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CONSTRUCT VALIDITY OF THE WISC-III VERBAL AND PERFORMANCE FACTORS FOR BLACK SPECIAL EDUCATION STUDENTS

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The underlying factor structure of the revised edition of the Wechsler Intelligence Scale for Children (WISC-R) was consistently found to be comparable between regular and special education students as well as across Anglo, Black, and Hispanic populations. A commensurate research base across exceptionality and ethnic group has not been established for the recently published third edition of the Wechsler Intelligence Scale for Children (WISC-III), making it vital that information regarding the psychometric properties of the WISC-III among diverse groups of children be collected. This study examines the factor structure of the 10 WISC-III core subtests among a sample of Black students receiving special education services. Results provided evidence of a large, first principal factor as well as the expected Verbal and Performance factors. Implications for psychologists are presented, and recommendations for future research are provided.

Psychologists have long been aware of the importance of nondiscriminatory testing and the concept of test bias (Reschly, 1981). Early claims of test bias pointed to commonly found mean score differences between majority and minority populations, but Thorndike (1971) and others delineated the limitations of this approach and presented more sophisticated definitions and approaches to detecting test bias. One fundamental method of determining the fairness of a test is examination of the evidence for its validity. As traditionally categorized, there are three types of validity: content, construct, and criterion-related (Cronbach, 1990). Test bias may exist under any or all of these divisions of validity (Reynolds & Kaiser, 1990).

A widely accepted empirical method used to investigate construct validity is factor analysis (Comrey, 1988). This multivariate technique allows for the statistical isolation of scales that intercorrelate while simultaneously remaining separate from other scales. Thus, factor analysis presents evidence regarding the underlying constructs or traits measured by a test. If a test fails to measure the same underlying construct across various sociocultural groups or if scores from the test reflect different traits across ethnic cultures, then the appropriateness of using these test scores for those groups becomes questionable. A comparison of factorial similarity across ethnic groups is a necessary, but not sufficient, condition for the indication of a nonbiased test.

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For the past 20 years, the revised edition of the Wechsler Intelligence Scale for Children (WISC-R; Wechsler, 1974) has been the most frequently used intelligence test for children in school settings (Goh, Teslow, & Fuller, 1981; Lutey & Copeland, 1982). Like other Wechsler instruments such as the revised edition of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-R; Wechsler, 1989) and the revised edition of the Wechsler Adult Intelligence Scale (WAIS-R; Wechsler, 1984), the WISC-R provides an overall measure of general intellectual functioning as well as verbal and performance IQs.

Notwithstanding their widespread popularity, the Wechsler tests are often criticized for their lack of an explicit theoretical formulation (Macmann & Barnett, 1992, 1994; Witt & Gresham, 1985). Despite the fact that the research is based on data that describe the structure of the Wechsler *test* rather than a theory that describes the structure of *intelligence* (Macmann & Barnett, 1994), construct validity for the verbal and performance scales of the WISC-R has been well established. A two-factor, verbal-performance solution has been shown to be stable across age (Conger, Conger, Farrell, & Ward, 1979), gender, (Reynolds & Gutkin, 1980) and ethnicity (Gutkin & Reynolds, 1981; Reschly, 1978) as well as for such diverse populations as gifted students (Sapp, Chissom, & Graham, 1985), deaf and hard-of-hearing students (Sullivan & Schulte, 1992), and students with limited English proficiency (e.g., Mexican American or Native American children; Taylor, Ziegler, & Partenio, 1984). Additionally, factorial similarity has been shown between Black and Anglo children on the WISC-R (Oakland & Feigenbaum, 1979; Reschly, 1978) as well as on other Wechsler tests including the original WISC (Wechsler, 1949; Lindsey, 1967) and the WPPSI (Kaufman & Hollenback, 1974).

Empirical studies examining the factor structure of the recently published, third edition of the Wechsler Intelligence Test for Children (WISC-III; Wechsler, 1991) have provided mixed results. Roid, Prifitera, & Weiss (1993) found support for four WISC-III factors in a regular education sample. However, other researchers (Sattler, 1992; Thorndike, 1992) have concluded that a three-factor solution better describes the data.

The extent to which the factor structure of the WISC-III will generalize to special education populations remains uncertain. Although some evidence suggests that a four-factor solution is most appropriate for special education children (Konold, Kush, & Canivez, in press), other research (Kush, 1996) has shown support for only the Verbal and Performance factors in a sample of learning disabled students. This uncertainty is compounded for minority, disabled children as separate data for minority students are not reported in the WISC-III technical manual. To date, only one study has examined the factor structure of the WISC-III among Black students. Slate and Jones (1995) examined the WISC-III factor structure in a small (N = 58) sample of Black students referred for psychological evaluation. Preliminary evidence was found for the construct validity of the Full Scale, Verbal scale, and Performance scale factors of the WISC-III, although psychometric characteristics of their factor analytic technique were not fully provided.

To date, factor analytic evidence regarding the WISC-III has come from research that included all 13 subtests, 10 required and 3 optional, in the analysis. In actual practice, however, many psychologists do not administer the optional subtests (Blumberg, 1995; Ward, Ward, Hatt, Young, & Mollner, 1995). For example, Glutting, Konold, McDermott, Kush, & Watkins (1996) analyzed a large sample of WISC-III cases gathered from six states and found that only one third of the protocols included the optional Digit Span and Symbol Search subtests and only 1% included the optional Mazes subtest. Thus, the generalizability of studies investigating the number of abilities measured by the WISC-III subtests, as applied in general practice, remains unresolved.

Similarly, because Black students comprise a small percentage of the overall WISC-III standardization sample (15.4%), additional research directing specific attention to this group is warranted. The primary objective of this study, therefore, was to

examine the factor structure of the 10 mandatory or core WISC-III subtests in a population of Black special education students. Specific methodological considerations include a replication of the factor analytic technique utilized with the standardization sample and the inclusion of subtests commonly used by practitioners.

Method

Participants

A total of 161 Black students, who received comprehensive psychological evaluations during a 3-year period, served as participants. Students were part of a larger database, generated as part of a state-wide initiative examining the WISC-III scores of disabled students. The sample included 116 males and 45 females in grades 1 through 11, with the majority of the sample (60%) enrolled in grades 3 through 8 and a mean age of 11 years (SD = 15.45). Students represented the total Black special education population from 18 urban and suburban school districts in Arizona. Student ethnicity was determined by enrollment forms completed by their parents. Special education status included 114 students with Learning Disabilities, 10 students with Emotional Disabilities, 28 students with Mild Mental Retardation, 8 students with Moderate Mental Retardation, and 1 student categorized as Other Health Impaired. Students referred for psychological evaluation but found to be ineligible for special education were excluded from the sample. Students came from primarily low-middle- and lower-class socioeconomic backgrounds, based upon school district eligibility criteria for reduced lunch programs.

Measure

The WISC-III is an individually administered test of intellectual ability for children aged 6-0 years to 16-11 years. It consists of 10 mandatory and 3 optional subtests (M = 10, SD = 3) that combine to yield Verbal (VIQ), Performance (PIQ), and Full Scale IQs (FSIQ; M = 100, SD = 15). For this study, the supplementary subtests of Digit Span, Symbol Search, and Mazes were excluded as they do not influence the formation of the FSIQ, VIQ, and PIQ indexes.

Procedure

The WISC-III was administered by state certified school psychologists as part of the legally mandated multidisciplinary evaluation process to determine eligibility for special education services. All evaluations included an individually administered test of academic achievement (M = 100, SD = 15). The revised edition of the Woodcock-Johnson Psycho-Educational Battery (Woodcock & Johnson, 1989) was the most commonly administered achievement battery (87%) although the Wechsler Individual Achievement Test (WIAT; Wechsler, 1992) and the Kaufman Test of Educational Achievement (Kaufman & Kaufman, 1985) were utilized with 11% of the participants. Special education placements were independently determined by a multidisciplinary team based on federal and state special education rules and regulations.

Data Analyses

Scaled scores from the 10 mandatory WISC-III subtests combined to form a 10 x 10 correlation matrix. An exploratory factor analysis using maximum likelihood extraction (squared multiple correlations on the diagonal) followed by Varimax rotation was selected and performed for all factors exceeding the Kaiser criteria (Kaiser, 1960) of eigenvalues of 1.0 or greater. This procedure is consistent with analyses reported in the WISC-III technical manual on data comprising the standardization sample. Data were analyzed utilizing the Statistical Package for the Social Sciences (SPSS; Norusis, 1994, for the Macintosh).

Because the Kaiser (1960) rule tends to identify too few factors when the number of variables is small (Thorndike, 1990), an examination of the scree plot (Cattell, 1966) and parallel analysis were also utilized. Parallel analysis is a procedure that compares eigenvalues extracted from the sample data with eigenvalues generated from a series of random data containing the same sample size and number of variables. Factors are considered meaningful when they are represented by larger eigenvalues than are produced by the random data (Lautenschlager, 1989).

Results

Descriptive statistics for WISC-III VIQ, PIQ, and FSIQs as well as individual subtests are presented in Table 1, along with reading, math, and written expression achievement scores. As expected in a special education population, academic achievement was lower than intellectual ability across all academic areas. Additionally, WISC-III subtest intercorrelations are presented in Table 2.

Results of the exploratory, maximum-likelihood factor analysis are presented in Table 3. An examination of the first unrotated factor indicates that a substantial percentage of total WISC-III variance (i.e., 55%) was accounted for by a large underlying general factor (*g*). This amount of variance is slightly larger than the 43% attributed to *g* in the standardization sample. When compared with the WISC-III standardization sample, a coefficient of congruence of .99 indicated a high degree of factorial similarity on the *g* factor between the two groups. Factor loadings of the individual subtests on the *g* factor were uniformly positive with all subtests except Coding loading above .60 and with 5 of the 10 subtests showing loadings above .70.

As recommended by Gorsuch (1983), multiple criteria were considered in determining the number of factors to subsequently extract. Consistency among extraction measures was achieved, with the Kaiser, scree, (both employed with the WISC-III standardization sample) as well as additional parallel analysis criteria, all suggesting that two factors were needed to adequately represent the data. As expected, the resulting factors appeared to reflect the traditional Wechsler verbal and performance intelligence dimensions. Taken together, these two factors comprised approximately 57% of the total test variance, a figure slightly higher than that produced in the standardization sample in which they accounted for 43% of WISC-III variance. Subtest loadings were relatively straightforward

Table 1
Standard Score Means, Standard Deviations, and Ranges for WISC-III VIQ, PIQ, FSIQ, VC, PO, and Subtests for Black Special Education Students

Variable	*M*	*SD*	Min	Max
Verbal IQ	80.98	15.10	48	114
Performance IQ	82.08	16.00	46	126
Full Scale IQ	79.84	15.45	44	120
VC factor	83.16	15.64	50	116
PO factor	82.70	16.31	50	128
Picture Completion	7.77	3.39	1	17
Information	6.49	2.93	1	12
Coding	7.53	3.42	1	19
Similarities	6.92	3.34	1	14
Picture Arrangement	6.63	3.16	1	15
Arithmetic	5.78	2.58	1	12
Block Design	6.35	3.60	1	19
Vocabulary	6.71	3.25	1	16
Object Assembly	7.02	3.40	1	17
Comprehension	7.45	3.59	1	17
Reading	76.67	15.55	26	129
Math	77.44	16.17	39	130
Written language	71.33	13.75	30	94

Note. WISC-III = third edition of the Wechsler Intelligence Scale for Children; VIQ = verbal IQ; PIQ = performance IQ; FSIQ = Full Scale IQ; VC = Verbal Comprehension; PO = Perceptual Organization; Min = minimum; Max = maximum.

Table 2
Intercorrelations Among WISC-III Subtests for Black Special Education Students

Subtest	1	2	3	4	5	6	7	8	9	10
1. PC		.47	.37	.59	.57	.47	.57	.55	.56	.53
2. IN		—	.36	.68	.45	.56	.41	.72	.47	.60
3. CD			—	.36	.38	.31	.46	.34	.34	.39
4. SM				—	.51	.45	.52	.75	.46	.72
5. PA					—	.47	.58	.52	.46	.57
6. AR						—	.40	.55	.29	.52
7. BD							—	.48	.61	.47
8. VO								—	.47	.70
9. OA									—	.41
10. CM										—

Note. WISC-III = third edition of the Wechsler Intelligence Scale for Children; PC = Picture Completion; IN = Information; CD = Coding; SM = Similarities; PA = Picture Arrangement; AR = Arithmetic; BD = Block Design; VO = Vocabulary; OA = Object Assembly; CM = Comprehension.

Table 3
Maximum Likelihood/Varimax Factor Loadings of the WISC-III for Black Special Education Students

		Rotated factors	
Subtest	*g* loading	Factor 1	Factor 2
Picture Completion	.72	.43	.60*
Information	.77	.75*	.29
Coding	.49	.25	.46*
Similarities	.83	.75*	.39
Picture Arrangement	.69	.41	.60*
Arithmetic	.62	.54*	.33
Block Design	.70	.25	.81*
Vocabulary	.85	.82*	.34
Object Assembly	.63	.30	.65*
Comprehension	.79	.71*	.37
Eigenvalue		5.54	1.00
% of variance accounted for	55	51	6

Note. WISC-III = third edition of the Wechsler Intelligence Scale for Children; *g* = general factor.
*Significant factor loading.

and aligned closely with their respective latent dimensions. Although traditionally considered performance subtests, Picture Completion and Picture Arrangement evidenced high loadings on both the Verbal and Performance factors. As with the *g* factor, a high degree of factorial similarity was found between the present sample and the standardization sample for both the Verbal and Performance factors (i.e., coefficients of congruence = .99 and .98, respectively).

Discussion

These results provide supportive evidence for the construct validity of the WISC-III in a population of Black special education students. As expected, results of the present study indicate that the WISC-III produces a substantial *g* loading among these students, which is very similar to findings derived from the standardization sample. Also as expected, the Verbal and Performance scales remain intact and appear to offer much diagnostic interpretability. The Verbal factor is defined by five strong subtest loadings (i.e., Information, Similarities, Arithmetic, Vocabulary, and Comprehension) as is the Performance factor (i.e., Picture Completion, Coding, Picture Arrangement, Block Design, and Object Assembly).

The relatively similar VIQ and PIQ scores were almost identical to the small VIQ-PIQ difference found in the WISC-R standardization sample for Black students (Kaufman & Doppelt, 1976), but are noticeably different from the 8.9-point WISC-R discrepancy found for an independent sample of Black children (Taylor et al., 1984). Current findings are also similar to those obtained in a preliminary study of Black students by Slate and Jones (1995).

Additional methodological considerations related to the present study should also be denoted. Although Varimax rotation was performed on the present data (to be consistent with analyses from the standardization data), an oblique method of rotation (such as direct-oblimin) may, in fact, be more appropriate for analyzing the WISC-III because of the high intercorrelations among the factors (Kush, 1996; Macmann & Barnett, 1994). A subsequent, posthoc analysis was performed using direct-oblimin rotation techniques. Additionally, as the WISC-III standardization data were subjected to a number of exploratory factor analysis procedures (i.e., principal-component, iterated principal-axis, as well as maximum-likelihood), the present data were further factor analyzed with these procedures. These results also consistently supported a two-factor interpretation of the data. The stability of the two-factor solution across multiple orthogonal and oblique approaches serves to increase the generalizability of these results and offers a good starting point for researchers who wish to extend these findings to new clinical samples.

Certainly, the current findings allow for no conclusions about the existence, or absence, of the Freedom from Distractibility and Processing Speed factors in the present sample. Because only the most commonly administered, mandatory WISC-III subtests were included in the present analysis, it is highly unlikely that a third or fourth factor would have been detected. Future factor analytic research that includes the Digit Span and Symbol Search subtests will be able to extend the current findings by determining the existence and generalizability of these hypothesized, additional factors in minority and disabled populations.

Results of this study do indicate that psychologists can reasonably conclude that WISC-III FSIQ, VIQ, and PIQ can each be thought of as relatively robust indexes of intelligence for Black special education students. When applying a construct validity definition of test fairness, it appears that the Full Scale, Verbal, and Performance scales of the WISC-III are not biased when used with this minority population. However, these results must be interpreted with some caution as the determination of construct validity is a necessary, but not sufficient, condition for fairness in test use.

Geographic restriction and participant characteristics may limit the generalizability of these results and offer suggestions for future research. Although consistent with other minority clinical samples, the mean FSIQ of the present sample was approximately 20 points lower than the mean FSIQ from the WISC-III standardization sample. However, the standard deviation from the present sample suggests adequate variability in the range of scores. Similarly, archival data collected from other states may contain students classified on the basis of varying state definitions for special education eligibility. Additionally, WISC-III scores utilized in the present study were part of a comprehensive battery of tests designed to determine special education eligibility. The isolated administration of the WISC-III may serve to increase concentration or reduce fatigue that, in turn, may alter IQ profiles.

Table 4
Maximum Likelihood/Direct-Oblimin Factor Loadings of the WISC-III for Black Special Education Students

		Rotated factors	
Subtest	*g* loading	Factor 1	Factor 2
Picture Completion	.72	.22	.58*
Information	.77	.87*	-.08
Coding	.48	.12	.43*
Similarities	.84	.79*	.09
Picture Arrangement	.68	.24	.52*
Arithmetic	.62	.54*	.12
Block Design	.65	-.15	.92*
Vocabulary	.85	.86*	.02
Object Assembly	.63	.03	.69*
Comprehension	.78	.78*	.03
Eigenvalue		5.47	1.02
% of variance accounted for	54.7	50.5	6.4

Note. WISC-III = third edition of the Wechsler Intelligence Scale for Children; *g* = general factor.
*Significant factor loading.

The determination of test fairness is an ongoing process of establishing empirical evidence that supports content, criterion, and construct validity. Both professional and societal demands require that empirical support be collected to demonstrate comparable test validity across ethnic group populations. Future research should continue to examine the possible differential factor structure of the WISC-III across other ethnic groups and special education classifications as well as with bilingual students. An increased knowledge of the interrelationships among these factors will be critical for psychologists who work with ethnically diverse populations. Additionally, future research should begin to examine the predictive power of these indexes in forecasting academic achievement across majority and minority populations.

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