

Practical Assessment, Research & Evaluation

A peer-reviewed electronic journal.

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Volume 7, Number 22, September, 2001

ISSN=1531-7714

A Confirmatory Analysis of the Wechsler Adult Intelligence Scale-Third Edition: Is the Verbal/Performance Discrepancy Justified?

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Now, in its third revision, the Wechsler Adult Intelligence Scale-III has a new factor structure. The theoretical structure of the new instrument is hierarchical in nature and contains four first-order factors with a second-order *g* factor at the apex. In addition to the theoretical hierarchical factor structure of the new instrument, there is an implied factor structure that is used for scoring. This implied structure contains a Full Scale IQ Index, Verbal IQ Index, and a Performance IQ Index. This study investigated the construct validity of both the implied and explicit theoretical structure of the instrument. The results indicate the WAIS-III provides an excellent measure of the four factor model and a general factor. The data, however, did not support the construct validity of a Verbal IQ Index/Performance IQ Index dichotomy. These findings and practical implications for the clinician using the instrument are discussed.

In 1997 The Psychological Corporation introduced the latest version of their adult intelligence test, The Wechsler Adult Intelligence Scale-III (WAIS-III). This instrument was first introduced in 1939 and is currently the most widely used test of adult intelligence. The basic format of the new instrument is very similar to the Wechsler Adult Intelligence Scale-Revised and its predecessor the Wechsler Adult Intelligence Scale. The factor structure of WAIS-III is also similar to earlier editions. One important aspect of the new instrument is the existence of an explicit and implicit first-order factor structure. The instrument's explicit factor structure is hierarchical in nature and contains a second-order general factor at the apex and broad first-order factors. The four broad first-order factors are identified as measures of verbal comprehension, perceptual organization, working memory, and processing speed. The inclusion additional broad first-order factors is more consistent with contemporary theories of intelligence (see Carroll, 1993).

Scores for the implied and theoretical models are calculated by combining scaled scores from the various subtests described in Table 1. The four first-order theoretical factors and their associated subtests are presented in Table 2. The calculation of scores for the four factor model is similar to the method used to calculate Verbal IQ (VIQ) and Performance IQ (PIQ) Index scores on earlier editions. It is still possible, however, to calculate VIQ and PIQ scores on the WAIS-III. Although at first this may make the clinician comfortable with the new instrument, it causes confusion when interpreting the results at a first-order factor level. This is because the publisher does not offer a theoretical justification for a using a dichotomous VIQ/PIQ factor structure. Yet, one must sum a participant's VIQ and PIQ scores to obtain a Full Scale IQ Index score (FSIQ). The use of first-order Verbal and Performance factors and a second-order general factor is considered an implicit factor structure because, as previously discussed, theoretical justification for the use of these factors is not contained in the instrument's technical manual. It appears the publisher may have retained the VIQ/PIQ dichotomy in difference to the Wechsler tradition, in contrast to psychometric theory. Therefore the authors offer the clinician both a theoretical factor structure containing four first-order factors and an implicit model with two first-order factors.

Table 1: Descriptions of the WAIS-III Subtests

<u>Subtest</u>	<u>Description</u>
Information	Samples an individual's fund of knowledge acquired through school and cultural experience.
Vocabulary	Measures an individual's vocabulary.
Similarities	The ability to find and synthesize verbal relationships.
Comprehension	Samples practical information and social knowledge.
Arithmetic	Measures mental concentration and computational skill.

Digit Span	Samples short-term memory by requiring the individual to recall increasingly longer strings of numbers.
Letter-Number Sequencing	Samples sequential processing by requiring an individual to correctly order letters and numbers presented orally.
Picture Arrangement	Samples nonverbal reasoning and planning by arranging pictures to tell a story.
Picture Completion	Samples an individual's attention to detail and visual recognition of objects.
Matrix Reasoning	Samples nonverbal perceptual reasoning by requiring an individual to complete the missing portion of abstract patterns.
Block Design	Samples visual-spatial integration by requiring an individual to reproduce abstract patterns.
Coding	Samples the accuracy and speed of visual motor coordination and scanning ability.
Symbol Search	Measures speed and accuracy and attention.
Object Assembly	Puzzles that form a meaningful whole (optional test)

Table 2: Theoretical Factor Structure of the WAIS-III

<u>Factor</u>	<u>Subtests</u>
Verbal Comprehension	Vocabulary, Similarities, Information, Comprehension
Perceptual Organization	Block Design, Matrix Reasoning, Picture Completion, Picture Arrangement
Working Memory	Digit Span, Arithmetic, Letter-Number Sequencing
Processing Speed	Digit Symbol-Coding, Symbol Search

The first purpose of this study is to investigate the construct validity of the two models. The second purpose is to provide the clinician with guidance to interpret results based on the implicit theoretical model of the WAIS-III and the explicit four factor theoretical model offered by the publisher in the technical manual.

Method

Participants

The sample for this study consisted of the standardization sample of the WAIS-III. The WAIS-III was standardized on 2,450 individuals. Thirteen age levels are represented, ranging from 16 to 89 years (For a description of the entire standardization sample see the WAIS-III Technical Manual, 1997.) The psychometric properties of the WAIS-III subtests have been termed "excellent" (Sattler & Ryan, 1999).

Analyses

The model was estimated using the averaged covariance matrix from ages 16-89 from the standardized data and the sample size was set at 200 for the analysis (the average sample size for each age level; see Keith, 1990; Keith & Witta 1997; and Bickley et al., 1995). Confirmatory factor analysis (CFA) via the AMOS program was used to test the fit of the data to each model (Arbuckle, 1997).

The *explicit* theoretical model is identified in the technical manual and provides the theoretical structure of the WAIS-III's four first-order factors. The *implicit* model specifies the WAIS-III model as portrayed on the test record to calculate FSIQ and therefore includes the appropriate placement of the first-order Verbal/Performance constructs. The Object Assembly subtest was omitted because it is an optional test.

Results and Discussion

In CFA, the factor structure is restricted a priori according to guidelines offered by theory. The obtained data is then compared with the restricted, theoretical model. Chi-square statistics indicate the degree of correspondence, or the "goodness of fit", between a proposed model and the empirical data. A number of indices of fit are reported, as suggested by several researchers (e.g., Keith, 1997). The Tucker-Lewis Index (TLI, also called the non-normed fit index), the Comparison Fit Index (CFI), and the Adjusted Goodness of Fit index (AGFI) provided additional measures of fit. For each of these additional indices of fit, values range from 0 to 1.0, with 0 indicating a poor fit, and 1.0 indicating a perfect fit. Generally, values over .90 are considered excellent. To make comparisons between factor models, chi-squares were compared, with significant reductions in the chi-square indicating a better fit of the data the theoretical model.

Figure 1 displays the factor loadings of the four factor model. Figure 2 contains the factor structure of the implied two factor model. Interestingly, the performance factor has a loading of 1.00 on the second-order factor. This indicates that the variance associated with this factor is completely subsumed by the general factor and eliminating the performance factor from the model may provide an improvement in fit. To test this hypothesis a third analysis was conducted with one intermediate first-order Verbal factor and a second-order general factor. The only difference between the model displayed in Figure 3 and the previous model is the Performance factor was eliminated.

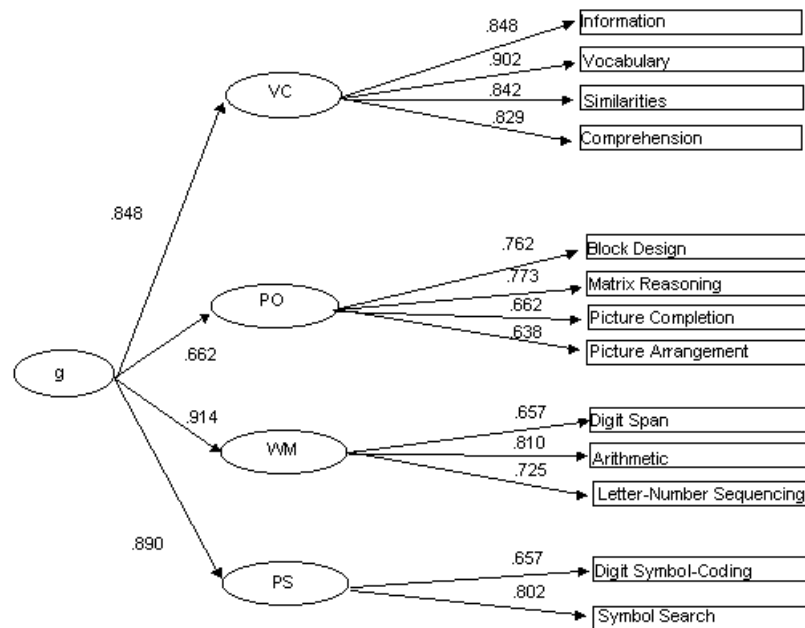


Figure 1. Results of a confirmatory factor analysis of the theoretical four factor model of the WAIS-III. VC = Verbal Comprehension, PO = Perceptual Organization, WM = Working Memory, PS = Processing Speed.

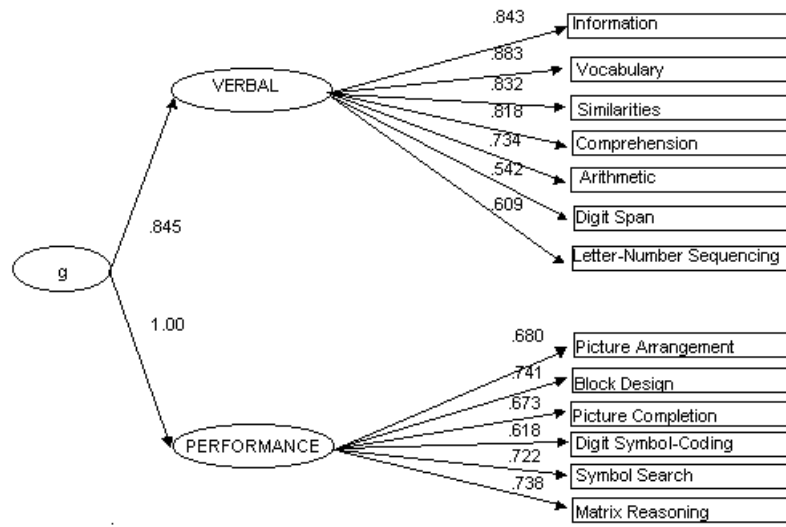


Figure 2. Results of a confirmatory factor analysis of the implied two factor model of the WAIS-III.

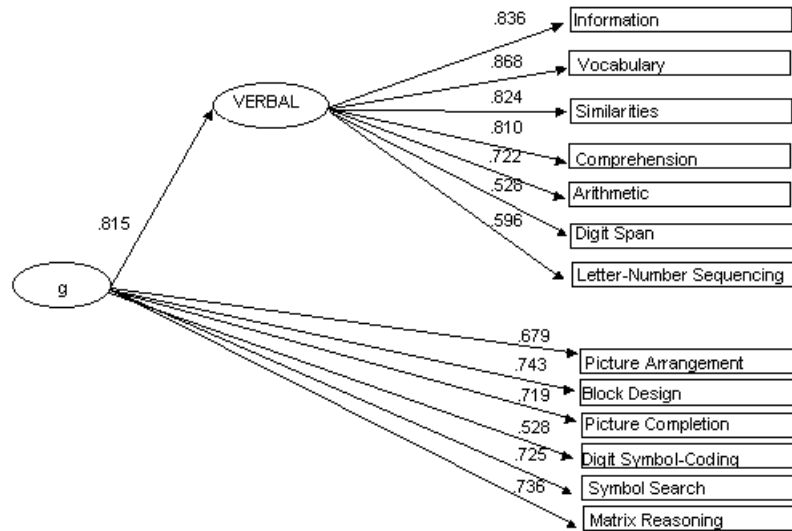


Figure 3. Results of a confirmatory factor analysis of the single intermediate first-order factor and a second-order general factor model of the WAIS-III.

Table 3 presents fit statistics of the three analyses. The first analysis tested the four factor theoretical mode. This analysis produced a χ^2 (df) = 81.79 (61). The TLI (.982) was high and suggested a good fit of the data to the model, as did the other fit indices.

Table 3: Comparisons of Fit Indices of Competing Models of the WAIS-III

Model	χ^2	(df)	AGFI	CFI	TLI	RMSEA	χ^2 diff
1. Four-Factor	81.78	(61)	.907	.986	.982	.041	
2. Implied Two-Factor	147.50	(64)	.830	.943	.930	.081	65.72*
3. Intermediate VIQ	152.92	(65)	.831	.940	.928	.082	71.14*

Note. AGFI = Adjusted goodness of fit index; CFI = Comparison fit index; TLI = Tucker-Lewis Index; RMSEA = Root mean square error of approximation. *p < .01.

As can be seen the fit indices of the second and third analyses also suggest a good fit to the data. These additional analyses were conducted to see if the change in parameters would result in an improvement beyond the four factor model. The change in Chi-square and degrees of freedom was used to evaluate the competing models. The results of the second analysis indicate that there was an increase in χ^2 and degrees of freedom (65.72(3), $p < .05$) thus suggesting that the data fit the two factor implied model significantly worse than the four factor model. Similar results were observed in the third analysis for the single first-order intermediate factor model (71.14 (4), $p < .05$). These results suggest the four-factor model provides the most parsimonious fit to the data. Since the Performance factor is subsumed by the second-order g factor, the utility of an implied two factor model was not supported. These results indicate the interpretation of performance on the WAIS-III based on a Verbal /Performance discrepancy or VIQ/PIQ factor structure cannot be supported.

Implication for Practice

Clinicians calculating a Full Scale IQ Index score on the WAIS-III will also obtain a participant's Verbal IQ Index Score, and Performance IQ Index Score. The results of this study indicate that the Performance IQ Index factor is indistinguishable from psychometric g. In other words, psychometric g completely subsumes the Performance factor. This finding is inconsistent with the implied factor structure of the instrument and its construct validity. Therefore, the practitioner is encouraged to exercise caution when making interpretations about first-order VIQ/PIQ differences. Specifically, caution should be employed when identify significant discrepancies between scores on first-order VIQ/PIQ constructs. Since it is necessary to calculate a FSIQ for a participant, it is recommended that interpretation at the first-order factor level be limited to the explicit four factor model.

Summary

This study did not support the VIQ/PIQ dichotomy, which is the hallmark of all Wechsler scales. This particular finding is significant, insofar as construct validity is necessary for treatment validity. "Measurement, even though it is based on observable responses, would have little meaning or usefulness unless it could be interpreted in light of the underlying theoretical construct" (Crocker & Algina, 1986, p. 7). The first-order PIQ is completely subsumed by the general second-order factor, and therefore the construct validity of a VIQ/PIQ dichotomy was not supported. When compared to the four factor model of the WAIS-III, the two factor and one intermediate factor models did not result in a significant improvement in fit. Therefore, the theoretical structure, rather than the one implied by the calculation of FSIQ appears to be the most parsimonious and accurate portrayal of the WAIS-III's factor structure. In contrast to historical practice, clinicians are not encouraged to make interpretations of a participant's performance on the WAIS-III using a the VIQ/PIQ dichotomy. Rather, they are encouraged to use the four factor model offered by the authors and discussed in detail in the technical manual when making interpretations and recommendations at the first-order factor level.

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Descriptors: *Intelligence Tests; *Interpersonal Competence; * Test Interpretation; Performance Factors; Factor Analysis

Citation: Taub, Gordon E. (2001). A confirmatory analysis of the wechsler adult intelligence scale-third edition: is the verbal/performance discrepancy justified?. *Practical Assessment, Research & Evaluation*, 7(22). Available online: <http://PAREonline.net/getvn.asp?v=7&n=22>.