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Construct Validity of the PASS Theory and CAS: Correlations With Achievement

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The relationship among Planning, Attention, Simultaneous, and Successive (PASS) processing scores of the Cognitive Assessment System (CAS) and the Woodcock–Johnson Revised Tests of Achievement (WJ-R) were examined with a sample of 1,559 students aged 5–17 years. Participants were part of the CAS standardization sample and closely represented the U.S. population on a number of important demographic variables. Pearson product–moment correlation between CAS Full Scale and the WJ-R Skills cluster was .71 for the Standard and .70 for the Basic CAS Battery scores, providing evidence for the construct validity of the CAS. The CAS correlated with achievement as well if not better than tests of general intelligence. The amount of variance in the WJ-R scores the CAS accounted for increased with age between 5- to 13-year-olds. The 4 PASS scale scores cumulatively accounted for slightly more of the WJ-R variance than the CAS Full Scale score.

There are many ways in which the validity of a theory of cognitive ability may be evaluated. Psychologists often attempt to relate information about a child's cognitive characteristics to that child's academic performance. Because cognitive ability and academic achievement share a significant portion of the same construct, tests of cognitive ability should correlate with tests of academic achievement. This shared construct representation constitutes a basic type of construct validity (Messick, 1995). If there is a strong relationship between the results of a cognitive ability test and measures of academic achievement, we assume that whatever that test measures plays an important role in academic performance.

Researchers have examined the relationships between intelligence and achievement for many years. Brody (1992) reported that these two constructs correlate about .55 for a wide variety of subjects and tests. Similarly, Naglieri (1999) found that the median correlation between the Full Scale IQ scores of the Wechsler Intelligence Scales for Children—Third Edition (WISC-III; Wechsler, 1991) and the Wechsler Individual Achievement Test (WIAT) scores (Wechsler, 1992) was .59 for a large representative sample of children aged 5 to 19 years from all regions of the country, different racial and ethnic groups, and parental educational levels ($N = 1{,}284$). This means that tests of general intelligence are moderately correlated with achievement, although the size of the correlation partially is due to the content overlap between tests of intelligence and achievement.

The most widely used IQ test for children, the WISC-III, contains some subtests that are very similar to those found in tests of achievement. For instance, subtests like General Information are also included on individual achievement tests (e.g., the Peabody Individual Achievement Test—Revised; Markwardt, 1997). Similarly, the WISC-III Vocabulary and Similarities subtests require knowledge of words, which is also assessed by vocabulary or word analogy tests on, for example, the Stanford Achievement Test, Ninth Edition (SAT[9]; 1995). The risk of circular reasoning is obvious. The recognition that this overlap in content is undesirable is not new (Boake, 2002) and has influenced the structure of tests such as the Kaufman Assessment Battery for Children (K-ABC; Kaufman & Kaufman, 1983) and the Naglieri Nonverbal Ability Test (N-NAT; Naglieri, 1997).

The correlation between a test of general ability and achievement can be strong even when the items do not have academic content. For instance, Naglieri (1997) reported that the N-NAT, which does not contain items with verbal and/or achievement content, correlated .64 ($N = 21{,}496$) with the SAT[9] (1995). Naglieri (1999) also found that the K-ABC, another ability measure without achievement content, correlated moderately with achievement. The average correlation between the K-ABC total Mental Processing score and achievement among children aged 2.5 through 12.5 years was .63 ($N = 2{,}636$). The correlation was similar to that found for the WISC-III and WIAT (.59; Naglieri, 1999). One advantage of tests like the K-ABC and N-NAT, therefore, is that they correlate well with achievement but do not contain items similar to those found in achievement tests. This can be important when the cognitive abilities of children with a history of academic failure are evaluated because their limited academic knowledge can deflate their scores on some IQ tests (Siegel, 1988).

Another ability test without academic skills content is the Cognitive Assessment System (CAS; Naglieri & Das, 1997b). Unlike the N-NAT, which is based on the general ability concept, the CAS measures four separate but interrelated cognitive abilities called planning, attention, simultaneous, and successive processes. These separate dimensions of ability were developed as a modern approach to intelligence, with the expectation that they would improve diagnoses and the selection of academic interventions

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(Naglieri, 1999; Naglieri & Pickering, 2003). The CAS has undergone extensive development and validation (see Das, Naglieri, & Kirby, 1994; Naglieri & Das, 1997a). It was standardized on a representative sample of 2,200 persons aged 5 to 17 years that closely matched the U.S. population on the basis of gender, race, region, community setting, classroom placement, educational classification, and parental education.

Although correlations between the Planning, Attention, Simultaneous, and Successive (PASS) processing scores of the CAS and achievement were reported in a cursory manner (Naglieri & Das, 1997b), important information was omitted in that report. The authors did not report means and standard deviations of the CAS and WJ-R scores, they did not provide the proportion of variance accounted for by combinations of PASS variables, nor did they compare Standard and Basic battery scores or compare the Full Scale with the combination of PASS variables. The purpose of this study, therefore, was to (a) examine the extent to which the CAS Full Scale scores and the four PASS processing scores correlate with various types of achievement as measured by the WJ-R (Woodcock & Johnson, 1989) for 5- to 17-year-old children, (b) report complete statistics on all variables for a more thorough examination of CAS's construct validity, (c) explore developmental trajectories in the correlation between CAS and achievement scores across four age groups, (d) compare the correlations between the CAS Full Scale Standard Battery score and the CAS Full Scale Basic Battery with achievement scores, and (e) evaluate the unique contribution of each of the four PASS processing scores in predicting achievement.

Method

Participants

The group of participants was a nationally representative sample of 1,559 children and adolescents aged 5 to 17 years, which was drawn from the CAS standardization sample ($N = 2{,}200$). Table 1 compares this study's sample with the U.S. population (based on 1990 Census reports) on key variables such as gender, race, parental education, geographic region, and the community setting they came from. To be included, participants had to have been individually administered all nine of the WJ-R (Woodcock & Johnson, 1989) by a trained examiner, following the administration of the CAS.

Instruments

Cognitive Assessment System. The CAS (Naglieri & Das, 1997a) is an individually administered test of cognitive functioning for children and adolescents ranging from 5 through 17 years of age that was designed to assess the four PASS cognitive processes: (a) Planning, (b) Attention, (c) Simultaneous, and (d) Successive. The four PASS scales and the Full Scale standard scores are set at a mean of 100 and a standard deviation of 15. The Standard Battery consists of all 12 subtests (four for each PASS scale), and the Basic Battery is comprised of two subtests per PASS scale. Descriptions of the subtests and scales as well as evidence for the reliability of the individual subtest scores and PASS Scale scores are amply provided in the manual (Naglieri & Das, 1997b). The average internal consistency alpha values for the PASS Standard (all 12 subtest) and Basic (8 subtest; in parentheses) Batteries are as follows: Planning = .88 (.85); Simultaneous = .93 (.90); Attention = .88 (.84); Successive = .93 (90); and Full Scale = .96 (.87).

Woodcock–Johnson Tests of Achievement—Revised. The WJ-R (Woodcock & Johnson, 1989) is a test of achievement. In this study, the reading (Letter Word Identification, Word Attack, Reading Vocabulary, Passage Comprehension), math (Calculation, Applied Problems, Quantitative Concepts), and writing (Dictation, Proofing) subtests were included. These nine WJ-R subtests are combined in various ways to form a number of clusters, which are as follows: Broad Reading (Letter-Word Identification and Passage Comprehension); Basic Reading (Letter-Word Identification and Word Attack); Reading Comprehension (Passage Comprehension and Reading Vocabulary); Broad Math (Calculation and Applied Problems); Basic Math (Calculation and Quantitative Concepts); Math Reasoning (Applied Problems); Basic Writing (Dictation and Proofing); and Skills cluster (Letter-Word Identification, Applied Problems, and Dictation).

Table 1
Description of the Sample That Was Administered the CAS and WJ-R Tests of Achievement (N = 1,559)

Variable	*N*	%	U.S.%
Age group (in years)			
5–7	617	39.6	
8–10	443	28.4	
11–13	217	13.9	
14–17	282	18.1	
Gender			
Male	781	50.1	51
Female	778	49.9	49
Race			
White	1,205	77.3	77
African American	198	12.7	14
Other	156	9.9	10
Hispanic origin			
Hispanic	162	10.4	11
Non-Hispanic	1,397	89.6	89
Parental education			
No high school degree	282	18.1	20
High school graduate	486	31.2	29
Some college	407	26.1	29
College graduate	384	24.6	23
Class placement			
Regular education classes	1,439	92.3	
Special education classes	112	7.1	
Other–unknown	8	0.6	
Community setting			
Rural	405	26.0	25
Urban–suburban	1,154	74.0	75
Geographic region			
Midwest	383	24.6	25
Northeast	293	18.8	19
South	531	34.1	34
West	352	22.6	22

Note. CAS = Cognitive Assessment System; WJ-R = Woodcock–Johnson Revised Tests of Achievement.

Results

CAS and WJ-R standard scores were used in all analyses. Means and standard deviations of the CAS Standard Battery Full Scale score, the PASS processing scores, and the WJ-R subtest scores and cluster scores are presented in Table 2. Although the participants had CAS scores that were very similar to the CAS normative values ($M = 100$, $SD = 15$), their WJ-R subtest scores tended to deviate from the normative mean of 100 ($SD = 15$). The CAS means ranged from 99.6 to 100.4, whereas the WJ-R means ranged from 94.6 to 104.8. Similarly, the CAS standard deviations ranged

Table 2
Means and Standard Deviations (N = 1,559)

Scale	*M*	*SD*
CAS Standard		
Full Scale	100.0	14.7
Planning	100.2	14.9
Simultaneous	100.3	14.6
Attention	100.3	14.6
Successive	99.6	14.5
CAS Basic		
Planning	100.4	15.0
Simultaneous	100.1	14.8
Attention	100.1	14.6
Successive	99.7	14.6
Full Scale	99.9	14.7
WJ-R subtests		
Letter-Word Identification	102.1	16.8
Passage Comprehension	104.5	16.6
Calculation	102.9	17.9
Applied Problems	104.8	17.4
Dictation	94.6	14.6
Word Attack	100.4	17.4
Reading Vocabulary	103.3	16.6
Quantitative Concepts	101.7	17.2
Proofing	99.4	15.9
WJ-R clusters		
Broad Reading	103.1	17.0
Basic Reading	101.3	16.9
Reading Comprehension	104.1	16.7
Broad Math	103.2	18.7
Basic Math	101.8	18.1
Math Reasoning	104.8	17.4
Basic Writing	96.4	16.4
Skills Cluster	100.0	16.3

Note. CAS = Cognitive Assessment System; WJ-R = Woodcock–Johnson Revised Tests of Achievement.

from 14.5 to 15.0, whereas the WJ-R standard deviations ranged from 14.6 to 18.7.

Table 3 presents the Pearson product–moment correlations between the CAS Basic and Standard Battery Full Scale scores and the four PASS scales scores with the WJ-R subtest and cluster scores. The CAS Standard and Basic Battery Full Scale scores had very similar correlations with the WJ-R subtests and clusters. For the WJ-R subtests, the mean correlation for the Standard Battery was .61 (*SD* = .04, ranging from .55 to .66), whereas the mean correlation for the Basic Battery was .60 (*SD* = .04, ranging from .55 to .64). For the WJ-R clusters, the mean correlation for the Standard Battery was .65 (*SD* = .03, ranging from .61 to .71), and the mean correlation for the Basic Battery was also .65 (*SD* = .03, ranging from .61 to.70). The CAS Full Scale correlation with the WJ-R Skills cluster, which is considered a summary score of achievement because of the diverse skills it includes, was .71 for the Standard and .70 for the Basic CAS Battery scores.

Regression coefficients of multiple determination (R^2) for CAS variables predicting WJ-R subscale and cluster scores are presented in Table 4. Column 1 contains the R^2 values for the CAS Standard Battery Full Scale scores, whereas column 2 contains the R^2 values of the cumulative PASS scores. The difference between the values in columns 1 and 2 was that the CAS Full Scale score was a univariate predictor, whereas the four cumulative PASS scales scores were multivariate predictors. Table 4 also contains information about the relative loss of predictive power of the cumulative PASS scores when one of the PASS scale scores was withheld (columns 3 to 6).

The mean R^2 for the CAS Full Scale scores across WJ-R subtests was .37 (*SD* = .04), for the cumulative PASS scores R^2 was .39 (*SD* = .05), for the cumulative PASS score without Planning R^2 was .36 (*SD* = .05), for the cumulative PASS score without Simultaneous R^2 was .31 (*SD* = .03), for the cumulative PASS score without Successive R^2 was .32 (*SD* = .05), and for the cumulative PASS score without Attention R^2 was .38 (*SD* = .05). Similarly, the mean R^2 for the CAS Full Scale score across WJ-R clusters was .42 (*SD* = .04), for the cumulative PASS scores R^2 was .45 (*SD* = .04), for the cumulative PASS score without Planning R^2 was .41 (*SD* = .03), for the combined PASS score without Simultaneous R^2 was .36 (*SD* = .03), for the combined PASS score without Successive R^2 was .38 (*SD* = .05), and for the combined PASS score without Attention R^2 was .44 (*SD* = .04).

Tables 5, 6, 7, and 8 contain the same information as Table 4, but separately for each of the four age groups. As can be seen in Figure 1, the predictive powers of the CAS Standard Battery Full Scale score and the cumulative PASS score changed with age. In Figure 1, the proportion of WJ-R subscale and cluster means predicted by the CAS Full Scale score across the four age groups can be seen (this figure is a graphic display of the means of the WJ-R subscale and cluster scores obtained from the first column in Tables 5–8). The CAS power of prediction increased between childhood and early adolescence and reached a plateau with the 11- to 13-year-old age group. Presumably because of the higher reliability of the clusters, CAS consistently had greater predictive power for the WJ-R clusters as opposed to the WJ-R subtests.

Figures 2 and 3 depict the contribution of the four PASS scales by displaying the partial power loss in predicting achievement when single PASS scales were omitted across four age groups (Figure 2 for the prediction of WJ-R subtests, Figure 3 for WJ-R clusters). Shorter bars indicate smaller predictive loss when a particular scale was omitted, and higher bars reflect greater loss. The Attention scale contributed relatively little beyond the other three scales to the overall prediction of WJ-R subtest performance across the age ranges. The relatively strongest prediction came from the Simultaneous scale.

Discussion

The CAS is a cognitive ability test that reconceptualizes intelligence as four basic psychological processes shown here to correlate strongly with achievement. The correlation between the Standard and Basic Battery CAS Full Scale and the WJ-R Skills cluster score was .71 and .70, respectively. This means that there was a substantial relationship between achievement as measured by the WJ-R and the PASS theory as operationalized by the CAS. It also means that the construct validity of the eight-subtest CAS Basic Battery was very similar to the 12-subtest Standard Battery. The relationship between cognitive ability and achievement followed a nonlinear trajectory, starting out relatively low for the youngest age group and leveling off with the 11- to 13-year-olds. That the PASS scales were important predictors of academic performance as measured by the WJ-R is a sign of good construct validity of the CAS.

(*text continues on page 180*)

Table 3

Pearson Product–Moment Correlations Between the CAS Basic Battery and Standard Battery Full Scale Scores and the WJ-R Subscale and Cluster Scores (N = 1,559)

	CAS Full Scale scores		CAS Standard Battery subtests			
Scale	Standard	Basic	Planning	Simultaneous	Successive	Attention
WJ-R subtests						
Letter-Word Identification	.62	.62	.47	.53	.49	.42
Passage Comprehension	.59	.58	.43	.50	.47	.39
Calculation	.58	.56	.50	.47	.36	.43
Applied Problems	.65	.64	.49	.60	.47	.44
Dictation	.63	.63	.50	.53	.49	.44
Word Attack	.55	.55	.41	.48	.44	.37
Reading Vocabulary	.59	.58	.42	.53	.50	.35
Quantitative Concepts	.66	.65	.51	.59	.49	.44
Proofing	.58	.57	.44	.48	.44	.40
WJ-R clusters						
Broad Reading	.64	.64	.48	.55	.50	.43
Basic Reading	.63	.63	.47	.54	.49	.42
Reading Comprehension	.61	.61	.44	.54	.50	.39
Broad Math	.66	.65	.54	.58	.45	.47
Basic Math	.67	.65	.55	.58	.46	.47
Math Reasoning	.65	.64	.49	.60	.47	.44
Basic Writing	.65	.65	.51	.55	.48	.45
Skills Cluster	.71	.70	.54	.62	.53	.48

Note. CAS = Cognitive Assessment System; WJ-R = Woodcock–Johnson Revised Tests of Achievement.

Table 4

Proportion of Variance in WJ-R Subscale and Cluster Achievement Test Standard Scores by the CAS Standard Battery Full Scale Scores and Full Scale Scores Minus One PASS Score (N = 1,559)

	Full Scale score Standard Battery					
			Full Scale scores minus the PASS score below			
Scale	Full Scale	PASS	Planning	Simultaneous	Successive	Attention
WJ-R subtests						
Letter-Word Identification	.38	.40	.37	.33	.33	.40
Passage Comprehension	.35	.36	.34	.29	.29	.36
Calculation	.33	.35	.29	.29	.32	.33
Applied Problems	.42	.45	.42	.34	.38	.44
Dictation	.40	.41	.38	.35	.35	.41
Word Attack	.31	.32	.30	.26	.26	.32
Reading Vocabulary	.34	.38	.35	.28	.28	.38
Quantitative Concepts	.44	.46	.43	.36	.39	.46
Proofing	.34	.35	.32	.29	.29	.34
WJ-R clusters						
Broad Reading	.41	.43	.41	.35	.35	.43
Basic Reading	.39	.41	.39	.34	.33	.41
Reading Comprehension	.38	.41	.38	.31	.31	.40
Broad Math	.44	.46	.41	.37	.41	.45
Basic Math	.45	.47	.41	.38	.42	.46
Math Reasoning	.42	.45	.41	.34	.38	.44
Basic Writing	.42	.44	.40	.37	.37	.43
Skills Cluster	.50	.52	.48	.42	.44	.52

Note. $R^2 \times 100$ measures the percentage of the variation in the dependent variable that is explained by variations in the independent variable. PASS scores entered as multiple independent variables. CAS = Cognitive Assessment System; WJ-R = Woodcock–Johnson Revised Tests of Achievement; PASS = Planning, Attention, Simultaneous, and Successive.

Table 5

Proportion of Variance in WJ-R Subscale and Cluster Achievement Scores Accounted for by the CAS Standard Battery Full Scale Scores and Full Scale Scores Minus One PASS Score of 5- to 7-Year-Olds (n = 617)

	Full Scale score Standard Battery					
			Full Scale scores minus the PASS score below			
Scale	Full Scale	PASS	Planning	Simultaneous	Successive	Attention
WJ-R subtests						
Letter-Word Identification	.30	.32	.28	.27	.29	.32
Passage Comprehension	.23	.23	.21	.21	.21	.23
Calculation	.23	.25	.19	.24	.25	.25
Applied Problems	.39	.41	.40	.33	.39	.40
Dictation	.30	.32	.28	.28	.30	.31
Word Attack	.19	.21	.18	.17	.18	.21
Reading Vocabulary	.22	.25	.23	.22	.20	.25
Quantitative Concepts	.42	.45	.42	.38	.41	.45
Proofing	.15	.16	.14	.13	.14	.16
WJ-R clusters						
Broad Reading	.30	.31	.28	.27	.29	.31
Basic Reading	.30	.31	.28	.27	.29	.31
Reading Comprehension	.25	.26	.24	.23	.22	.25
Broad Math	.38	.39	.34	.35	.38	.39
Basic Math	.39	.41	.34	.37	.38	.41
Math Reasoning	.39	.41	.40	.33	.39	.40
Basic Writing	.30	.31	.27	.27	.31	.31
Skills Cluster	.41	.43	.38	.36	.41	.24

Note. $R^2 \times 100$ measures the percentage of the variation in the dependent variable that is explained by variations in the independent variable. PASS scores entered as multiple independent variables. CAS = Cognitive Assessment System; WJ-R = Woodcock–Johnson Revised Tests of Achievement; PASS = Planning, Attention, Simultaneous, and Successive.

Table 6

Proportion of Variance in WJ-R Subscale and Cluster Achievement Scores Accounted for by the CAS Standard Battery Full Scale Scores and Full Scale Scores of 8- to 10-Year-Olds (n = 443)

	Full Scale score Standard Battery					
			Full Scale scores minus the PASS score below			
Scale	Full Scale	PASS	Planning	Simultaneous	Successive	Attention
WJ-R subtests						
Letter-Word Identification	.43	.46	.44	.38	.40	.45
Passage Comprehension	.46	.50	.48	.42	.43	.50
Calculation	.37	.38	.32	.34	.36	.37
Applied Problems	.45	.48	.43	.39	.46	.48
Dictation	.44	.45	.42	.39	.40	.45
Word Attack	.39	.42	.41	.35	.36	.41
Reading Vocabulary	.47	.53	.51	.42	.46	.53
Quantitative Concepts	.40	.44	.40	.36	.39	.43
Proofing	.42	.44	.42	.37	.41	.43
WJ-R clusters						
Broad Reading	.49	.53	.51	.44	.46	.53
Basic Reading	.44	.47	.46	.39	.41	.47
Reading Comprehension	.52	.57	.55	.46	.50	.57
Broad Math	.49	.51	.45	.43	.49	.51
Basic Math	.45	.47	.42	.41	.44	.47
Math Reasoning	.45	.49	.43	.40	.46	.49
Basic Writing	.48	.49	.46	.42	.45	.49
Skills Cluster	.53	.55	.52	.46	.50	.55

Note. $R^2 \times 100$ measures the percentage of the variation in the dependent variable that is explained by variations in the independent variable. PASS scores entered as multiple independent variables. CAS = Cognitive Assessment System; WJ-R = Woodcock–Johnson Revised Tests of Achievement; PASS = Planning, Attention, Simultaneous, and Successive.

Table 7

Proportion of Variance in WJ-R Subscale and Cluster Achievement Scores Accounted for by the CAS Standard Battery Full Scale Scores and Full Scale Scores of 11- to 13-Year-Olds (n = 217)

	Full Scale score Standard Battery					
			Full Scale scores minus the PASS score below			
Scale	Full Scale	PASS	Planning	Simultaneous	Successive	Attention
WJ-R subtests						
Letter-Word Identification	.53	.54	.50	.49	.51	.55
Passage Comprehension	.49	.52	.50	.47	.45	.52
Calculation	.46	.47	.43	.40	.47	.48
Applied Problems	.51	.53	.51	.44	.51	.54
Dictation	.52	.54	.53	.48	.49	.54
Word Attack	.43	.45	.43	.38	.43	.45
Reading Vocabulary	.45	.51	.48	.42	.47	.53
Quantitative Concepts	.39	.42	.40	.32	.41	.43
Proofing	.49	.49	.46	.45	.47	.48
WJ-R clusters						
Broad Reading	.57	.59	.56	.53	.54	.59
Basic Reading	.54	.55	.52	.48	.52	.56
Reading Comprehension	.51	.56	.54	.48	.50	.58
Broad Math	.53	.55	.52	.47	.54	.56
Basic Math	.47	.50	.47	.40	.49	.51
Math Reasoning	.51	.52	.50	.43	.50	.53
Basic Writing	.53	.53	.52	.48	.50	.53
Skills Cluster	.60	.61	.59	.54	.57	.62

Note. $R^2 \times 100$ measures the percentage of the variation in the dependent variable that is explained by variations in the independent variable. PASS scores entered as multiple independent variables. CAS = Cognitive Assessment System; WJ-R = Woodcock–Johnson Revised Tests of Achievement; PASS = Planning, Attention, Simultaneous, and Successive.

Table 8

Proportion of Variance in WJ-R Subscale and Cluster Achievement Scores Accounted for by the CAS Standard Battery Full Scale Scores and Full Scale Scores of 14- to 17-Year-Olds (n = 282)

	Full Scale score Standard Battery					
			Full Scale scores minus the PASS score below			
Scale	Full Scale	PASS	Planning	Simultaneous	Successive	Attention
WJ-R subtests						
Letter-Word Identification	.45	.49	.49	.43	.38	.48
Passage Comprehension	.39	.44	.43	.36	.36	.43
Calculation	.51	.54	.51	.40	.54	.53
Applied Problems	.52	.58	.57	.40	.55	.57
Dictation	.46	.48	.45	.43	.40	.47
Word Attack	.37	.40	.38	.38	.30	.40
Reading Vocabulary	.35	.39	.39	.34	.31	.39
Quantitative Concepts	.54	.57	.55	.44	.52	.56
Proofing	.45	.47	.45	.43	.38	.47
WJ-R clusters						
Broad Reading	.50	.55	.54	.47	.43	.54
Basic Reading	.47	.51	.50	.47	.39	.51
Reading Comprehension	.41	.46	.46	.38	.37	.45
Broad Math	.56	.62	.59	.44	.60	.61
Basic Math	.57	.61	.59	.46	.60	.60
Math Reasoning	.52	.58	.57	.40	.55	.57
Basic Writing	.49	.51	.48	.47	.41	.51
Skills Cluster	.58	.62	.61	.51	.54	.61

Note. $R^2 \times 100$ measures the percentage of the variation in the dependent variable that is explained by variations in the independent variable. PASS scores entered as multiple independent variables. CAS = Cognitive Assessment System; WJ-R = Woodcock–Johnson Revised Tests of Achievement; PASS = Planning, Attention, Simultaneous, and Successive.

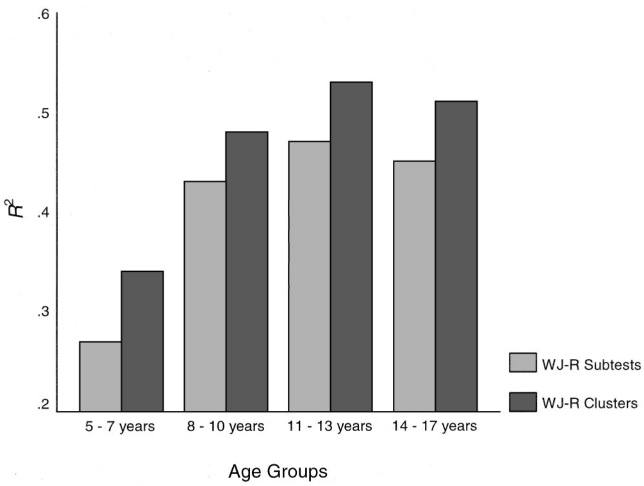

Figure 1. Predicting achievement measured by mean Woodcock–Johnson Revised Tests of Achievement (WJ-R) subscale and cluster scores with the Cognitive Assessment System Full Scale score across four age groups with regression coefficients of multiple determination (R^2).

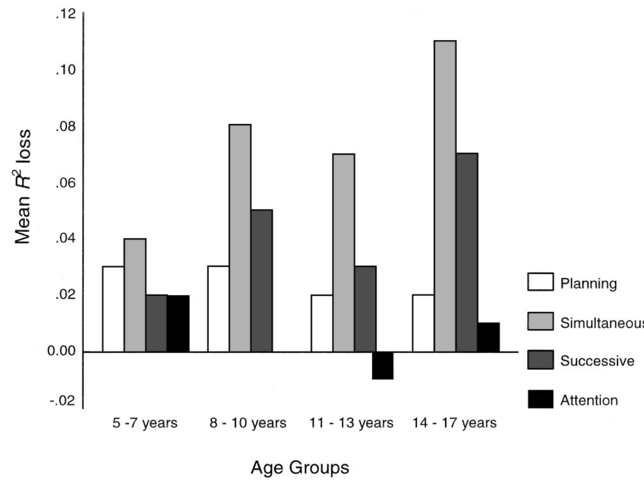

Figure 3. Mean regression coefficients of multiple determination (R^2) loss of Planning, Attention, Simultaneous, and Successive (PASS) scores predicting Woodcock–Johnson Revised Tests of Achievement (WJ-R) clusters achievement if the respective PASS scale was omitted across four age groups.

The CAS correlated with achievement at least as well as tests of general intelligence, as summarized by Naglieri (1999). This is relevant because the CAS does not use achievement-like subtests that would inflate the correlation between tests of ability and achievement. The more content overlap between ability and achievement tests, the more contaminated the correlation between the two. Moreover, measures of cognitive ability without achievement-like subtests are more appropriate than achievement-laden tests for children with a history of school problems and especially for culturally and linguistically diverse populations.

The WJ-R scores in this study deviated from the mean of 100 (SD = 15) to which the scores were originally set by the test authors, although the CAS values were very close to the expected values (M = 100 and SD = 15). Given that the sample of this study was representative of the U.S. population on a number of demographic variables, the values found here may represent the actual current values of central tendency and dispersion of the WJ-R. It is likely that differences in the sampling procedures for the CAS and WJ-R standardization samples and the methods used to calculate the norms resulted in these findings. For example, the number of children in special education was not reported in the *WJ-R Technical Manual*, which could have restricted the standardization sample.

Vellutino, Scanlon, and Lyon (2000) stated that the correlation between intelligence and reading achievement is low. In contrast, our data indicate that the correlation between PASS processing scores and reading achievement was substantial. For example, the CAS Full Scale score correlated .62 with Letter Identification and .59 with Passage Comprehension. Our results were consistent with Vellutino (2001) insofar as the relationship between ability and achievement increased with age. In this study, the amount of variance accounted for in Letter-Word Identification on the WJ-R by the four cumulative PASS scores was 32%, 46%, 54%, and 49% for the 5–7, 8–10, 11–13, and 14–17 age groups, respectively. These results also corroborate the findings of Stanovich, Cunningham, and Freeman (1984) and Naglieri (2000) that the relationship between cognitive processing and reading increases with age. The interesting question is why they increase. One hypothesis is that the demands of reading, as well as math, become more complex, increasing the involvement of the four PASS processes, as the complexity of the academic tasks increase.

The present results are also consistent with Naglieri and Ronning (2000) in that the correlations between ability and achievement were lower in younger than in older children. However, the present data showed a larger increase than reported by Naglieri and Ronning (2000) for the N-NAT. The differences in the rates of change across developmental periods warrant further examination.

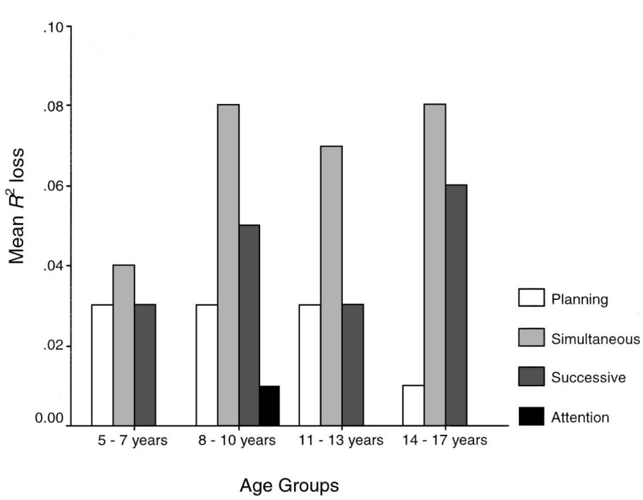

Figure 2. Mean regression coefficients of multiple determination (R^2) loss of Planning, Attention, Simultaneous, and Successive (PASS) scores predicting Woodcock–Johnson Revised Tests of Achievement (WJ-R) subtests achievement if the respective PASS scale was omitted across four age groups.

Among other issues, it should be determined if changes in those correlations are due to characteristics of cognitive ability and the nature of the achievement tests. For example, the extent to which planning is involved in a test of mathematics calculation may depend on the way the test is constructed.

The PASS processes were differentially related to achievement. The differences reflected both the importance of the academic skills and the underlying cognitive dimensions involved in addressing particular sets of achievement items. For example, when a child has to attend selectively to the relevant portion of the answer (e.g., a math problem with an answer of 1.21) and to resist responding to similar options (such as 12.1 or 121), the task involves a considerable amount of attention in addition to academic skills. In contrast, mathematics tests that do not require the selection of the correct answer from a number of similar options will pose a smaller demand on attention. It is likely that because the WJ-R Calculation subtest is not in a multiple-choice format, the importance of selective attention is reduced. The nature of the achievement task can, therefore, lead to increased or decreased relationships with different PASS processes.

The cumulative predictive power of the four PASS scales was slightly higher than that of the CAS Full Scale, which itself was derived from the sum of all the subtests from the four scales. It is likely that the amount of increase was modest because these data were obtained from a sample of normal children whose PASS scores were likely to be similar (i.e., have an even PASS scales profile). Future research should examine this question for special education children who are more likely to have uneven PASS profiles (Naglieri, 2000). Additionally, researchers should determine if PASS scales profiles are related to diagnostic categories (see Naglieri, 1999) and treatment response (see Naglieri & Johnson, 2000; Naglieri & Pickering, 2003).

In summary, this study provides support for the construct validity of the CAS. The CAS Full Scale was substantially correlated with achievement with correlations higher than those obtained using measures of general intelligence (e.g., N-NAT). Furthermore, the size of the correlation increased between the ages of 5 and 13 years before leveling off. Researchers should further examine the relationships between the PASS constructs and other types of achievement tests, including both individual and group-administered instruments. Additionally, researchers should examine the relationships between the CAS and achievement for specific populations, such as those referred for evaluation and those identified and placed in programs for children with special educational needs as well as various race and ethnic groups.

References

Boake, C. (2002). From the Binet–Simon to the Wechsler–Bellevue: Tracing the history of intelligence testing. *Journal of Clinical & Experimental Neuropsychology, 3,* 383–405.

Brody, N. (1992). *Intelligence.* San Diego, CA: Academic Press.

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

Kaufman, A. S., & Kaufman, N. L. (1983). *Kaufman Assessment Battery for Children.* Circle Pines, MN: American Guidance.

Markwardt, F. C. (1997). *Peabody Individual Achievement Test—Revised.* Circle Pines, MN: American Guidance Service.

Messick, S. (1995). Validity of psychological assessment. *American Psychologist, 50,* 741–749.

Naglieri, J. A. (1997). *Naglieri Nonverbal Ability Test.* San Antonio, TX: The Psychological Corporation.

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

Naglieri, J. A. (2000). Can profile analysis of ability test scores work? An illustration using the PASS theory and CAS with an unselected cohort. *School Psychology Quarterly, 15,* 419–433.

Naglieri, J. A., & Das, J. P. (1997a). *Cognitive Assessment System.* Itasca, IL: Riverside.

Naglieri, J. A., & Das, J. P. (1997b). *Cognitive Assessment System interpretive handbook.* Itasca, IL: Riverside.

Naglieri, J. A., & Johnson, D. (2000). Effectiveness of a cognitive strategy intervention to improve math calculation based on the PASS theory. *Journal of Learning Disabilities, 33,* 591–597.

Naglieri, J. A., & Pickering, E. B. (2003). *Helping children learn.* Baltimore: Brookes.

Naglieri, J. A., & Ronning, M. E. (2000). The relationships between general ability using the N-NAT and SAT Reading Achievement. *Journal of Psychoeducational Assessment, 18,* 230–239.

Siegel, L. S. (1988). IQ is irrelevant to the definition of learning disabilities. *Journal of Learning Disabilities, 22,* 469–479.

Stanford Achievement Test (9th ed.). (1995). San Antonio, TX: The Psychological Corporation.

Stanovich, K. E., Cunningham, A. E., & Freeman, D. J. (1984). Intelligence, cognitive skills, and early reading progress. *Reading Research Quarterly, 19,* 278–303.

Vellutino, F. R. (2001). Further analysis of the relationship between reading achievement and intelligence: Response to Naglieri. *Journal of Learning Disabilities, 34,* 306–310.

Vellutino, F. R., Scanlon, D. M., & Lyon, G. R. (2000). Differentiating between difficult-to-remediate and readily remediated poor readers: More evidence against the IQ-achievement discrepancy definition of reading disability. *Journal of Learning Disabilities, 33,* 223–238.

Wechsler, D. (1991). *Wechsler Intelligence Scale for Children—Third Edition manual.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1992). *Wechsler Individual Achievement Scale.* San Antonio, TX: The Psychological Corporation.

Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock–Johnson Revised Tests of Cognitive Ability: Standard and supplemental batteries.* Itasca, IL: Riverside.

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