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A MULTIVARIATE ANALYSIS OF THE WECHSLER/WOODCOCK-JOHNSON DISCREPANCY CONTROVERSY

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The Woodcock-Johnson Tests of Cognitive Ability (WJ-COG) is a relatively new measure of intellectual ability that is being used by psychoeducational practitioners. Research comparisons suggest strong concurrent and superior predictive validity when compared with the WISC-R. However, early research reports suggested that for some children the WJ-COG produced "lower" scores than the WISC-R, a finding that produced much controversy. The current study examined the validity of three content difference hypotheses (viz., differences in *g*, verbal, or achievement content) that have been advanced to explain WISC-R/WJ-COG discrepancies. A series of canonical correlational analyses were conducted with an elementary school sample of 167 children to explore the redundancy between the WISC-R, WJ-COG, and achievement as measured by the Woodcock-Johnson Tests of Achievement. Inspection of the canonical variates, redundancy coefficients, and canonical loadings on the two significant variates extracted in each analysis did not support any of the content difference hypotheses. The findings suggest that the WISC-R/WJ-COG mean score discrepancy may be due to different factor structures that have not been appreciated fully in prior research.

Since its publication, the Woodcock-Johnson Psychoeducational Battery (WJ; Woodcock & Johnson, 1977) has enjoyed increased use among psychoeducational personnel. However, despite strong concurrent validity with the WISC-R Full Scale IQ (median correlation of .77 across 19 comparisons; McGrew, 1986) and evidence of superior predictive validity when compared to the WISC-R (Cummings & Moscato, 1984a, 1984b; McGrew, 1986), the cognitive section of the WJ, the Woodcock-Johnson Tests of Cognitive Ability (WJ-COG), has been the focus of much controversy (Cummings & Moscato, 1984a, 1984b; Thompson & Brassard, 1984b; Woodcock, 1984a, 1984b). A review of the major WJ literature summaries (Cummngs & Moscato, 1984a, 1984b; McGrew, 1986; Thompson & Brassard, 1984b; Woodcock, 1984a, 1984b) suggests that the primary reason for this controversy has been the finding that the WJ-COG provides "lower" scores than the WISC-R. In two reviews of 21 WISC-R/WJ-COG research comparisons, McGrew (1986) and Woodcock (1984a) both note median mean score discrepancies of approximately 5 to 6 scaled score points across all types of samples, in the direction of higher WISC-R scores. Although not an extremely large difference, reports of larger discrepancies in academically handicapped groups (LD in particular) have been a major concern. For example, McGrew's (1986) review revealed median

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discrepancies (all in the direction of lower WJ-COG scores) of 1.4, 3.6, and 9.1 in studies with normal, referral, and academically handicapped samples, respectively. This increasing mean score discrepancy as a function of increased academic handicap has been a major concern in the field.

A number of content difference hypotheses have been advanced to explain the WISC-R/WJ-COG mean score discrepancies. McGrew (1984) suggested differences in the proportion of general intellectual ability *g* present in each instrument based on inspection of the respective WISC-R (Kaufman, 1979) and WJ-COG (McGrew, 1984) subtest *g* characteristics. A more popular content difference hypothesis has been the suggestion that the WJ-COG is saturated more heavily with verbal abilities than the WISC-R (Coleman & Harmer, 1985; Cummings & Moscato, 1984a; Phelps, Rosso, & Falasco, 1984, 1985). Finally, Ysseldyke, Shinn, and Epps (1980, 1981) and Shinn, Algozzine, Marston, and Ysseldyke (1982) advanced the achievement content hypothesis, which suggests that lower WJ-COG scores, particularly in academically handicapped samples, are due to the fact that the WJ-COG is loaded inappropriately with achievement content. Because the achievement content hypothesis will be the primary focus of this article and because it has been the most controversial and frequently invoked hypothesis to explain WJ-COG/WISC-R mean sccore differences (Phelps et al., 1984, 1985; Shinn et al., 1982; Thompson & Brassard, 1984a, 1984b; Ysseldyke et al., 1980, 1981), its underlying rationale will be discussed in greater detail.

The achievement content hypothesis rests on three sources of information. First, Shinn et al. (1982) analyzed the WJ cognitive and achievement growth curves from the perspective of Cattell's fluid/crystallized model of intelligence (Cattell, 1963) and concluded that approximately half of the cognitive subtests demonstrated growth curves similar to those for achievement subtests. Second, in a sample of 50 fourth-grade LD children, Shinn et al. (1982) found that the LD group performed significantly less well than the standardization sample on six subtests, three of which had growth curves similar to achievement subtests. Shinn et al. (1982) concluded that "on the basis of this research, it would appear that the Tests of Cognitive Ability of the battery are heavily weighted by subtests that measure achievement" (p. 226) and that the WJ-COG "appears to stack the deck against children with learning problems" (p. 225). Finally, the previously noted superior predictive validity of the WJ-COG, when compared to the WISC-R (McGrew, 1986), is viewed as a result of correlating achievement with achievement in the case of the WJ-COG.

Although a popular explanation, the achievement content hypothesis suffers from one significant flaw. In neither of the original presentations (Shinn et al., 1982; Ysseldyke et al., 1980) was the WISC-R subjected to a similar analysis to determine whether it, too, contained similar levels of crystallized abilities (Cummings & Moscato, 1984a; Estabrook, 1984; Ipsen, McMillan, & Fallen, 1983). This hypothesis overlooks a body of literature that suggests that a substantial portion of the WISC-R subtests (viz., the entire Verbal Scale) are measures of crystallized intelligence and, thus, are achievement related (Kaufman, 1979).

In contrast to the achievement content hypothesis, a number of other investigators have suggested that the WJ-COG and WISC-R may differ in abilities measured or factor structures (Bracken, Prasse, & Breen, 1984; Estabrook, 1984; Ipsen et al., 1983; Reeve, Hall, & Zakreski, 1979). Estabrook (1984), through the applica-

tion of canonical correlational analysis, found that the WJ-COG and WISC-R are most similar in verbal abilities and that "the most likely explanation of the mean-score discrepancy between the WJTCA and the WISC-R for children suspected of having learning disabilities is attributable to unique factor structures" (p. 1176).

Given the potential implications of the WJ-COG/WISC-R content difference hypotheses, it was deemed important that these hypotheses receive additional examination. In particular, the achievement content hypothesis of Ysseldyke et al. (1980, 1981) and Shinn et al. (1982) warranted closer inspection because the research that served as the cornerstone of this argument failed to make similar analyses of the WISC-R subtests (Cummings & Moscato, 1984a; Estabrook, 1984; Ipsen et al., 1983). This article presents the results of a study that examined the WISC-R/WJ-COG content difference hypotheses with methodology that addressed most of the shortcomings in prior research. A series of canonical correlation analyses were employed to explore the interrelationships among the WISC-R, WJ-COG, and the domain of achievement. The canonical correlation approach (Cooley & Lohnes, 1971; Thompson, 1984; Thompson & Keeves, 1985) studies relationships between two variable sets when each variable set consists of at least two variables (Thompson, 1984). In the context of the current exploratory study, the canonical methodology was chosen because it allowed identification of shared abilities between these sets of intellectual and achievement measures, as well as a determination of the proportion of variance within each measure that is attributed to the shared abilities.

METHOD

Subjects

The children for this study were combined third- (N = 83) and fifth- (N = 84) grade samples used in the WJ's criterion-related validity studies as originally reported in the WJ technical manual (Woodcock, 1978). The 167 children were selected randomly from the third and fifth grades across 12 elementary schools representative of a cross-section of a moderately large Minnesota school system. As originally reported by Woodcock (1978), the third-grade sample had a mean WISC-R Full Scale of 108.2 (SD = 13.2) and an age range of 104 to 127 months (M = 115.5; SD = 11.6). The fifth-grade sample had a mean WISC-R Full Scale of 106.2 (SD = 10.9) and an age range of 120 to 144 months (M = 134; SD = 11.1).

Procedures

The measures that served as the basis for the current analyses were the subtest scores from the 10 standard WISC-R subtests, the 12 WJ-COG subtests, and the 4 Woodcock-Johnson Tests of Achievement (WJ-ACH) clusters. The WISC-R subtest scores were in the form of the usual subtest scaled scores (M = 10; SD = 3), while the WJ-COG and WJ-ACH scores were converted to standard scores with a mean of 100 and standard deviation of 15 (McGrew & Woodcock, 1985; Woodcock & Johnson, 1977). Because the current study was concerned with WISC-R/WJ-COG mean score discrepancies, only the 10 standard WISC-R subtests that contribute to the Full Scale IQ were included.

Three separate, but related canonical correlation analyses were completed. Similar to Estabrook (1984), one canonical analysis explored the relationship between the

WJ-COG and WISC-R subtests (WISC-R with WJ-COG). Two additional canonical analyses explored the relationship between each of these intellectual measures and the domain of achievement as measured by the Reading, Mathematics, Written Language, and Knowledge clusters of the WJ-ACH (WISC-R with WJ-ACH; WJ-COG with WJ-ACH). For each canonical analysis the following information was obtained: (1) canonical correlations and related statistics; (2) significant canonical variates and canonical loadings (i.e., structure coefficients) on the rotated variates; (3) proportion of variance extracted by each pair of unrotated variates; and (4) overall redundancy coefficients. Because the primary focus of the current study was to identify the type and amount of shared abilities among the WJ-COG, WISC-R, and the domain of achievement (viz., WJ-ACH), interpretation of the redundancy coefficients was considered most important. As originally developed by Stewart and Love (1968), redundancy coefficients represent the "average proportion of variance in the variables in one set that is reproducible from the variables in the other set" (Thompson, 1984, p. 25). Similar to factor analysis, the theoretical interpretation of the unrotated variate solutions can be very difficult (McLean & Kaufman, 1986). Although rotation of canonical variates is not without problems (McLean & Kaufman, 1986; Thompson, 1984), rotation to the Varimax criterion was employed to facilitate interpretation. The benefits of rotation were judged to outweigh the potential problems because the primary basis of interpretation was the amount of shared variance or total redundancy among the three sets of measures, values that are computed from the unrotated solutions.

RESULTS

Table 1
Means and Standard Deviations for All WJ-COG, WJ-ACH, and WISC-R Variables Used in Canonical Analyses (N = 167)

	M	*SD*		*M*	*SD*
WJ-COG			WISC-R		
Pic. Vocabulary	102.1	13.4	Information	10.6	2.4
Spatial Rels.	99.4	13.9	Similarities	11.1	2.8
Mem. for Sent.	101.2	11.9	Arithmetic	10.7	2.6
Vis.-Aud. Lrng.	102.7	13.9	Vocabulary	10.9	2.7
Blending	108.5	12.0	Comprehension	11.9	2.9
Quant. Concepts	105.3	12.0	Pic Comp.	10.7	2.3
Visual Matching	102.7	13.2	Pic. Arrang.	11.3	2.8
Antonyms-Syn.	103.6	11.9	Block Design	10.9	2.7
Analysis-Synth.	103.2	15.1	Obj. Assembly	11.1	2.5
Numbers Rev.	101.1	13.9	Coding	10.0	2.9
Concept Form.	102.7	12.4			
Analogies	104.8	13.7			
WJ-ACH					
Reading	102.6	10.2			
Mathematics	104.0	11.7			
Written Language	100.6	12.2			
Knowledge	101.2	10.4			

Table 1 presents the basic descriptive statistics for all variables employed in the analyses. Table 1 reveals that the sample was within the average range on all variables and that no major heterogeneity of variance was present.

Table 2
Summary Table of Canonical Correlations Among the Variables from the Wechsler Intelligence Scale for Children-Revised (WISC-R), Woodcock-Johnson Tests of Cognitive Ability (WJ-COG), and Woodcock-Johnson Tests of Achievement (WJ-ACH)

Comparison	Variate	Canonical correlation	Eigenvalue (*R* squared)	Chi square	*df*	Sig.
WISC-R with	1	.872	.76038	390.040	120	<.001
WJ-COG	2	.609	.37088	168.855	99	<.001
WJ-COG with	1	.917	.84089	386.005	48	<.001
WJ-ACH	2	.540	.29160	97.291	33	<.001
WISC-R with	1	.880	.77440	339.682	40	<.001
WJ-ACH	2	.630	.39690	103.774	27	<.001

Table 2 summarizes the significant canonical correlations obtained in each of the canonical analyses. Because canonical correlation analysis can capitalize on sampling error in smaller samples and identify significant canonical correlations that are in reality trivial (Thompson, 1984), the .001 level of significance was chosen to evaluate the results. This decision was most important for the WISC-R with WJ-COG analysis, where the subject-to-variable ratio of 7.6:1 was below the commonly cited 10:1 multivariate rule of thumb. The WJ-COG with WJ-ACH (10.4:1) and WISC-R with WJ-ACH (11.9:1) analyses were adequate according to this rule of thumb. Two significant canonical correlations were obtained in each analysis.

WISC-R with WJ-COG Analysis

Table 2 reveals two significant canonical correlations (i.e., .872 and .609) in the WISC-R with WJ-COG analysis. The first pair of canonical variates accounted for approximately 76.04% of the variance between the linear WJ-COG and WISC-R composites. The second set accounted for approximately 37.09% of the residual variance. Table 3 reveals that the total proportion of subtest variance extracted by the first pair of variates was 38.37% for the WJ-COG and 34.98% for the WISC-R. The redundancy coefficients (viz., total redundancy in Table 3) indicate that 29.18% of the WJ-COG subtest variance was predictable from the linear combination of WISC-R subtests on the first variate. In comparison, 26.60% of the WISC-R subtest variance was predictable from the linear combination of the WJ-COG subtests on the first variate.

Analysis of the significant canonical loadings (loadings of .50 or above) on the first unrotated variate indicated the presence of a large general ability dimension defined by all WJ-COG subtests except Spatial Relations, Blending, and Visual Matching, and loadings for all Verbal subtests and Block Design from the WISC-R. Similar to Estabrook's (1984) study, inspection of the rotated first variate suggested that the large general variate is verbal in nature. The subtests with rotated loadings

of .50 or above were Picture Vocabulary, Quantitative Concepts, Antonyms-Synonyms, and Analogies from the WJ-COG, and Information, Similarities, Vocabulary, and Comprehension from the WISC-R. These WJ-COG and WISC-R subtests are those most frequently considered as measures of verbal abilities or crystallized intelligence within each measure (Kaufman, 1979; McGrew, 1986).

Table 3
Summary Canonical Statistics for First Unrotated and Two Significant Rotated Canonical Variates in WJ-COG with WISC-R Analysis

Subtests	Loadings of first unrotated variate	Loadings on significant rotated variates (1st var.)	(2nd var.)
WJ-COG			
Picture Vocab.	.654*	.907*	−.046
Spatial Rels.	.400	.140	.448
Memory for Sen.	.594*	.247	.620*
Vis.-Aud. Lrng.	.504*	.272	.455
Blending	.406	.287	.288
Quant. Concepts	.833*	.639*	.534*
Visual Matching	.489	.058	.679*
Antonyms-Synonyms	.879*	.750*	.478
Analysis-Synthesis	.549*	.288	.505*
Numbers Reversed	.575*	.180	.670*
Concept Formation	.508*	.205	.537*
Analogies	.806*	.659*	.470
Variance extracted **		38.37%	9.07%
Total redundancy **		29.18%	3.36%
WISC-R			
Information	.778*	.848*	.213
Similarities	.592*	.617*	.194
Arithmetic	.718*	.344	.698*
Vocabulary	.833*	.820*	.327
Comprehension	.633*	.718*	.141
Picture Completion	.336	.480	−.039
Picture Arrangement	.340	.332	.137
Block Design	.525*	.169	.604*
Object Assembly	.439	.357	.258
Coding	.485	.006	.729*
Variance extracted **		34.98%	10.85%
Total redundancy **		26.60%	4.02%

* Loadings of .50 or above. ** Values computed from unrotated solutions.

The total proportion of variance extracted by the second pair of variates was 9.07% and 10.85% for the WJ-COG and WISC-R, respectively. Total redundancy was 3.36% and 4.02% for the WJ-COG and WISC-R, respectively. Inspection of the rotated loadings reveals a dimension defined by Memory for Sentences, Quantitative Concepts, Visual Matching, Analysis-Synthesis, Numbers Reversed, and Concept Formation from the WJ-COG, and WISC-R Arithmetic, Block Design, and Coding. The four highest loadings on this variate were for Visual Matching, Numbers Reversed, Arithmetic, and Coding, subtests that all use numeric stimuli.

Table 4
Summary Canonical Statistics for Significant Rotated Canonical Variates in WJ-COG with WJ-ACH and WISC-R with WJ-ACH Analyses

WJ-COG with WJ-ACH analysis			WISC-R with WJ-ACH analysis		
Subtests	Rotated 1st var.	Rotated 2nd var.	Subtests	Rotated 1st var.	Rotated 2nd var.
WJ-COG			WISC-R		
Pic. Vocab.	.930*	−.045	Information	.810*	.386
Spatial Rels.	.155	.394	Similarities	.627*	.215
Mem. for Sent.	.230	.511*	Arithmetic	.201	.856*
Vis.-Aud. Lrng.	.331	.338	Vocabulary	.783*	.388
Blending	.304	.265	Comprehension	.582*	.240
Quant. Concepts	.525*	.712*	Pic. Comp.	.521*	−.033
Visual Matching	.081	.633*	Pic. Arrang.	.438	.007
Antonyms-Synonyms	.772*	.473	Block Design	.212	.477
Analysis-Synth.	.258	.508*	Obj. Assembly	.144	.350
Numbers Rev.	.151	.633*	Coding	−.061	.612*
Concept Form.	.149	.619*			
Analogies	.608*	.541*			
Variance extracted **	37.63%	8.80%		34.32%	10.04%
Total redundancy **	31.64%	2.57%		26.58%	3.98%
WJ-ACH					
Reading	.717*	.479		.440	.708*
Mathematics	.911*	.232		.240	.938*
Written Language	.785*	.374		.449	.653*
Knowledge	.325	.931*		.935*	.332
Variance extracted **	71.75%	12.18%		67.67%	13.51%
Total redundancy **	60.33%	3.55%		52.40%	5.36%

* Loadings of .50 or above. ** Values computed from unrotated solutions.

The moderate loadings of Analysis-Synthesis and Concept Formation (measures with strong ties to math aptitude) (Hessler, 1982; McGrew, 1986; Woodcock, 1978), as well as Quantitative Concepts, reinforces a possible quantitative interpretation. Alternatively, the high loadings of Coding and Visual Matching bear a resemblance to the perceptual speed factor that was the second variate in Estabrook's (1984) referral sample. The difficult interpretation of this variate may be due to unstable results as a function of a less than adequate sample size for this particular canonical analysis. This second variate must be interpreted with caution.

WJ-COG with WJ-ACH and WISC-R with WJ-ACH Analysis

Inspection of the canonical analyses in Tables 2 and 4, where the WISC-R and WJ-COG were analyzed separately with the domain of achievement (WJ-ACH), revealed two significant canonical correlations in each analysis. The first pair of canonical variates (canonical correlations of .917 and .880) accounted for approximately 84.09% and 77.44% of the variance between the linear WJ-COG with WJ-ACH and WISC-R with WJ-ACH composites, respectively. The second variates produced canonical correlations of .540 and .630, which accounted for approximately 29.16% and 39.69% of the variance between the linear WJ-COG with WJ-ACH

and WISC-R with WJ-ACH composites, respectively. Table 4 indicates that the two achievement-related variates were very similar in each analysis, but emerged in reversed order. The WISC-R was found to have 26.58% redundancy (first variate), with an achievement dimension defined primarily by the WJ-ACH Knowledge cluster, which is comprised of the Science, Social Studies, and Humanities subtests. All WISC-R Verbal subtests with the exception of Arithmetic, and Picture Completion loaded on this acquired knowledge or achievement ability. The second variate, of which the WISC-R demonstrated 3.98% redundancy with the WJ-ACH, appeared to be a basic skills achievement factor defined by the Reading, Math, and Written Language achievement clusters. The highest loadings for WJ-ACH Math and WISC-R Arithmetic suggested a quantitative emphasis to this dimension. The total WISC-R redundancy with the domain of achievement was 30.56% (sum of redundancy indices from both variates).

In the WJ-COG with WJ-ACH analysis, the same two achievement dimensions appeared, but they emerged in an unexpected reversed order. The WJ-COG Picture Vocabulary, Quantitative Concepts, Antonyms-Synonyms, and Analogies subtests loaded together with the basic skills achievement (math oriented) variate, while the acquired knowledge/achievement variate (as defined by the WJ-ACH Knowledge cluster) loaded with Memory for Sentences, Quantitative Concepts, Visual Matching, Analysis-Synthesis, Numbers Reversed, Concept Formation, and Analogies. The total WJ-COG overlap (sum of first and second variate redundancy indices) with the domain of achievement was 34.21%, a value 3.65% higher than the WISC-R.

DISCUSSION

The current results do not support any of the three content difference hypotheses advanced to explain WJ-COG/WISC-R mean score discrepancies. First, McGrew's (1984) *g* difference hypothesis can be evaluated by inspecting the first unrotated variate in the WISC-R with WJ-COG analysis. The first unrotated canonical variate is analagous to the first principal component identified in principal components analysis (McLean & Kaufman, 1986; Thompson, 1984), the customary procedure employed statistically to define *g* in ability tests (Jensen, 1984; Kaufman, 1979). Inspection of the canonical subtest loadings on the first unrotated WISC-R/WJ-COG variate (Table 3) reveals a pattern of loadings within each instrument that is consistent with subtest *g* loadings reported for the WISC-R (Kaufman, 1979) and WJ-COG (McGrew, 1984). Thus, when one interprets the first WISC-R/WJ-COG variate as *g,* the finding of very similar redundancy figures (difference of only 2.58%, in favor of the WJ-COG) suggests similar levels of general ability. This conclusion is reinforced by Estabrook's (1984) WISC-R/WJ-COG canonical comparison in a referral sample. In his analysis a similar *g* variate was present in the WJ-COG (23.55% total redundancy) and WISC-R (26.89% total redundancy); the two instruments differed by only 3.34% (in this case, in favor of the WISC-R). The WISC-R/WJ-COG differences of approximately 3% in all probability do not reflect any meaningful difference beyond sampling error. Also, McGrew and Fletcher (1986) found differences of only .2% for a *g* canonical variate identified in the Spanish translations of the WISC-R and WJ-COG.

Second, the rotated first variate in Table 3 is clearly a verbal ability defined by the WISC-R Information, Similarities, Vocabulary, and Comprehension subtests, and the WJ-COG Picture Vocabulary, Quantitative Concepts, Antonyms-Synonyms, and Analogies subtests. The differences of approximately 3% in this analysis, as well as Estabrook's (1984) analysis, do not support the hypothesis that the WJ-COG is loaded more heavily with verbal content than the WISC-R. The results from the WISC-R/WJ-COG analysis, which are very similar to Estabrook's (1984) results, suggest that *the verbal ability domain is the area of greatest similarity between the WISC-R and WJ-COG, not a major area of difference, as has been suggested.*

Third, the analyses that included the domain of achievement (as measured by the WJ-ACH) do not support the contention of Ysseldyke et al. (1980, 1981), Shinn et al. (1982), and others (Phelps et al., 1984, 1985; Thompson & Brassard, 1984a, 1984b) that the WJ-COG is more loaded with achievement than is the WISC-R. In the separate analysis of the WJ-COG and WISC-R with the domain of achievement (Table 4), the total redundancy difference between these two intellectual measures with the two achievement dimensions was only 3.65%. Although one can argue whether the shared dimensions between the two intellectual and one set of achievement measures should be labeled crystallized intelligence or achievement, the critical finding is that the *WISC-R and WJ-COG appear to possess the same proportion of this crystallized intelligence or achievement dimension.* The unexpected reversed order of extraction of the two achievement/crystallized variates (viz., basic skills and acquired knowledge variates) in the separate WJ-COG with WJ-ACH and WISC-R with WJ-ACH analyses suggests that although the two intellectual measures may contain the same proportion of achievement/crystallized content, they may differ *within* this domain. Although this finding may reflect sampling error, it warrants additional research.

The combined canonical analyses suggest that prior hypotheses that have suggested WISC-R/WJ-COG differences in *g,* verbal abilities, or crystallized and/or achievement content may not be valid. The current results, as well as those of Estabrook (1984), suggest that the WISC-R and WJ-COG are most similar in coverage of verbal, crystallized, or achievement abilities. Although the second shared WISC-R/WJ-COG ability may be a quantitative or speed dimension (Table 3), when combined with the canonical studies of Estabrook (1984) and McGrew and Fletcher (1986) the overriding commonality is a speeded visual factor defined primarily by Visual Matching and Spatial Relations from the WJ-COG and by WISC-R Coding. Although Estabrook (1984) also reported a third shared ability between the WJ-COG and WISC-R, it was only significant at the .05 level and was comprised primarily of Numbers Reversed from the WJ-COG and Arithmetic (and to a lesser extent Digit Span) from the WISC-R. This third variate may have surfaced by inclusion of the WISC-R Digit Span subtest in Estabrook's (1984) analysis. (Digit Span was not included in the current analysis.) Because the total redundancy of Estabrook's third variate was only 1% to 2% and because it was not replicated by this study or by that of McGrew and Fletcher (1986), its relative importance is minimal. When the first two WISC-R/WJ-COG variates in the current study are combined with those of Estabrook (1984), it is clear that there is approximately one-third overlap between the WJ-COG and WISC-R (i.e., approximately 30%-33% redundancy). This overlap is in the form of a large verbal ability, followed

by a small perceptual speed factor (McGrew, 1986). This conclusion reinforces the hypothesis that the WISC-R/WJ-COG mean score discrepancies may be due to the fact that the two instruments possess different factor structures (Bracken et al., 1984; Estabrook, 1984).

What is important to note is that these structural WISC-R/WJ-COG differences are not where most investigators have been looking (viz., *g,* verbal, crystallized, or achievement related abilities). The differences appear to be reflected in those WISC-R and WJ-COG subtests that *do not* load on the two significant WISC-R/WJ-COG variates. In particular, the domains in which the two instruments may differ the most are visual-spatial or perceptual organizational abilities (viz., the WISC-R Performance subtests), auditory or sequential processing (viz., WJ-COG Numbers Reversed, Memory for Sentences, and Blending), and reasoning or learning in response to novel learning tasks (viz., WJ-COG Concept Formation, Analysis-Synthesis, and Visual-Auditory Learning; McGrew, 1986). The realization that these "different" subtests may represent the WISC-R/WJ-COG differences, as well as the observation that these particular WJ-COG subtests are characterized by growth curves that are some of the least "achievement" oriented as defined by Shinn et al. (1982), also may explain the superior predictive validity of the WJ-COG. Inspection of the WJ-COG and Wechsler individual subtest correlations with four achievement domains across three random samples (Woodcock, 1984a) reveals average correlations for the "different" WISC-R subtests in the mid .20s, while they are in the .40s for the "different" WJ-COG subtests. Thus, the higher predictive validity for the WJ-COG appears not to be a function of greater achievement contamination (the canonical analyses suggests that it contains no more "achievement" than the WISC-R), but is probably due to the fact that the WJ-COG auditory/sequential processing and new learning ability subtests are associated more strongly with academic learning than are the Wechsler Performance subtests. The established finding that the Wechsler Performance subtests contribute little to the prediction of academic achievement (Hale, 1981) is consistent with this hypothesis. This conclusion reinforces Cummings and Moscato's (1984b) and McGrew's (1986) suggestion that the WJ-COG is a better predictor of school performance than the WISC-R because it was designed specifically to perform this function, not because it is contaminated with "achievement."

Finally, because of the small sample size used in this study, replication and cross-validation with additional samples are needed. The similarity of the first and second variates in the current study, in Estabrook's (1984) referral sample, and in the Spanish versions of the WISC-R and WJ-COG (McGrew & Fletcher, 1986) suggests that the current conclusions are not sample specific. However, the current study has been the only one to include measures of achievement, an observation that indicates the need to include achievement measures in future cross-validation studies. Also, the next logical extension of this line of research would be the testing of the hypothesized relationships among the shared and different WISC-R, WJ-COG, and achievement abilities in larger samples with covariate structural analysis (LISREL) methodology.

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