). The correlation coefficient between the WISC-IV Perceptual Reasoning Index and the Leiter-3 Nonverbal IQ was .73. A comparison of the mean score on the Leiter-3 Processing Speed scale and the WISC-IV Processing Speed Index was nearly equal and showed a high correlation of .71.

COMMENTARY AND SUMMARY. The Leiter-3 is a useful measure of nonverbal intelligence for children and adults who have limited speech or language skills or have other impairments that make assessment with more traditional language-loaded tests unfeasible. The Leiter-3 authors have succeeded in their goal of constructing a reliable and valid nonverbal measure of intellectual ability and attention/memory. Guided by feedback

from users of previous versions, the redesigned Leiter-3 is more engaging for examinees yet less time consuming for examiners while still providing several diagnostic indexes, scores, and interpretive options to guide program planning for a wide range of individuals.

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