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Factor Analysis of the Spanish Version of the WAIS: The Escala de Inteligencia Wechsler para Adultos (EIWA)

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The standardization of the Escala de Inteligencia Wechsler para Adultos (EIWA) and the original Wechsler Adult Intelligence Scale (WAIS) were subjected to principal-components analysis to examine their comparability. The robustness of the overall intelligence dimension for the EIWA was supported. A 2-factor solution provided a clear interpretive structure representing the Verbal and Performance scales. A 3-factor solution was not seen as interpretively or statistically viable. Congruence coefficients were .99 for a single factor and .96 and .97 for 2 factors. The similarity of the EIWA and WAIS factor structure was supported. Clinical implications are discussed.

Hispanics constitute the largest linguistic minority group in the United States, but research examining the integrity of psychological instruments for Spanish-speaking populations has largely been ignored. The 1989 U.S. census estimated the Hispanic population at 20.076 million, an increase of 38.9% over 1980, the largest for any ethnic group (Schick & Schick, 1991). Thus, an urgent need exists for psychological instruments that address this much-neglected and burgeoning population. A review of the literature concerning Hispanics reveals that most of the research pertains to children (McShane & Cook, 1985); research on adults is virtually nonexistent. One of the most widely used instruments in psychological, educational, and research settings is the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955) and its revision, the WAIS-R (Lubin, Larsen, Matarazzo, & Seever, 1985; Wechsler, 1981). A Spanish version of the WAIS exists, the Escala de Inteligencia Wechsler para Adultos (EIWA; Wechsler, 1968), but it has received little attention.

Structurally, the EIWA is patterned after the WAIS. It contains 11 subtests, but many were changed to make them suitable to Spanish-speaking respondents (in this case, Puerto Ricans). For example, the Information subtest question that asks the respondent to name four presidents since 1950 was changed to one that asks the respondent to name the three languages spoken in Latin America. The reliability coefficients of the Verbal, Performance, and Full Scale IQs are comparable to the WAIS: .65 to .96 for subtest scores and .95, .97, and .98 for the Performance, Verbal, and Full Scale IQs, respectively. Although intuitively it might seem that Puerto Rican norms differ from Mexican-American, Cuban, or Guatemalan norms, this has yet to be investigated. However, it is common to administer the EIWA to any Spanish-speaking person, a practice that may be dubious but necessary.

Numerous studies, using diverse samples and a variety of factor-analytic techniques, have examined the factor structure of the WAIS and the WAIS-R. In general, Cohen's (1957) tripartite structure—verbal, performance, and "memory efficiency" or "freedom from distractibility"—and Wechsler's (Matarazzo, 1972) dichotomy of verbal and performance have emerged as the preferred solutions. Some researchers favor a two-factor solution and others a three-factor solution; however, the issue seems to be one of preference, factor order, degree of complexity, or level of analysis, and neither can be said to be correct or incorrect on mathematical grounds alone. Among this multitude of research and controversy, there exists to date only one factor-analytic English-language publication on the EIWA. Kunce and Schmidt de Vales (1986) derived the factor structure for a sample of Mexican psychiatric patients, but their study involved some serious limitations. Specifically, the authors did not state the factor-analytic method they used, claimed to account for 100% of the variance with three factors, did not report their rationale for extracting factors, and were unclear about the identity of their sample, referring to them at times as psychiatric patients and at times as Mexico City workers. The lack of both conceptual and statistical clarity leads one to readily dismiss this study.

A search of English-language journals identified only three other empirical studies examining the EIWA (Davis & Rodriguez, 1979; S. López & Romero, 1988; L. R. López & Taussig, 1991). Davis and Rodriguez (1979) compared the Block Design and Vocabulary subtests of the EIWA and WAIS in a repeated

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Table 1
Combined Age Group EIWA Interscale Correlation Matrix

Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Information	—													
2. Comprehension	.77	—												
3. Arithmetic	.64	.61	—											
4. Similarities	.71	.67	.58	—										
5. Digit Span	.61	.55	.63	.53	—									
6. Vocabulary	.83	.78	.59	.70	.60	—								
7. Digit Symbol	.69	.64	.60	.57	.69	.67	—							
8. Picture Completion	.70	.63	.52	.56	.53	.66	.67	—						
9. Block Design	.65	.59	.60	.55	.57	.61	.65	.67	—					
10. Picture Arrangement	.69	.64	.51	.57	.53	.66	.69	.75	.68	—				
11. Object Assembly	.56	.55	.49	.48	.49	.55	.57	.70	.68	.64	—			
12. Verbal	.86	.80	.71	.75	.67	.83	.74	.71	.70	.71	.62	—		
13. Performance	.77	.71	.63	.64	.63	.74	.74	.81	.77	.80	.75	.81	—	
14. Total scale	.86	.79	.70	.73	.69	.82	.78	.79	.77	.79	.70	—	—	—

Note. EIWA = Escala de Inteligencia Wechsler para Adultos.

measures design using a bilingual Latin American psychiatric population. They found that scores differed significantly enough to seriously question the comparability of both tests. These results can, at best, be viewed as preliminary considering their very small sample size. S. López and Romero (1988) examined the comparability of the WAIS and EIWA and found that there were differences in the subtest items (only 43% of the items were identical), excluding the Digit Symbol subtest. In addition, differences were also found in the administration, content, and assignment of scores for all subtests except Digit Span and Object Assembly. Finally, L. R. López and Taussig (1991) examined whether the EIWA overestimates or the WAIS-R underestimates the cognitive functioning of a Spanish-speaking elderly Alzheimer dementia and non–Alzheimer dementia sample. They examined raw and scale scores for EIWA–WAIS-R Similarities and Vocabulary subtests. Their findings indicate that the EIWA is appropriate with a lower educated sample of monolingual Spanish speakers and inappropriate with a population that is highly educated, that is fluent in English, and that ranks high in job status. However, the authors expressed caution in generalizing their findings when considering their specific sample (elderly) and use of only 2 of 11 EIWA–WAIS-R subtests.

Given the significant number of changes in the Spanish version of the WAIS and the absolute dearth of empirical documentation evaluating this instrument, there exists a clear need for basic, exploratory research. The present report will attempt to fill this vacuum by first factor analyzing data obtained from

Table 2
EIWA Subscale Factor Loadings for One-, Two-, and Three-Factor Solutions

		Two factors		Three factors		
Scale	One factor	1	2	1	2	3
Information	.88	.80	.13	.77	.13	.08
Comprehension	.84	.81	.07	.83	.07	.02
Arithmetic	.76	.83	−.04	.16	−.02	.80
Similarities	.78	.91	−.11	.86	−.10	.09
Digit Span	.74	.72	.06	.02	.07	.84
Vocabulary	.86	.83	.07	.85	.07	.02
Digit Symbol	.83	.44	.44	.29	.42	.24
Picture Completion	.83	.10	.81	.26	.76	−.08
Block Design	.81	.17	.72	−.03	.68	.31
Picture Arrangement	.83	.16	.75	.32	.70	−.09
Object Assembly	.75	−.15	.99	−.12	.92	.07
Eigenvalue	7.2	7.2	.79	7.2	0.79	0.62
% total variance	66	66	6	66	6	6

Note. EIWA = Escala de Inteligencia Wechsler para Adultos. Factors were obtained using a principal-components method of extraction with an oblique rotation.

the EIWA's standardization sample and then comparing these various factor solutions with similar ones obtained from the WAIS standardization sample to better determine the degree of comparability between the two instruments.

Method

The data for this study were taken from the EIWA and WAIS manuals. Scale intercorrelations are given for only three age groups for both the EIWA (16–19 years, $n = 236$; 25–34 years, $n = 224$; and 45–54 years, $n = 156$) and WAIS (18–19 years, $n = 200$; 25–34 years, $n = 300$; and 45–54 years, $n = 300$) because Wechsler saw these groups as being representative of the entire sample. An overall correlation matrix was constructed from the EIWA tables and is presented in Table 1.

The values in this matrix were determined by transforming the interscale correlations in each of the age groups into a z score, weighting by sample size, and then aggregating. The resulting z scores were then converted back into correlations. This matrix was then subjected to a principal-components analysis with unities on the diagonal. One-, two-, and three-factor solutions were extracted and obliquely rotated. Although varimax rotations have been the preferred method in these circumstances (Hill, Reddon, & Jackson, 1985), there are both technical and theoretical reasons that argue against such an approach. First, there is no reason to assume that intellectual abilities represent independent entities. No theory of intelligence suggests one set of abilities to be distinct from any other set. Second, whereas varimax rotations are used to approximate simple structure in the data, an examination of the results of such analyses with the WAIS usually shows considerable nonzero loadings of the subscales (e.g., above .2) on the nondominant factors (e.g., Atkinson & Cyr, 1984; Beck, Horwitz, Seidenberg, Parker, & Frank, 1985; Ryan, Rosenberg, & DeWolfe, 1984). There is evidence that oblique solutions provide better fits to WAIS data (e.g., O'Grady, 1983; Piedmont, Sokolove, & Fleming, 1991).

A similar interscale correlation matrix was also calculated from the WAIS standardization data. Using the data presented in Tables 7, 8, and 9 of the manual (Wechsler, 1955), overall correlations were determined in a manner identical to that used with the EIWA. This matrix was also factor analyzed, and one-, two-, and three-factor solutions were produced. The weights from these solutions were compared with the weights derived from similar EIWA solutions to determine the factor comparability of the two instruments.

Table 3
Congruence Coefficients Between Comparable EIWA and WAIS Factor Solutions

	WAIS					
		Two factors		Three factors		
EIWA	One factor	1	2	1	2	3
One factor	.99					
Two factors						
1		.97				
2			.96			
Three factors						
1				.99		
2					.96	
3						.92

Note. EIWA = Escala de Inteligencia Wechsler para Adultos; WAIS = Wechsler Adult Intelligence Scale.

Table 4
Mean Variance Components for the EIWA Over Three Age Groups

Scale	Reliability	Common	Specific	Error
Information	.94	.78	.15	.06
Comprehension	.81	.67	.14	.19
Arithmetic	.87	.54	.33	.13
Similarities	.91	.57	.34	.09
Digit Span	.66	.50	.16	.34
Vocabulary	.95	.75	.21	.05
Digit Symbol	.85	.63	.22	.15
Picture Completion	.90	.68	.22	.10
Block Design	.88	.63	.25	.12
Picture Arrangement	.88	.67	.21	.12
Object Assembly	.77	.58	.19	.23

Note. EIWA = Escala de Inteligencia Wechsler para Adultos.

Results

Table 2 provides the factor loadings for the three EIWA solutions. As can be seen, the first factor emerges with an eigenvalue of 7.2 and accounts for 66% of the total variance. With no subtest loading less than .74, this factor clearly represents "g." When a second factor is extracted, it accounts for only 6% of the total variance and has an eigenvalue less than unity. Interpretively, this solution clearly represents the Verbal and Performance dimensions of the EIWA. However, Digit Symbol retains a significant presence on both dimensions. Although not indicated by either a scree test or by the eigenvalue greater than one criterion, a three-factor solution resembles the familiar tripartite scheme of Verbal Comprehension, Perceptual Organization, and Freedom from Distraction initially proposed by Cohen (1952). However, there does exist some interpretive ambiguity; aside from the high loadings for Arithmetic and Digit Span, there are significant secondary loadings for Digit Symbol (which loads on all three factors) and Block Design. From a purely statistical perspective, the one-factor model fits the data best, although a two-factor solution is interpretively appropriate. Extracting more than two factors results in dimensions that are both interpretively curious and account for little additional variance.[1]

[1] Two additional factor analyses were conducted. The first used a principal-axis factor procedure with an oblique solution. The results of this analysis were virtually identical to the results of the ones presented; thus, the results presented here involve principal-components analysis using a varimax rotation. These results, although showing a similar pattern as presented in Table 2, did not evidence good simple structure. In the two-factor solution, loadings on the first factor ranged from .28 to .58, and loadings on the second factor ranged from .28 to .45. For the three-factor solution, loadings on the nondominant scales ranged from .20 to .46. From an interpretive perspective, the use of

To determine the degree of factor comparability between the EIWA and the WAIS, congruence coefficients (Wrigley & Neuhaus, 1955) were calculated for each set of factor solutions. The results are presented in Table 3. As can be seen, there is a very high degree of similarity between comparable EIWA and WAIS solutions. Thus, despite the many changes necessitated by the translation of the WAIS to Spanish, the underlying structure of the new instrument remains virtually identical to its parent, regardless of the factor solution.

The total variance of a subtest score can be divided into three components: variance common with the other subtests, variance specific to the subtest in question, and error variance. Table 4 provides estimates for each of these components that are aggregated over the three age groups. The common variance represents the squared multiple (adjusted) correlation of each subtest with the remaining subtests. Specific variance was obtained by subtracting the common variance from the reliability of the scale, as reported in Table 6 of the EIWA manual. Finally, the error variance was obtained by subtracting the reliability from unity, the total variance. The simple averages of the three variance components, across age groups, are shown in Table 4.

Ideally, the common variance should exceed both the specific variance and the error variance, in that order. Silverstein (1982), who analyzed the WAIS and WAIS-R in this manner, suggested that for a subtest to warrant specific interpretation, the specific variance should be greater than the error variance and should also account for at least one quarter of the total variance. Using these criteria, the Arithmetic, Similarities, and Block Design scales all warrant specific interpretations. The pattern of findings presented here closely resembles Silverstein's findings for the WAIS. Thus, some interscale comparisons used with the WAIS for interpretive purposes can also be appropriately applied to EIWA interscale scores.

Discussion

These analyses show that the EIWA has, essentially, one underlying dimension that represents 66% of the total variance. Thus, one could argue that interpretation of EIWA performance should be limited to the Full Scale IQ only. Despite the overwhelming presence of this general dimension, extracting an additional factor provides a clear interpretive structure that represents the Verbal and Performance scales. The three-factor solution is statistically less compelling and interpretively more ambiguous and should not be, given these data, the preferred solution. The tenuousness of the three-factor solution has also been noted with the WAIS-R (e.g., Piedmont et al., 1991).

Given the relatively small normative sample size and its lack of representativeness (Puerto Ricans only), further research that includes a more heterogeneous Hispanic sample is needed to provide a better estimate of the EIWA's factor structure. Yet, despite these limitations and the very real concerns that arise when an instrument is translated into another language (e.g., in the case of the EIWA, some of the original WAIS items were dropped and new ones were added; in fact, some of the EIWA scales have only a small item overlap with the WAIS), it is remarkable that the EIWA, at least structurally, emerges as a psychometric reflection of the WAIS. To be cautiously optimistic, the possibility may exist for generalization research done on the WAIS to include the EIWA. This may help tentatively fill some interpretive gaps.

Of course, further work needs to be done that focuses on the cognitive abilities captured by each subscale. This would provide direct evidence of the interpretive comparability between the two instruments. Nonetheless, researchers and clinicians can have a degree of confidence in the EIWA as a measure of intellectual dimensions similar to the WAIS. This has particular relevance for neuropsychological testing, in which intertest scatter is more important than actual full scale scores. We hope that further research will be directed at addressing norms and validity markers for the EIWA to make clear the strengths and weaknesses of the instrument.

oblique rotations provides superior simple structure in data of this type. Similar conclusions have been reached with the WAIS-R data as well (e.g., O'Grady, 1983; Piedmont, Sokolove, & Fleming, 1991). Copies of these results can be obtained by writing to Francisco C. Gómez, Jr.

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