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Incremental Validity of WISC–III Profile Elevation, Scatter, and Shape Information for Predicting Reading and Math Achievement

Marley W. Watkins
Pennsylvania State University

Joseph J. Glutting
University of Delaware

The use of cognitive subtest profiles to hypothesize about children's learning strengths and weaknesses implicitly assumes that subtest profiles are predictive of academic performance. To test this assumption, Wechsler Intelligence Scale for Children—Third Edition (WISC–III) subtest profiles were decomposed into elevation, scatter, and shape components and sequentially regressed onto reading and math achievement scores for 1,118 nonexceptional and 538 exceptional students. Profile elevation was statistically and practically significant for both exceptional (R = .36–.61) and nonexceptional (R = .72–.75) students. Profile scatter did not aid in the prediction of achievement. Profile shape accounted for an additional 5%–8% of the variance in achievement measures. It was concluded that using WISC–III subtest scatter and shape to predict academic performance was not supported by the accumulated scientific evidence.

Although most researchers now agree that cognitive subtest profiles are not accurate in diagnosing childhood psychopathology, use of subtest profiles to hypothesize about students' relative cognitive strengths and weaknesses remains endemic in psychological training and practice (Aiken, 1996; Bracken, McCallum, & Crain, 1993; Groth-Marnat, 1997; Kaufman, 1994; Prifitera, Weiss, & Saklofske, 1998). As explained by Gregory (1999), profile interpretation is relied on to identify the distinctive abilities of a person and, consequently, to generate hypotheses regarding that person. This practice implicitly assumes that cognitive subtest profiles are predictive of performance in important academic, social, or behavioral endeavors (Kaufman, 1994).

Unfortunately, subtest profiles have consistently failed to demonstrate utility in predicting students' social and behavioral functioning (Dumont, Farr, Willis, & Whelley, 1998; Lipsitz, Dworkin, & Erlenmeyer-Kimling, 1993; McDermott & Glutting, 1997; Piedmont, Sokolove, & Fleming, 1989; Rispens et al., 1997) and have been discounted as valid indicators of children's social and behavioral conditions. Thus, Teeter and Korducki (1998) have concluded that "in general there appears to be a consensus in the literature that there are no distinctive Wechsler [subtest] patterns that can provide reliable, discriminative information about a child's behavior or emotional condition" (p. 124).

The belief that cognitive subtest profiles identify learning strengths and weaknesses is also ubiquitous (Banas, 1993; Blumberg, 1995; Groth-Marnat, 1997; Kaufman & Lichtenberger, 2000; Kellerman & Burry, 1997; Truch, 1993). Although differential diagnosis of learning disabilities from subtest profiles has been eschewed (Kamphaus, 1993; Kaufman & Lichtenberger, 2000), elaborate interpretative systems have been developed to identify specific subtest patterns, shapes, profiles, or regroupings from which specific academic or instructional hypotheses, recommendations, and interventions will, at least partially, be developed (Teeter & Korducki, 1998). Most prominently, Kaufman (1994) has asserted that "insightful subtest interpretation" (p. 32) allows the examiner to understand why a student experiences learning difficulties and how to remediate them.

Clinical use of an instrument requires consideration of several aspects of incremental utility and validity, however (Haynes, Nelson, & Blaine, 1999). A robust relationship between academic achievement and global intelligence scores has been well documented (Neisser et al., 1996). Nevertheless, the robust predictive validity of summary IQ indexes cannot be assumed to generalize to IQ subtest profiles (Haynes, Richard, & Kubany, 1995; Kamphaus, 1993). Thus, cognitive subtest profile interpretation must demonstrate utility and validity in the prediction of academic performance to support its application in clinical practice (Foster & Cone, 1995).

To allow the utility and validity of cognitive subtest profiles to be tested they must first be decomposed into their elemental components. The unique, incremental predictive validity of each component can then be separately analyzed to determine what aspect(s), if any, of the profile should be used for predicting academic performance. Fortunately, Cronbach and Gleser (1953) have found that subtest profiles contain only three types of information: *elevation*, *scatter*, and *shape*. Elevation information is represented by a person's mean score over subtests. For example, the mean scores of the three cognitive profiles illustrated in Figure 1 indicate that profile elevation rank orders Students A, B, and C from high to low (M subtest scores = 12.5, 6.5, and 4.5, respectively).

A profile's scatter information is defined by how widely scores in that profile diverge from its mean. This is typically operation-

Marley W. Watkins, Department of Educational and School Psychology and Special Education, Pennsylvania State University; Joseph J. Glutting, Department of Educational Studies, University of Delaware.

Correspondence concerning this article should be addressed to Marley W. Watkins, Department of Educational and School Psychology and Special Education, Pennsylvania State University, 227 CEDAR Building, University Park, Pennsylvania 16802. Electronic mail may be sent to mww10@psu.edu.

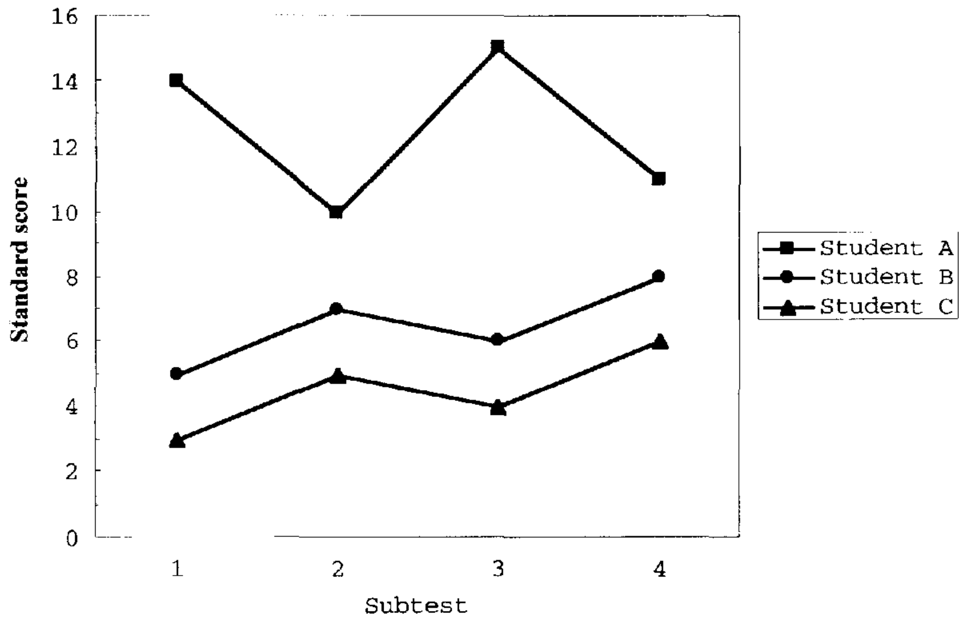

Figure 1. Elevation, scatter, and shape information in subtest profiles.

alized by the standard deviation of the subtest scores in the profile. In Figure 1, Student A's cognitive profile exhibits the greatest scatter, whereas the profiles of Students B and C are identical (*SD* = 2.4, 1.3, and 1.3, respectively). In practice, however, clinicians often rely on a series of univariate comparisons whereby each subtest is compared with the profile mean using a single critical value for interpretation of strengths and weaknesses (e.g., 3 points) in preference to the calculation of a summary measure of scatter such as the standard deviation (Gregory, 1999; Kaufman & Lichtenberger, 2000).

Finally, shape information reflects where the ups and downs in the profile occur. Even if two profiles have the same elevation and scatter, their high and low points might be different. Shape is definable by the rank order of scores for each person (Nunnally & Bernstein, 1994). Thus, Student A's subtest scores are rank ordered 3, 1, 4, and 2, whereas Student B and Student C's profiles are identically ranked in order 4, 2, 3, 1. In practice, clinicians often focus on the low points of cognitive subtest shape profiles to make diagnostic inferences (Kramer, Henning-Stout, Ullman, & Schnellenberg, 1987). For example, shape of the Wechsler subtest profile has often been used to identify groups and speculate on cognitive strengths and weaknesses (Kavale & Forness, 1984). Several Wechsler shape configurations, in fact, have gained wide clinical recognition (e.g., ACID, SCAD). These profiles display characteristic low points on specific subtests (e.g., Arithmetic, Coding, Information, and Digit Span subtests for the ACID profile), which are speculated to be diagnostic for learning and behavioral problems (Kaufman, 1994; Prifitera & Dersh, 1993).

Much experimental and clinical practice has inextricably mixed elevation, scatter, and shape information when analyzing cognitive subtest profiles. However, the relative contributions of Wechsler Intelligence Scale for Children—Revised (WISC–R; Wechsler, 1974) elevation, scatter, and shape information in predicting the concurrent academic achievement of 269 students referred for psychological evaluation were analyzed by Hale and Saxe (1983). They found that elevation information was the most potent predictor of both reading and arithmetic achievement (accounting for 32% and 38% of the variance, respectively). Scatter information did not contribute to achievement prediction beyond elevation, but shape information accounted for another 8% of the variance in achievement. Hale and Saxe (1983) noted, however, that this incremental increase in predictive efficiency due to shape information was "almost inconsequential" (p. 155) in terms of practical usefulness.

Kline, Snyder, Guilmette, and Castellanos (1993) also investigated the concurrent predictive validity of cognitive subtest profiles. They analyzed WISC–R, Kaufman Assessment Battery for Children (K–ABC; Kaufman & Kaufman, 1983), and Stanford–Binet Intelligence Scale–Fourth Edition (SB–IV; Thorndike, Hagen, & Sattler, 1986) profiles among 146 students referred for special education evaluation. K–ABC profile elevation accounted for 29% of the variability in academic achievement, whereas the WISC–R accounted for 38% and the SB–IV for 43%. WISC–R profile scatter was not a significant predictor of academic achievement, but shape accounted for an additional 7%–11% of the variance in achievement. As with Hale and Saxe (1983), Kline et al. (1993) concluded that profile scatter and shape information was of little practice use.

Although cognitive subtest profiles have not demonstrated an ability to substantially predict achievement beyond the information carried by elevation, past studies have been limited in terms of instruments and participants. First, there has been no investigation of the current Wechsler Intelligence Scale for Children—Third Edition (WISC–III; Wechsler, 1991). Although it is a direct descendant of the WISC–R, only around 73% of the WISC–R items were retained in the WISC–III (Edwards & Edwards, 1993). Additionally, the WISC–III contains a new subtest as well as numerous revisions of materials and administration procedures. These changes make it difficult to know whether results of previous profile research can be applied to the WISC–III (Kline et al., 1993).

Second, previous studies have applied criterion achievement measures that are useful for screening (i.e., Wide Range Achievement Test [Jastak & Wilkinson, 1984] and K–ABC Achievement scale [Kaufman & Kaufman, 1983]) but may be inadequate measures of academic achievement for analysis of incremental validity (Flanagan, 1997). Finally, previous research has used small samples of students who are assessed as part of an evaluation to determine special education eligibility. Given the known biases in special education referrals (Gottlieb & Weinberg, 1999), it is possible that subtest profiles are useful in predicting academic achievement but this utility is obscured by sampling error associated with small referral samples. Alternately, the shape of subtest profiles may be useful with exceptional students but not nonexceptional students or vice versa. Consequently, the present study has been designed to assess the incremental validity of WISC–III profile elevation, scatter, and shape for concurrently predicting broad measures of reading and math performance among large samples of normal and exceptional students.

Method

Participants

Nonexceptional sample. A subset of the Wechsler Individual Achievement Test (WIAT) standardization sample was also administered the WISC–III. This nationally representative linking sample of 550 male and 568 female students (M = 10.9 years of age, SD = 3.1) constituted the first group of participants. Ethnicity was 76% White, 12% Black, 10% Hispanic, and 2% other. As expected, their WISC–III scores were average (Full Scale IQ [FSIQ] M = 100, Verbal IQ [VIQ] M = 99, Performance IQ [PIQ] M = 101). Complete details of this sample are provided in Wechsler (1992).

Exceptional sample. All students who received comprehensive psychoeducational evaluations in four southwestern United States suburban school districts during 1 school year were initially eligible. Participants were selected from special education records on the basis of three criteria: (a) cognitive assessment by means of the 10 mandatory and 2 optional (Digit Span and Symbol Search) subtests of the WISC–III; (b) placement in a special education program; and (c) Broad Reading and Broad Math scores from the Woodcock-Johnson Tests of Achievement—Revised (WJ–R; Woodcock & Johnson, 1989). Students' special education eligibility and placement were determined by multidisciplinary evaluation teams following assessment by a state-certified school psychologist. Teams followed state special education regulations, which were similar to U.S. federal guidelines.

These selection criteria identified 538 students (373 male and 165 female) who were enrolled in kindergarten (K) through Grade 11 (M = 10.4 years of age, SD = 2.4). Of this total, 468 were classified as learning disabled, 40 as seriously emotionally disturbed, and 30 as mildly mentally retarded. Ethnicity, as assessed by parental report, was 48% White, 23% Hispanic, 11% Black, and 18% Native American. WISC–III scores were lower than the normative sample (FSIQ M = 87, VIQ M = 86, PIQ M = 91) but consistent with other samples of exceptional students (Kavale & Nye, 1985).

Instruments

Intelligence. The WISC–III is an individually administered test of intellectual ability for children age 6 years 0 months to 16 years 11 months. It consists of 10 mandatory subtests and 2 optional subtests (M = 10, SD = 3) that combine to yield VIQ, PIQ, FSIQ, Freedom from Distractibility–IQ (FDIQ), and Perceptual Speed-IQ (PSIQ) (M = 100, SD = 15). Full details of the instrument are available in Wechsler (1991).

Academic achievement. The WIAT (Wechsler, 1992) is an individually administered test of academic achievement, which has been standardized with 4,252 children in Grades K–12. This test contains nine subtests, which are aggregated into four composite scores: reading, mathematics, language, and writing (M = 100, SD = 15). Full details of this instrument are available in Wechsler (1992).

The WJ–R is an individually administered test of academic achievement that contains nine subtests, which tap five academic skill areas: reading, mathematics, written language, knowledge, and skills (M = 100, SD = 15). Detailed information about the WJ–R can be found in Woodcock and Johnson (1989).

Both instruments are comprehensive measures of academic achievement that exhibit good concurrent validity with the WISC–III (Zimmerman & Woo-Sam, 1997). Their respective reading and mathematics subtests are substantially intercorrelated (i.e., .67–.79; Wechsler, 1992), and both instruments exhibit good-to-excellent content, construct, and criterion-related validity (Salvia & Ysseldyke, 1998; Sattler, 1992).

Procedure

The WIAT was administered with the nonexceptional sample, and the WJ–R was given to the exceptional sample, to measure academic achievement. The WISC–III was administered to both exceptional and nonexceptional samples. WISC–III subtest profiles were first decomposed into elevation and scatter indices. Elevation was represented by the mean and scatter by the standard deviation of each student's 12 WISC–III subtests.

Profile shape information was then operationalized in a multistep procedure. Initial group membership was determined by applying the classification formula provided by Glutting, McDermott, and Konold (1997) from their cluster analysis of the WISC–III normative sample. Using this generalized distance metric (Osgood & Suci, 1952), all 1,656 participants were placed into one of the nine normative clusters. However, 155 of these students were not close matches to their respective clusters when Glutting et al.'s (1997) fit standards were applied. Consequently, these 155 students' WISC–III subtest scores were submitted to hierarchical clustering using Ward's minimum-variance method (Lorr, 1994) to determine if there were any unique subtest groupings among these participants. On the basis of similarity coefficients and inspection of the resulting dendrogram, 3 new clusters were formed. The means for all 12 clusters were then submitted as seeds to a k-means iterative clustering procedure to allow relocation of misaligned cases (McDermott, 1998). Because computation of correlations removes scatter and elevation information (Lorr, 1994), these final cluster means were then correlated with each student's WISC–III subtest scores to create a shape score for each modal cluster for each student. Thus, these correlations indicated the degree to which each of the 1,656 students resembled each of the clusters. Finally, shape correlations were transformed to z scores by means of Fisher's formula, as recommended by Skinner and Lei (1980).

Hierarchical multiple regression analyses were then used to estimate the incremental validity of profile elevation, scatter, and shape information in predicting students' reading and math achievement. Four separate regression analyses were conducted on the total sample of students. The three profile components served as independent variables in each regression analysis. Profile elevation in the form of subtest mean score was first entered into the regression. Next, profile scatter, as represented by subtest standard deviation, was entered. Shape information in the form of 12 z scores was entered in a final predictor block. WIAT reading and math composite scores for the nonexceptional sample were the criterion variables in two analyses, whereas WJ–R reading and math total scores for the exceptional sample served as dependent variables in the final two analyses.

An identical set of four hierarchical regression analyses were conducted only for those participants who exhibited at least one subtest–mean profile discrepancy of 3 or more points (Gregory, 1999; Kaufman & Lichtenberger, 2000). Thus, these analyses were focused on the incremental validity of profile elevation, scatter, and shape information in predicting reading and math achievement of students whose subtest scatter might be interpreted in clinical settings (Gregory, 1999).

Results

Descriptive statistics for the WISC–III subtest scores across the final 12 clusters are provided in Table 1 and illustrated in Figure 2. The 9 WISC–III normative clusters were primarily distinguished by elevation (Glutting, McDermott, Konold, Snelbaker, & Watkins, 1998). Exceptional students were distributed across all 12 clusters, but more were found in clusters with low subtest means than in clusters with high subtest means. For example, 69% were members of clusters with subtest means less than 10, and 31% were members of clusters with means above 10. Most notably, 97% of the students enrolled in classes for mildly mentally retarded students were classified into Cluster 12.

Results of the regression analyses for the total sample of participants are presented in Table 2. For all four analyses, WISC–III elevation was a significant and substantial predictor of academic achievement. For WIAT reading and math among nonexceptional students, WISC–III subtest elevation information accounted for 52% to 56% of the variance, respectively. WISC–III subtest profile elevation information was much less predictive of WJ–R reading ($R^2 = .125$) and math ($R^2 = .371$) achievement among exceptional students.

Addition of subtest profile scatter information to profile elevation added significantly only to prediction of WJ–R Broad Math. In that case, scatter information accounted for an additional 1% of the variance in math achievement for exceptional students.

Finally, addition of subtest profile shape information to elevation and scatter significantly improved the multiple correlations squared for both normal and exceptional student samples. Shape information accounted for an additional 8.2%–8.4% in the academic achievement of nonexceptional students and 4.8%–7.9% of exceptional students.

Inspection of the significant ($p < .01$) standardized regression coefficients of the 12 shape indices revealed that Cluster 2 was positively and Cluster 6 was negatively related to reading. Table 1 and Figure 2 indicate that Cluster 2 had elevations on three verbal subtests (SM, IN, and VO) and depressions on three performance subtests (CD, SS, and PA). In contrast, negatively predictive Cluster 6 had elevations on four performance subtests (PC, PC, BD, and PA) and depressed scores on the remaining eight subtests. Cluster 2 was also positively related to WIAT math performance but did not reach significance for the WJ–R math composite. However, Clusters 4 and 7 were significantly negatively related to both WIAT and WJ–R math scores. These clusters exhibited similar verbal and performance subtest patterns but an inverse picture for CD and SS subtests (high on Cluster 7 and low on Cluster 4). Arithmetic was the second lowest subtest on Cluster 4 and third lowest on Cluster 7.

Results of the regression analyses for the 1,045 nonexceptional and 486 exceptional students who exhibited at least one subtest–mean profile discrepancy of 3 or more points are presented in Table 3. These results were virtually identical to those of the total sample reported in Table 2. Given that 92.5% of the participants exhibited univariate scatter of ≥3 points, the similarity of these results was not surprising.

Discussion

If WISC–III subtest profile elevation, scatter, and shape have utility in hypothesizing about learning strengths and weaknesses, they should be able to demonstrate incremental validity when predicting concurrent academic performance. The present results are congruent with previous research on the WISC–R, K–ABC, and SB–IV in demonstrating that cognitive subtest profiles are predictive of academic achievement among both exceptional and nonexceptional students primarily due to the elevation information carried by the subtests (Hale & Saxe, 1983; Kline et al., 1993). In other words, it was averaged, norm-referenced information that predicted achievement. This information is essentially redundant to the predictive efficacy available from global intelligence scores (i.e., VIQ, PIQ, and FSIQ).

Subtest profile scatter did not aid in the prediction of achievement even when students were selected for exhibiting clinical scatter on at least one subtest. Subtest profile shape accounted for 4.8%–9.1% of the unique variance in reading and math

Table 1
Wechsler Intelligence Scale for Children—Third Edition Subtest Scores for Final 12 Clusters

Cluster	%	IN	SM	VO	CM	PC	PA	BD	OA	CD	SS	AR	DS	*M*	*SD*
1	7	13.8	13.7	13.6	13.3	13.8	14.2	14.2	13.4	12.9	14.0	13.6	12.5	13.6	0.504
2	7	13.6	13.7	13.2	12.6	12.4	10.1	11.4	11.5	9.7	9.8	12.5	11.6	11.8	1.424
3	7	11.6	11.7	11.3	11.3	9.7	11.1	10.8	10.3	14.1	13.3	11.5	11.9	11.6	1.194
4	11	10.4	11.1	10.3	11.2	11.7	11.5	10.1	10.4	9.3	9.6	9.1	8.2	10.2	1.039
5	8	10.7	10.1	10.5	9.3	8.8	7.9	9.1	9.1	9.4	9.6	10.6	12.2	9.8	1.128
6	11	7.9	8.3	7.6	7.8	10.8	9.6	9.9	11.2	7.5	8.5	7.7	7.9	8.7	1.313
7	10	8.5	8.4	7.8	7.8	9.3	9.1	8.6	8.8	13.4	12.3	8.4	9.4	9.3	1.736
8	10	8.8	9.0	8.8	9.7	8.0	7.6	6.4	7.1	7.6	7.7	7.6	7.5	8.0	0.920
9	9	6.4	5.9	5.6	6.0	6.4	6.4	5.1	5.9	6.9	6.7	6.2	6.9	6.2	0.549
10	8	10.3	10.2	9.9	9.7	11.9	12.8	13.5	14.3	11.6	12.6	10.0	10.5	11.5	1.571
11	9	5.3	5.4	4.8	5.3	8.2	7.2	8.3	9.7	9.5	9.2	5.8	7.0	7.2	1.808
12	4	3.5	3.3	2.6	2.8	4.0	3.6	3.0	4.2	5.4	4.9	3.7	4.7	3.8	0.866

Note. IN = Information; SM = Similarities; VO = Vocabulary; CM = Comprehension; PC = Picture Completion; PA = Picture Arrangement; BD = Block Design; OA = Object Assembly; CD = Coding; SS = Symbol Search; AR = Arithmetic; DS = Digit Span.

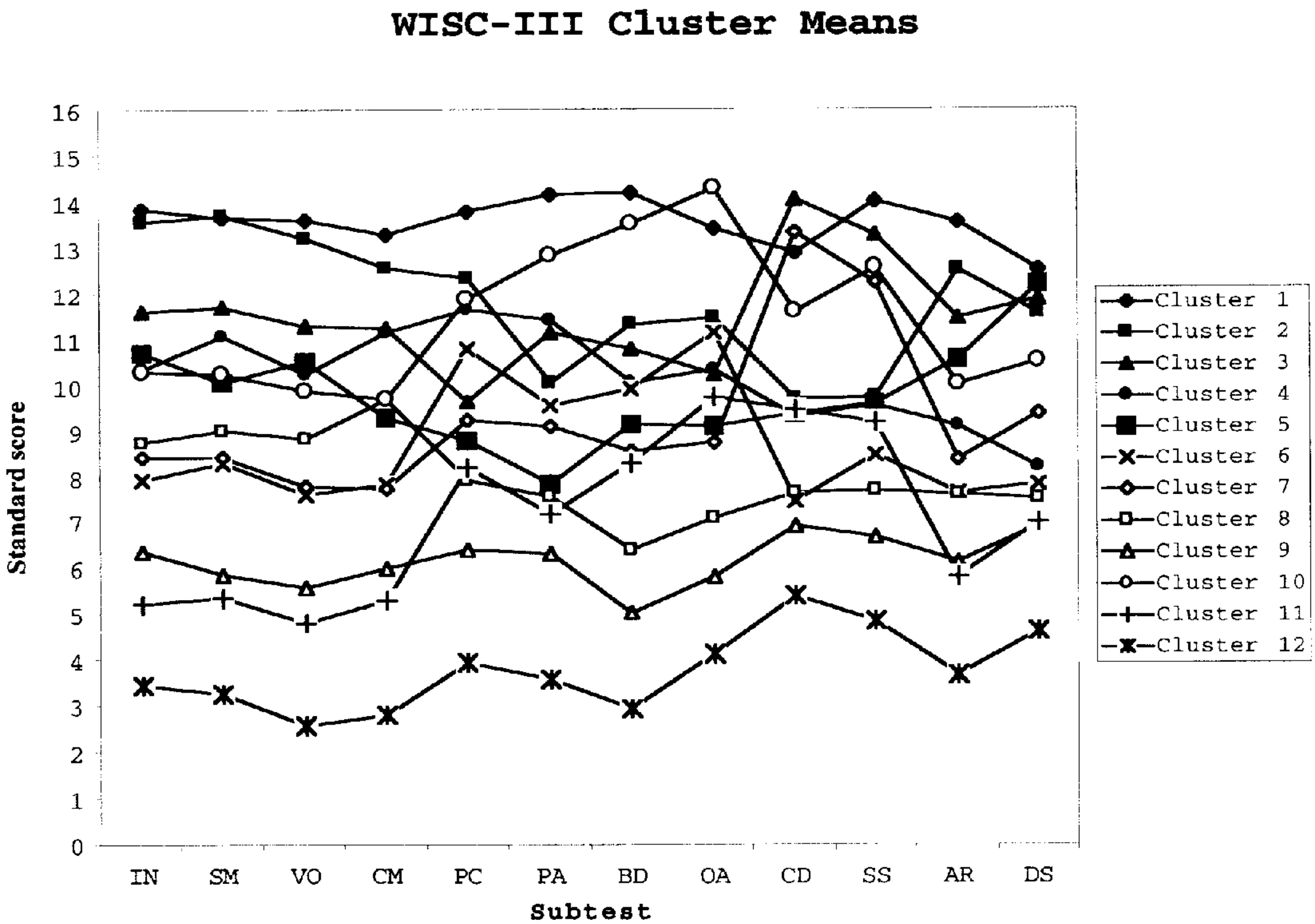

Figure 2. Wechsler Intelligence Scale for Children—Third Edition (WISC–III) subtest scores for final 12 clusters. IN = Information; SM = Similarities; VO = Vocabulary; CM = Comprehension; PC = Picture Completion; PA = Picture Arrangement; BD = Block Design; OA = Object Assembly; CD = Coding; SS = Symbol Search; AR = Arithmetic; DS = Digit Span.

achievement, but even these modest gains were probably artifically inflated by measurement error (Schmidt & Hunter, 1996).

These results were remarkably similar for exceptional and nonexceptional students and across different operationalizations of academic achievement (i.e., WIAT and WJ–R). However, the strength of the relationship between intelligence and achievement varied across student samples: Multiple correlations for nonexceptional students ranged from .72 to .75, whereas multiple correlations for exceptional students ranged from .36 to .61. Minor range restrictions were partially responsible for these differences. State special education procedures, however, were probably more influential. These rules required that students demonstrate a severe

Table 2
Hierarchical Regressions of WIAT and WJ–R Reading and Math Achievement on WISC–III Profile Elevation, Scatter, and Shape for the Total Sample

		WIAT reading[a]		WIAT math[a]		WJ–R reading[b]		WJ–R math[b]	
Step	Entered	R^2	ΔR^2	R^2	ΔR^2	R^2	ΔR^2	R^2	ΔR^2
1	Elevation	.516	.516***	.556	.556***	.126	.126***	.371	.371***
2	Scatter	.517	.001	.556	.000	.132	.006	.378	.008**
3	Shape	.601	.084***	.639	.082***	.180	.048**	.458	.079***

Note. WISC–III = Wechsler Intelligence Scale for Children—Third Edition; WIAT = Wechsler Individual Achievement Test; WJ–R = Woodcock–Johnson Tests of Achievement—Revised.
[a] $n = 1,118$. [b] $n = 538$.
** $p < .01$. *** $p < .001$.

Table 3
Hierarchical Regressions of WIAT and WJ–R Reading and Math Achievement on WISC–III Profile Elevation, Scatter, and Shape for Students With Clinical Scatter

		WIAT reading[a]		WIAT math[a]		WJ–R reading[b]		WJ–R math[b]	
Step	Entered	R^2	ΔR^2	R^2	ΔR^2	R^2	ΔR^2	R^2	ΔR^2
1	Elevation	.509	.509***	.550	.550***	.112	.112***	.345	.345***
2	Scatter	.511	.002	.550	.000	.116	.004	.352	.006*
3	Shape	.602	.091***	.638	.089***	.169	.053*	.438	.086***

Note. WISC–III = Wechsler Intelligence Scale for Children—Third Edition; WIAT = Wechsler Individual Achievement Test; WJ–R = Woodcock–Johnson Tests of Achievement—Revised.
[a] n = 1,045. [b] n = 486.
* $p < .05$. *** $p < .001$.

ability–achievement discrepancy to be eligible for a learning disability diagnosis. In essence, this automatically selected students for whom the normal correlation between intelligence and achievement does not hold (Stanovich, 1988) and resulted in a reduction of the ability–achievement R within the exceptional sample.

Shape patterns that contributed to prediction were intuitive: Relatively high verbal scores positively predicted both reading and math achievement, and relatively low scores on the WISC–III Arithmetic subtest were negatively related to math achievement. These patterns comport closely with those found by Hale and Saxe (1983) and Kline et al. (1993). Beyond these two robust but somewhat uninformative patterns, WISC–III subtest profile scatter and shape information had inconsequential incremental validity for predicting reading and math achievement for both exceptional and nonexceptional students.

These results are not supportive of current professional training and practice that attribute great importance to profile scatter and shape information (Aiken, 1996; Banas, 1993; Blumberg, 1995; Groth-Marnat, 1997; Kaufman, 1994; Kaufman & Lichtenberger, 2000; Kellerman & Burry, 1997; Truch, 1993). As noted by Kamphaus (1998), psychologists have three options when interpreting the WISC–III: "(a) to act in the absence of scientific evidence, (b) to act in opposition to scientific evidence, or (c) to act in accordance with the scientific evidence" (p. 41). This study, when considered in the context of other nonconfirming research on the utility of WISC–III subtest profiles (Glutting et al., 1998; Hale & Saxe, 1983; Kavale & Forness, 1984; Kline et al., 1993; Kramer et al., 1987; McDermott, Fantuzzo, & Glutting, 1990; McDermott, Fantuzzo, Glutting, Watkins, & Baggaley, 1992; Watkins, 1996; Watkins & Kush, 1994; Watkins, Kush, & Glutting, 1997a, 1997b), suggests that using WISC–III subtest scatter and shape to predict academic performance or differential diagnosis is a decision to act in opposition to the scientific evidence. In contrast, a measure of cognitive elevation was the most parsimonious predictor of reading and math achievement among both exceptional and nonexceptional students in this study and is supported by a robust scientific literature (Neisser et al., 1996). Thus, use of global intellectual indices would reflect a decision to act in accordance with the scientific evidence.

As with all studies, these results must be considered within the limitations imposed by research design and methodology. In the current study, sampling variability of the exceptional student sample potentially limits generalizability of findings. For example, the geographic region of residence and ethnic makeup of this sample are not representative of the larger U.S. population. Future research should recruit exceptional students more representative of the general population to ensure that these conclusions can be validly generalized.

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