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Can Profile Analysis of Ability Test Scores Work? An Illustration using the PASS Theory and CAS with an Unselected Cohort

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A new approach to ipsative, or intraindividual, analysis of children's profiles on a test of ability was studied. The Planning, Attention, Simultaneous, and Successive (PASS) processes measured by the Cognitive Assessment System were used to illustrate how profile analysis could be accomplished. Three methods were used to examine the PASS profiles for a nationally representative sample of 1,597 children from ages 5 through 17 years. This sample included children in both regular (n = 1,453) and special (n = 144) educational settings. Children with significant ipsatized PASS scores, called Relative Weaknesses (RW), were identified. Results indicated that these children earned average scores on PASS and achievement, showing that the ipsative approach did not identify a group of children with low achievement scores. In contrast, children with Cognitive Weaknesses (CW) earned lower achievement scores. CW scores were those that showed significant intraindividual variation using the ipsative approach and one of the PASS scores was below a cut score of 90, 85, or 80. Children with a CW at each level were also more likely to have been previously placed in special education settings. Results suggest that the new approach to profile analysis may offer promise for identification of cognitive weaknesses related to academic failure and special educational placement.

The analysis of subtest and scale variation on tests such as the Wechsler Scales is a method called profile analysis that has been advocated by Kaufman (1994) and others (e.g., Sattler, 1988) as a way to identify intellectual strengths and/or weaknesses. Information about strengths and weaknesses is then used to generate hypotheses that are integrated with other information so that decisions can be made regarding eligibility, diagnosis, and treatment. Despite the widespread use of this method, some have argued that subtest profile analysis does not provide useful information beyond that which is obtained from the IQ scores (McDermott, Fantuzzo, & Glutting, 1990). Others argue that subtest profile analysis does not contribute to treatment decisions (Witt & Gresham, 1985). Naglieri (1999) proposed that subtest analysis is problematic because the Wechsler Scales were not designed, and are therefore not effective for, determining varia-

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tions in cognitive abilities required to achieve the goals of profile analysis. Naglieri (1999) further suggested that what is needed is profile analysis based upon a sound theory of cognitive processes, rather than individual subtest level analysis.

Naglieri (1999) proposed that profile analysis could be accomplished using the Planning, Attention, Simultaneous, Successive (PASS) theory operationalized by the Cognitive Assessment System (CAS; Naglieri & Das, 1997a). CAS provides a theory-based approach to analysis of PASS profiles that emphasizes cognitive processes rather than subtest scores. The shift from subtests to scales is important for two reasons. First, the method of subtest analysis made popular for the Wechsler scales is based on an assumption that the subtests measure separate and discrete abilities. It is important to recall that Wechsler adopted his materials from the *Army Mental Testing Program* described by Yoakum and Yerkes (1920). Wechsler took tests such as the Manikin and Feature Profile (Object Assembly), The Digit Symbol Test (now Digit Symbol), Picture Arrangement (now by the same name), Cube Construction (a variant is now Block Design), and items included in subtests currently named Arithmetic, Comprehension, Similarities, and Information (Naglieri, 1999) directly from the military testing program. There was no theoretical rationale for the development of these individual subtests that would render them potentially effective for the determination of cognitive strengths and weaknesses as has subsequently been done. Moreover, because of to their lower reliability, subtest profile analysis seems to have been questionable from the start. Second, the shift from Wechsler subtest profile analysis to PASS Scale analysis provides a theoretically based alternative to subtest level analysis. This alternative, described by Naglieri (1999), provides a way to combine the intuitive advantages of profile analysis with good psychometric qualities of a theoretical perspective applied with sufficient reliability and validity. Important methodological advantages are, therefore, provided but other issues also must be accounted for if the validity of a new method of profile analysis is to be examined.

Glutting, McDermott, Konold, Snelbaker, and Watkins (1998) reviewed the literature on profile analysis and suggested that circular reasoning confounded much of the research on this method. For example, they state that the "use of subtest profiles for both the initial formation of diagnostic groups and the subsequent search for profiles that might inherently define or distinguish those groups" (p. 601) results in methodological problems that must be remedied. They suggested that researchers should "begin with unselected cohorts (i.e., representative samples, a proportion of which may be receiving special education), identify children with and without unusual subtest profiles, and subsequently compare their performance on external criteria" (p. 601). This research methodology was followed in the present investigation. In addition, a theory-based (PASS) approach was applied to define the areas of cognitive abilities and then examination of the ipsative scores was conducted. This includes Naglieri's (1999) concepts of a "Relative Weakness" and "Cognitive Weaknesses." The purpose of this article, therefore, is to illustrate how profile analysis could be accomplished using these alternative approaches with an unselected cohort.

METHOD

Participants

Participants were a nationally representative sample of 1,597 children from ages 5 to 17 years who formed a substantial portion of the 2,200 children who comprised the CAS standardization group. The children in this nationally representative subgroup of the CAS standardization sample were selected for inclusion in a special validity study of the relationship between PASS and achievement based upon the demographic characteristics in Table 1. The children in this subgroup of the standardization sample were individually administered tests of achievement after being given the CAS. Examination of the characteristics of the regular educational sample (n = 1,453), described in Table 1, showed that the group

TABLE 1. Description of the Cognitive Assessment System Regular Education (n = 1,453) and Special Education (n = 144) Samples

	Regular Education		Percentage in US	Special Education	
	n	%	Population	n	%
Region					
Northeast	266	18	25	31	22
South	485	33	19	67	47
North Central	348	24	34	41	28
West	354	24	22	5	3
Gender					
Female	742	51	49	55	38
Male	711	49	51	89	62
Parental Education Levels					
Less than High School	258	18	20	34	23
High School	462	32	29	36	25
Some College	379	26	29	37	26
Four or More Years of College	354	24	23	37	26
Race					
Caucasian	1,122	77	77	104	72
African American	178	12	14	33	23
Other	153	11	10	7	5
Hispanic Origin					
Non-Hispanic	1,293	89	89	135	94
Hispanic	160	11	11	90	6
Community Setting					
Urban/Suburban	1,081	74	75	106	74
Rural	372	26	25	37	26

Note: U.S. percentages are based on the 1990 Census reports from Naglieri and Das (1997b).

closely matched the demographic characteristics of the U.S. population according to 1990 Census reports.

The characteristics of the sample of children in special education (n = 144) was also examined and described in Table 1. These children were independently identified and placed in special educational settings for children with Speech and Language problems (n = 20, 14%), Learning Disabilities (n = 85, 59%), Mental Retardation (n = 24, 17%), and Serious Emotional Disturbance (n = 15, 10%) by their local school district personnel based on state and federal regulations. Each of these children was individually administered nine of the Woodcock-Johnson-Revised (WJ-R) Tests of Achievement (Woodcock & Johnson, 1989) by a trained examiner following administration of the CAS (Naglieri & Das, 1997a).

INSTRUMENTS

Cognitive Assessment System

The four PASS cognitive processes were assessed using the CAS (Naglieri & Das, 1997a), which is an individually administered test for children from the ages of 5 through 17 years. The CAS is comprised of 12 subtests that have undergone extensive development and validation (Das, Naglieri, & Kirby, 1994; Naglieri, 1999 ; Naglieri & Das, 1997b). The test is standardized on 2,200 persons from the ages of 5 years, 0 months to 17 years, 11 months, who closely match the U.S. population on the basis of gender, race, region, community setting, classroom placement, educational classification, and parental education. Subtests are combined into specific PASS Scales and a Full Scale, each of which are expressed as standard scores with a mean of 100 and SD of 15. The average internal reliabilities for the PASS Scales for the standardization sample were: Planning = .88; Simultaneous = .93; Attention = .88; Successive = .93; and Full Scale = .96. Each CAS subtest is amply described by Naglieri and Das (1997b) and Naglieri (1999) and therefore will only be reviewed briefly here along with the PASS Scale on which it appears.

Planning Scale. The CAS Planning scale consists of three subtests, each of which is sensitive to the child's use of strategies for efficient completion of the task. For example, Matching Numbers is best completed when children devise a method to find and underline two numbers that are the same in a row. The numbers increase in length across the four pages from one digit to seven digits and are constructed so that plans can be readily applied. Similarly, Planned Codes contains two pages, each with a distinct set of codes and arrangement of rows and columns. A legend at the top of each page shows how letters correspond to simple codes (e.g., A, B, C, D correspond to OX, XX, OO, XO, respectively). Children fill in the appropriate codes in empty boxes beneath each letter in any manner they think is efficient (a plan). The third subtest on this scale is Planned Connections, which requires children to connect numbers in sequence or numbers and letters in alternating sequential order.

Attention Scale. This scale demands focused cognitive activity and resistance to distraction. The cognitive demands of an Attention Scale subtest are well illustrated by the Expressive Attention subtest, which requires the child to name the color ink the words, Blue, Yellow, Green, and Red, are printed in when in every instance the word and the color differ. This conflict is the essence of the CAS Attention subtests. Similarly, the Number Detection subtest consists of pages of numbers that are printed in different formats. On each page, children are required to find a particular stimulus (e.g., the numbers 1, 2, and 3 printed in an open font) on a page containing many distractors (e.g., the same numbers printed in a different font). The child's performance is assessed using the ratio of accuracy (total number correct minus the number of false detections) to total time. Receptive Attention is the third subtest in this scale, which requires the child identify letter pairs that meet specified criteria among many letter pairs that do not.

Simultaneous Scale. This scale requires children to inter-relate parts or concepts to arrive at the correct answer. The cognitive demands of a Simultaneous Scale subtest are well illustrated by Nonverbal Matrices, a subtest that uses shapes and geometric designs that are interrelated through spatial or logical organization. Similarly, Verbal-Spatial Relations items require the comprehension of logical and grammatical descriptions of spatial relationships. Children are shown items containing six drawings and a printed question at the bottom of each page. The items involve both objects and shapes that are arranged in a specific spatial manner. For example, the item "Which picture shows a circle to the left of a cross under a triangle above a square?" includes six drawings with various arrangements of geometric figures, only one of which matches the description. The final subtest in this scale is Figure Memory which requires the child identify a geometric design when it is embedded in a more complex figure.

Successive Scale. All the subtests in this scale demand that the child use or retain information that is arranged in a specific sequence. For example, Word Series requires the child repeat words in the same order as stated by the examiner. Similarly, Sentence Repetition requires the child repeat sentences, such as "The blue is yellowing," that are read aloud by the examiner. Sentence Questions uses the same sentences as those in Sentence Repetition but in this subtest children (ranging in age from 8 to 17 years) are read a sentence and then asked a question about the sentence. For example, the examiner says, "The blue is yellowing" and asks the following question: "Who is yellowing?" The correct answer is "The blue." Children from ages 5 to 7 years were administered Successive Speech Rate, which requires the child to repeat a series of words in particular linear order.

Woodcock-Johnson Tests of Achievement-Revised

Mather (1991) provided ample description of the WJ-R Tests of Achievement subtests. Nine of the WJ-R subtests were included in this study. These nine subtests are combined to form a number of clusters (McGrew, Werder, & Woodcock, 1991) as follows: (a) Broad Reading = Letter-Word Identification and Passage Comprehension; (b) Basic Reading = Letter-Word Identification and Word Attack; (c) Reading Comprehension = Passage Comprehension and Reading Vocabulary; (d) Broad Math = Calculation and Applied Problems; (e) Basic Math = Calculation and Quantitative Concepts; (f) Math Reasoning = Applied Problems; (g) Basic Writing = Dictation and Proofing; and (h) Skills Cluster = Letter-Word Identification, Applied Problems, and Dictation. The following WJ-R subtests were administered: Letter Word Identification, Passage Comprehension, Calculation, Applied Problems, Dictation, Word Attack, Reading Vocabulary, Quantitative Concepts, and Proofing (see McGrew et al., 1991 for further information).

PROCEDURES

Three approaches to ipsative analysis were used in this article. First, the application of the ipsative approach to PASS profile analysis called a RW was assessed. Second the concept of a CW, and third, Cognitive Weakness and Academic Weakness (CWAW) were examined. Naglieri (1999) defined these three methods as follows: An RW is a significant weakness that is low in relation to the child's mean determined using the ipsative methodology originally proposed by Davis (1959) and modified by Silverstein (1982, 1993). A problem with the approach is that a child may be found to have a significant weakness that falls within the Average range if the majority of scores are above average. In contrast, a CW is found when a child has a significant intraindividual difference (using the ipsative system) and the lowest score also falls below some cut off designed to indicate what is typical or average. The standard scores of 90, 85, and 80 were scores used to determine below average performance. These cut scores are based on being below the Average (90–109) and Low Average (80–89) descriptive categories of PASS scores (Naglieri & Das, 1997*a*, Table C.1). The difference between an RW and CW, therefore, is that the CW method uses a dual criterion based on having a low score relative to the child's mean and a low score relative to the norm group.

Naglieri (1999) further argued that a CW should also be accompanied by an achievement test score that is comparable to the level of the PASS scale cognitive weakness. These children have a cognitive weakness and an academic test score that is similar to their low PASS score. According to Naglieri and Ashman (1999), the PASS cognitive weakness and associated academic weakness may be relevant to instruction and intervention as found by Naglieri and Gottling (1995, 1997) and Naglieri and Johnson (in press). Children with a cognitive weakness and associated academic weakness could be considered those for whom specialized instructional accommodations may be appropriate. To identify this group, children with a CW at each of the 90, 85, and 80 levels in addition to an achievement score at least that low were also studied. Ipsative scores that exceeded the mean (relative strengths) were not included in this study because the focus was on learning problems not cognitive strengths, which are not relevant to the issue of determining the appropriateness of special educational services. Children with more than one cognitive weakness were also not studied because less than 5% of the entire sample had more than one weakness of any type.

The frequency of occurrence of children with a relative weakness, cognitive weakness, and a cognitive weaknesses accompanied by a similarly low achievement score was studied. Standard scores for the PASS Scales and achievement tests were computed for the entire sample of regular education students, special education students, students with RW, CW at < 90, < 85, < 80 levels, and those with CWAW at < 90, < 85, < 80 levels. χ^2 analyses were conducted to compare the percentages of children with RW and CW at different levels in regular and special education settings. The differences in the PASS and achievement standard scores between groups were examined using *d*-ratios (Becker, 1991). The *d*-ratio, an effect size statistic, reflects the difference between group means divided by the pooled standard deviations of the two samples.

RESULTS

The means and SDs earned by the children in regular education settings (n = 1,453) are provided in Table 2. These data demonstrate that the regular education sample earned PASS and achievement scores that were in the average range and tended to be only slightly above the normative mean of 100. The sample of children placed in special educational settings (n = 144) earned considerably lower scores, as would be expected given that the group included children with mental retardation and learning disabilities.

The means, SDs, and numbers of children from the sample of children in regular education (n = 1,453) who had relative and cognitive weaknesses less than 90, 85, and 80 are provided in Table 3. These results indicate that, as a group, children with relative weaknesses earned average scores on PASS and achievement. An RW does not appear to be related to low achievement scores. In fact, the correlation between the presence or absence of an RW with WJ-R Skills achievement standard scores was .01 ($p > 0.05$). Importantly, however, the children in the regular education sample who had at least one cognitive weakness earned lower achievement scores than regular education children with a relative weakness. In fact, as the degree of a CW varied from < 90 to < 80, the achievement test scores consistently declined. Additionally, the presence or absence of a CW < 90, CW < 85, and CW < 80 correlated significantly ($p < 0.001$) with WJ-R Skills standard scores (rs = .23, .30, and .30, respectively). It is, of course, expected that those children with a CWAW at < 90, < 85, and < 80 would also earn low achievement scores. The PASS and achievement standard scores earned by these children in regular education settings who had a cognitive weakness along with a comparable academic score are provided in Table 4.

The differences between the regular education sample who did not have a cognitive weakness (Table 2) and those that had a cognitive weakness on PASS

TABLE 2. Cognitive Assessment System and Woodcock-Johnson-Revised Achievement Standard Score Means and SDs and Numbers of Children from Regular (n = 1,453) and Special (n = 144) Education Settings.

	Regular Education			Special Education		
	n	Mean	SD	*n*	Mean	SD
Planning	1,232	103.0	13.6	143	88.0	15.3
Simultaneous	1,256	102.8	13.8	144	88.8	13.9
Attention	1,229	103.1	13.4	141	88.8	14.6
Successive	1,239	102.4	13.0	144	88.4	15.6
Full Scale	1,197	103.8	13.0	140	84.4	15.0
Word Identification	1,257	105.0	15.9	144	86.5	15.9
Passage Comprehension	1,249	107.3	15.9	144	90.7	16.7
Calculation	1,252	105.3	16.7	144	86.6	19.9
Applied Problems	1,256	107.5	16.6	144	91.4	17.8
Dictation	1,255	97.3	13.3	143	78.8	14.9
Word Attack	1,240	103.3	16.7	142	83.6	16.4
Reading Vocabulary	1,235	106.2	15.7	142	87.7	15.5
Quantitative Concepts	1,255	104.5	16.4	142	86.6	17.2
Proofing	1,221	102.0	14.6	140	84.5	17.7
Broad Reading	1,249	106.1	15.9	144	87.2	17.1
Basic Reading	1,240	104.2	16.1	141	85.1	15.7
Broad Comprehension	1,234	107.0	15.8	142	89.3	16.1
Broad Math	1,251	106.1	17.6	144	87.1	20.1
Basic Math	1,250	104.8	17.1	143	84.9	19.4
Math Reasoning	1,256	107.5	16.6	144	91.6	17.7
Basic Writing	1,219	99.4	15.2	140	79.7	16.5
Skills	1,254	103.0	15.1	144	83.1	16.2

Note: Numbers of participants vary slightly because of missing data.

(Table 3), in addition to those with a cognitive weakness along with a comparable academic score (Table 4) are provided in Table 5. This table provides the *d*-ratios comparing children who had no cognitive weakness with those who had each type of weakness. The data show that children with relative weaknesses differed minimally from children with no cognitive weaknesses. The median achievement *d*-ratio between these groups was .06 and there was a minor 0.16 *d*-ratio between their CAS Full Scale standard scores. In contrast, the differences between regular education children and those with cognitive weaknesses were more pronounced. The CAS Full Scale *d*-ratios ranged from 0.77 to 1.33, all of which are considered medium to large using Cohen's (1988) suggestions. Similarly, the median achievement *d*-ratios for children with cognitive weaknesses ranged from 0.39 to 0.70 (small to large). The *d*-ratios for children with cognitive weaknesses and comparable achievement (CWAW) scores were more pronounced. The CAS Full Scale *d*-ratios (0.95 to 1.58) and the median achievement *d*-ratios (0.78 to 1.23) were large.

TABLE 3. Cognitive Assessment System and Woodcock-Johnson-Revised Achievement Standard Score Means and SDs of Regular Education Children with Relative and Cognitive Weaknesses of Three Magnitudes From the Total Sample (N = 1,453)

	RW			CW < 90			CW < 85			CW < 80		
	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD
Planning	610	102.6	15.5	423	96.6	14.8	304	94.3	14.8	196	91.0	14.7
Simultaneous	610	101.6	15.2	423	96.2	14.3	304	93.9	14.1	196	91.1	13.6
Attention	610	101.6	15.3	423	95.4	13.8	304	92.7	13.7	196	90.6	13.9
Successive	610	100.3	16.1	423	95.5	15.6	304	92.9	16.0	196	89.9	16.0
Full Scale	610	101.7	13.6	423	94.4	9.9	304	91.0	9.3	196	87.3	8.3
Word Identification	610	103.6	16.3	423	98.7	14.5	304	96.2	14.2	196	93.7	14.5
Passage Comprehension	608	106.0	16.1	421	101.1	15.1	303	98.7	13.9	196	96.7	13.9
Calculation	608	105.5	16.9	422	101.1	16.1	303	99.4	16.4	196	97.8	16.8
Applied Problems	610	106.5	16.7	423	101.5	15.7	304	97.8	14.6	196	95.4	14.9
Dictation	609	96.6	14.0	422	92.1	12.8	303	89.8	12.7	196	87.4	13.2
Word Attack	601	101.7	16.9	417	97.1	15.0	299	95.5	14.7	192	94.2	14.6
Reading Vocabulary	601	105.0	16.3	415	100.5	15.4	300	98.5	15.1	193	96.3	14.4
Quantitative Concepts	610	103.7	16.4	423	98.2	14.3	304	95.7	14.1	196	92.7	13.6
Proofing	600	101.2	15.4	415	96.7	13.7	297	94.8	13.3	193	93.1	13.3
Broad Reading	608	104.6	16.4	421	99.3	14.7	303	96.7	14.0	196	94.2	14.2
Basic Reading	601	102.8	16.3	417	97.8	14.4	299	95.5	14.1	192	93.4	14.3
Broad Comprehension	601	105.8	16.2	415	100.8	15.2	300	98.5	14.5	193	96.1	13.9
Broad Math	608	105.7	17.6	422	100.2	16.4	303	97.0	15.8	196	94.6	16.2
Basic Math	608	104.3	17.1	422	98.7	15.3	303	96.2	15.1	196	93.5	14.9
Math Reasoning	610	106.6	16.7	423	101.5	15.7	304	97.8	14.6	196	95.4	14.9
Basic Writing	599	98.6	16.0	414	93.3	13.9	296	90.9	13.7	193	88.2	13.8
Skills	609	101.9	15.6	422	96.6	14.1	303	93.5	13.4	196	90.7	13.9

Note: CW, Cognitive Weaknesses; CW < 90, Cognitive Weakness that is less than a standard score of 90; RW, Relative Weaknesses.

Table 6 shows the percentages of these children in regular (n = 1,453) and special (n = 144) education programs who had RW, CW at three levels, and CWAW at three levels. Although about the same proportion (51%) of special education children had a relative weaknesses as the regular education sample (42%), this was not true for cognitive weaknesses. In fact, the proportion of children in special education with a CW < 80 was about three times as high as those in regular education settings. χ^2 results provided in Table 6 showed that the proportions of children in regular and special education settings with a RW did not differ significantly. In contrast, the proportions of children in regular and special education with CW and CWAW did differ significantly, indicating that cognitive weaknesses are more often found for special education children. It is important to recall that these children were not identified using the CAS; therefore, it

TABLE 4. Cognitive Assessment System and Woodcock-Johnson-Revised Achievement Standard Score Means and SDs of Regular Education Children with Cognitive Weaknesses of Three Magnitudes and Comparable Academic Scores from the Total Regular Education Sample (N = 1,453)

	CWAW < 90			CWAW < 85			CWAW < 80		
	n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
Planning	281	95.5	14.7	172	92.3	14.7	94	88.0	13.1
Simultaneous	281	92.9	13.4	172	90.3	13.3	94	87.5	13.6
Attention	281	95.4	13.2	172	92.7	12.9	94	88.9	13.1
Successive	281	92.9	14.9	172	89.9	15.0	94	87.1	16.1
Full Scale	281	92.0	9.8	172	88.1	9.3	94	83.7	8.3
Word Identification	281	92.3	11.6	172	88.5	11.5	94	83.9	11.7
Passage Comprehension	280	94.9	12.1	171	92.1	11.9	94	88.9	12.1
Calculation	280	96.9	16.1	171	94.1	16.2	94	90.5	15.2
Applied Problems	281	95.9	13.9	172	91.2	12.8	94	87.4	13.2
Dictation	280	86.8	11.1	171	83.1	11.2	94	78.9	12.2
Word Attack	276	91.3	12.5	168	88.6	12.9	92	85.2	12.0
Reading Vocabulary	274	94.5	12.0	168	91.7	12.2	91	88.5	12.5
Quantitative Concepts	281	92.9	12.4	172	88.9	12.2	94	83.8	10.8
Proofing	275	91.3	11.6	168	88.7	12.0	93	85.7	12.7
Broad Reading	280	92.6	11.4	171	88.9	11.0	94	84.7	11.4
Basic Reading	276	91.2	11.2	168	87.7	11.2	92	83.4	10.9
Broad Comprehension	274	94.2	11.3	168	91.2	11.0	91	87.7	11.2
Broad Math	280	94.2	15.0	171	89.8	14.4	94	85.3	13.6
Basic Math	280	93.0	14.0	171	89.1	13.9	94	84.2	12.0
Math Reasoning	281	95.9	13.9	172	91.2	12.8	94	87.4	13.2
Basic Writing	274	87.0	11.2	167	83.2	11.2	93	78.7	11.5
Skills	280	90.0	10.8	171	85.5	10.3	94	80.7	10.7

is unlikely that the identification processes used by school personnel influenced these results.

The percentages of children in regular education settings who had RW, CW, and CWAW declined, as would be expected, as the level of the cognitive weakness decreased. The percentage of children with a CW < 80 was much less than the percentage with a CW < 90. The percentages of children in regular education settings with a CW < 90 and CW < 85 were not unusual, however. Only when a CW of 80 was used, did the percentage of children identified drop below 15. Approximately 14% of children in regular education settings have a PASS cognitive weakness that is less than 80. Of that group, approximately half also have an academic weakness of comparable level (~ 7% had CWAW). Using the CWAW method, approximately 12% or 7% of children in regular education settings were identified as having a PASS weakness and comparable achievement scores less than 85 or 80, respectively. It is important to recognize that those children who had a relatively flat PASS profile with any one PASS score less than 80 along

TABLE 5. PASS and Achievement *d*-ratios of Regular Education Students With and Without Relative Weaknesses, Cognitive Weaknesses, and Cognitive Weaknesses with Comparable Achievement Levels.

		CW			CWA		
	RW	< 90	< 85	< 80	< 90	< 85	< 80
Sample Size	610	423	304	196	281	172	94
Planning	0.03	0.46	0.63	0.87	0.54	0.78	1.11
Simultaneous	0.08	0.47	0.64	0.85	0.72	0.91	1.11
Attention	0.11	0.57	0.77	0.93	0.58	0.78	1.06
Successive	0.15	0.50	0.70	0.93	0.71	0.94	1.16
Full Scale	0.16	0.77	1.04	1.33	0.95	1.25	1.58
Word Identification	0.09	0.40	0.56	0.72	0.84	1.07	1.35
Passage Comprehension	0.08	0.39	0.55	0.68	0.81	0.98	1.17
Calculation	-0.01	0.25	0.35	0.45	0.51	0.67	0.89
Applied Problems	0.06	0.37	0.60	0.74	0.72	1.01	1.23
Dictation	0.05	0.39	0.57	0.75	0.81	1.09	1.39
Word Attack	0.10	0.38	0.48	0.55	0.75	0.90	1.10
Reading Vocabulary	0.08	0.36	0.49	0.64	0.78	0.95	1.14
Quantitative Concepts	0.05	0.40	0.55	0.74	0.74	0.98	1.29
Proofing	0.05	0.37	0.50	0.62	0.76	0.93	1.13
Broad Reading	0.09	0.44	0.60	0.76	0.89	1.12	1.37
Basic Reading	0.09	0.41	0.55	0.68	0.85	1.06	1.32
Broad Comprehension	0.08	0.40	0.55	0.70	0.85	1.03	1.24
Broad Math	0.02	0.34	0.53	0.66	0.69	0.95	1.20
Basic Math	0.03	0.37	0.51	0.67	0.71	0.94	1.23
Math Reasoning	0.05	0.37	0.60	0.74	0.72	1.01	1.23
Basic Writing	0.05	0.41	0.57	0.75	0.85	1.10	1.38
Skills	0.07	0.43	0.64	0.82	0.90	1.20	1.50
Median Achievement d-ratio	0.06	0.39	0.55	0.70	0.78	1.01	1.23

Note: CW, Cognitive Weaknesses; CWAW, Cognitive Weaknesses with Comparable Achievement Levels; RW, Relative Weaknesses.

with low achievement scores in the 80s (80–89) were not included in this group: only those with a significant PASS variability were selected.

DISCUSSION

The purpose of this article is to examine if an approach to profile analysis that used measures of the PASS theory would yield different results than have previously been found with subtest analysis typically used with traditional intelligence tests. Specifically, this study was designed to determine if a new method of ipsative analysis defined as a PASS cognitive weakness would improve the utility of this intra-individual approach to ability test interpretation. The present data offer important insights into these questions. First, it was found that the

TABLE 6. Number and Percentages of Children in Regular Education (n = 1,453) and Special Education (n = 144) with PASS Relative Weakness and Cognitive Weaknesses at Three Levels and Cognitive and Academic Weaknesses at Three Levels

	CW < 80		CW < 85		CW < 90		RW		CWAW < 80		CWAW < 85		CWAW < 90	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Regular Education	196	13.5	304	20.9	423	29.1	610	42.0	94	6.5	172	11.8	281	19.3
Special Education	46	31.9	52	36.1	60	41.7	74	51.4	40	27.8	47	32.6	56	38.9
χ^2 Value	40.54*		17.45*		9.79*		4.73		77.39*		48.6*		30.1*	

Note: Percentages are based on the Regular Education and Special Education samples sizes of 1,453 and 144, respectively. χ^2 values marked with an asterisk are significant at 0.05 using Bonferroni correction.

method of identifying children with relative ipsative weaknesses (the most common approach) resulted in a group of children who earned average scores on the CAS and on achievement. The concept of RW did not identify children who achieved differently from regular children. Second, children with cognitive weaknesses earned lower scores on achievement; the more pronounced the cognitive weakness, the lower the achievement scores. Third, children with a PASS cognitive weakness were more likely to have been previously identified and placed in special education settings. Finally, the presence of a cognitive weakness was significantly related to achievement, whereas the presence of a relative weakness was not.

The findings for relative weaknesses partially support previous authors who have argued against ipsative scores (for a recent summary, see Glutting et al. 1998). The results for cognitive weaknesses support the scale and PASS theory-driven approach that includes a dual criterion of ipsative and below normal performance (Naglieri, 1999). This method is different from the relative weakness approach which McDermott et al. (1990) and others have found to offer little interpretive advantage because it is not based on subtest analysis. The approach is also different from the subtest analysis approach because the method uses PASS theory-based Scales included in the CAS rather than the traditional approach of finding a subtest pattern and then looking for a model to explain it. Finally, the approach is different because the focus is on cognitive, rather than relative, weaknesses (Naglieri, 1999).

The present findings also support the view that PASS cognitive weaknesses are important and could be used to identify children with cognitive and related academic difficulties for the purpose of instructional planning and eligibility determination if that was appropriate. Naglieri and Sullivan (1999) illustrated how children with a PASS cognitive weakness and accompanying academic weakness might meet criteria for special educational programming and training. For example, a child with a cognitive weakness on the CAS Successive processing scale and comparable scores in reading decoding, along with other appropriate data, could be identified as having a specific learning disability following from regulations provided in IDEA '97. Similarly, a child with a cognitive weakness in Planning and comparable math scores could demonstrate a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, speak, read, write, spell, or do mathematical calculations, which is language included in federal and many state special education rules and regulations. In these examples, interventions such as the one used by Das, Mishra, and Pool (1995) for reading, and Naglieri and Gottling (1995, 1997) and Naglieri and Johnson (in press) for math could be considered (Naglieri & Ashman, 1999). The use of PASS cognitive weaknesses for the purpose of instructional planning was amply discussed in Kirby and Williams (1991), Naglieri and Ashman (1999), and Naglieri and Das (1997b).

Despite the difficulties previously experienced with profile analysis of ability tests, the current findings offer hope that by using a different approach, more valuable findings may be obtained. The PASS theory-driven scale level profile analysis method that used the dual criterion of both significant ipsative scores and a weakness that could be described as below average resulted in different results than the simple ipsative approach. These findings suggest that practitioners may find this alternative to subtest analysis of greater value for determination of cognitive problems associated with academic failure. These findings also suggest that it is reasonable for practitioners to conclude the following: (a) that profile analysis of PASS scores can be used effectively to identify cognitive weaknesses; (b) that children who have cognitive weaknesses are likely to have academic problems; and (c) children with cognitive weaknesses are likely to be similar to those children independently placed in special educational settings around the United States.

This study does have limitations. The sample sizes for the special populations did not allow for examination of the data by specific category (e.g., LD, ADHD, etc.). Additionally, neither cognitive strengths nor specific PASS profiles that may be associated with poor academic performance in specific academic skill areas were examined. Researchers should investigate these questions for children at different age levels and with limited achievement domains to reduce the complexity of the academic tasks and allow for examination of specific PASS contributions. PASS profiles should also be studied for different ethnic and racial groups, in addition to children from different socioeconomic levels, and to examine the relationships between PASS profiles and achievement for these groups. Finally, the stability of PASS profiles should also be examined. If these cognitive weakness profiles are not stable, then the validity of the process may be suspect. Because this is the first examination of PASS profiles, more research is needed to further understand the utility of the scale profiles found on the CAS.

REFERENCES

Becker, G. (1991). Alternative methods of reporting research results. *American Psychologist, 46,* 654–655.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). San Diego, CA: Academic Press.

Das, J. P., Mishra, R. K., & Pool, J. E. (1995). An experiment on cognitive remediation of word-reading difficulty. *Journal of Learning Disabilities, 28,* 66–79.

Das, J. P., Naglieri, J. A., & Kirby, J. R. (1994). *Assessment of cognitive processes.* Needham Heights, MA: Allyn & Bacon.

Davis, F. B. (1959). Interpretation of differences among averages and individual test scores. *Journal of Educational Psychology, 50,* 162-170.

Glutting, J. J., McDermott, P. A., Konold, T. R., Snelbaker, A. J., & Watkins, M. L. (1998). More ups and downs of subtest analysis: Criterion validity of the DAS with an unselected cohort. *School Psychology Review, 27,* 599–612.

Kaufman, A. S. (1994). *Intelligent testing with the WISC-III.* New York: Wiley.

Kirby, J. R., & Williams, N. H. (1991). *Learning problems: A cognitive approach.* Toronto: Kagan and Woo.

Mather, N. (1991). *An instruction guide to the Woodcock-Johnson Psychoeducational Battery-Revised.* Brandon, VT: CPPC.

McDermott, P. A., Fantuzzo, J. W., & Glutting, J. J. (1990). Just say no to subtest analysis: A critique of Wechsler theory and practice. *Journal of Psychoeducational Assessment, 8,* 290–302.

McGrew, K. S., Werder, J. K., & Woodcock, R. W. (1991). *Woodcock-Johnson Technical Manual.* Itasca, IL: Riverside Publishing.

Naglieri, J. A. (1999). *Essentials of CAS assessment.* New York: Wiley.

Naglieri, J. A., & Ashman A. A. (1999). Making the connection between PASS and intervention. In J. A. Naglieri (Ed.), *Essentials of CAS assessment* (pp. 151–181). New York: Wiley.

Naglieri, J. A., & Das, J. P. (1997a). *Cognitive Assessment System.* Chicago: Riverside Publishing Company.

Naglieri, J. A., & Das, J. P. (1997b). *Cognitive Assessment System: Interpretive handbook.* Chicago: Riverside Publishing Company.

Naglieri, J. A., & Gottling, S. H. (1995). A cognitive education approach to math instruction for the learning disabled: An individual study. *Psychological Reports, 76,* 1343–1354.

Naglieri, J. A., & Gottling, S. H. (1997). Mathematics instruction and PASS cognitive processes: An intervention study. *Journal of Learning Disabilities, 30,* 513-520.

Naglieri, J. A., & Johnson, D. (in press). Effectiveness of a cognitive strategy intervention to improve math calculation based on the PASS theory. *Journal of Learning Disabilities.*

Naglieri, J. A., & Sullivan, L. D. (1998). IDEA '97 and identification of children with specific learning disabilities. *Communiqué, 27,* 20–21.

Sattler, J. M. (1988). *Assessment of children* (3rd ed.). San Diego, CA: Author.

Silverstein, A. B. (1982). Pattern analysis as simultaneous statistical inference. *Journal of Consulting and Clinical Psychology, 50,* 234–240.

Silverstein, A. B. (1993). Type I, Type II, and other types of errors in pattern analysis. *Psychological Assessment, 5,* 72–74.

Witt, J. C., & Gresham, F. M. (1985). Review of the Wechsler Intelligence Scale for Children-Revised. In J. Mitchell (Ed.), *Ninth mental measurements yearbook* (pp. 1716–1719). Lincoln, NE: Buros Institute.

Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock-Johnson Psycho-Educational Battery-Revised.* Itasca, IL: Riverside Publishing.

Yoakum, C. S., & Yerkes, R. M. (1920). *Army mental tests.* New York: Holt.

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