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Predictive Ability of the General Ability Index (GAI) Versus the Full Scale IQ Among Gifted Referrals

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The General Ability Index (GAI) is a composite ability score for the Wechsler Intelligence Scale for Children—Fourth Edition (WISC–IV) that minimizes the impact of tasks involving working memory and processing speed. The goal of the current study was to compare the degree to which the Full Scale IQ (FSIQ) and the GAI predict academic achievement in math and reading among a group of 88 children tested for gifted programming. All students had significant variability among their index scores on the WISC–IV. Whereas both the FSIQ and GAI significantly predicted standardized achievement test scores in reading and math, the FSIQ explained more of the variance. In sequential regression analyses, both working memory and verbal comprehension scores explained significant, unique variance in reading and math scores. However, measures of processing speed and perceptual reasoning did not account for significant amounts of variance in achievement scores over and above measures of working memory and verbal comprehension. The inclusion of working memory scores in calculation of the FSIQ appears to account for the difference in prediction between the FSIQ and the GAI.

Keywords: gifted, assessment, GAI, WISC–IV, working memory

Giftedness among children can be defined in many ways, but a common definition is found in the No Child Left Behind Act of 2002. According to this definition from the Federal Government, gifted or talented children are those

> . . . who give evidence of high achievement capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who need services or activities not ordinarily provided by the school in order to fully develop those capabilities. (p. 544)

Given this relatively broad definition, it is not surprising that educators and psychologists employ various methods for the identification of students who are gifted. In its position paper *The Role of Assessments in the Identification of Gifted Students*, the National Association for Gifted Children (2008a) highlighted three general categories of assessments that are commonly used. These include performance assessments (such as portfolios, a written report, or a scientific paper) and rating scales or interviews. The final type of assessment is objective instruments. Examples of objective instruments are tests of creativity, achievement tests, or IQ tests.

Most school districts require several sources of information for the identification of gifted students, and an intelligence test is often one component of an evaluation for cognitive giftedness (Volker & Phelps, 2004; Winner, 2000). Among the individually administered cognitive tests available to psychologists, the Wechsler Intelligence Scale for Children—Fourth Edition (WISC–IV; Wechsler, 2003a) is the most popular for the identification of gifted students (Rimm, Gilman, & Silverman, 2008; Volker & Phelps, 2004). Often children are deemed intellectually gifted if their global IQ score is above a certain criterion level such as 2 standard deviations above the mean (Wechsler, 2003b; Winner, 2000).

Cognitive Scores Among Gifted Students

Intellectually gifted children have demonstrated higher mean scores on intelligence tests, but studies and reports have also described con-

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siderable variability in the composite scores of gifted children (Rimm et al., 2008; Sparrow & Gurland, 1998; Wechsler, 2003b; Winner, 2000). Specifically, among gifted students the index scores assessing working memory and processing speed are often lower than those for verbal comprehension and perceptual reasoning. This was the case for the sample of students identified as intellectually gifted in the *WISC–IV Technical and Interpretive Manual* (Wechsler, 2003b). In this sample of gifted students, the mean scores for the Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), and Processing Speed Index (PSI) were 124.7, 120.4, 112.5, and 110.6, respectively. Furthermore, in a comparison between gifted students and matched controls presented in the *WISC–IV Technical and Interpretive Manual*, there was no significant difference in scores on the Coding subtest, one of the two core subtests assessing processing speed. A study with Petermann and Petermann's German version of the WISC–IV, the Hamburg Wechsler Intelligenztest fur Kinder (as cited in Hagmann-von Arx, Meyer, & Grob, 2008), corroborated the findings of a lower mean index score for processing speed as compared with the other three WISC–IV factors (Hagmann-von Arx et al., 2008). Thus, Kaufman's (1992) observation that gifted children are not always superior in sheer speed seems valid.

The General Ability Index

Because of the frequent variability in scores, some researchers have suggested that the Full Scale IQ (FSIQ) score may not always be the best indicator of ability for gifted children on the WISC–IV or its predecessor, the WISC–III (Prifitera, Weiss, & Saklofske, 1998; Rimm et al., 2008; Volker & Phelps, 2004; Watkins, Greenawalt, & Marcell, 2002; Winner, 2000). As an alternative to the FSIQ score, Prifitera et al. (1998) proposed the General Ability Index (GAI) for use with the WISC–III. On the WISC–IV, the GAI consists of the three core verbal comprehension subtests (Similarities, Vocabulary, and Comprehension) and the three core perceptual reasoning subtests (Block Design, Matrix Reasoning, and Picture Concepts). Because calculation of the GAI does not include the working memory or processing speed subtests, it represents a composite measure of cognitive ability that, in comparison with the FSIQ, minimizes the impact of working memory and processing speed.

In support of the GAI, Watkins et al. (2002) used exploratory factor analysis with a sample of 505 gifted students given the WISC–III. Those researchers identified a two-factor model mirroring the Verbal Comprehension and Perceptual Organization indexes. In the factor analysis, the Coding and Arithmetic subtests did not load highly on either factor. Because the subtests measuring processing speed (Coding) and working memory (Arithmetic) did not load on the two primary factors, the researchers recommended the GAI instead of the FSIQ in determining eligibility for gifted programming and services (Watkins et al., 2002).

The GAI also offers some benefits over the FSIQ as an overall summary of intelligence. First is the expediency of administration. Ryan, Glass, and Brown (2007) measured the administration time of the 10 core subtests for the FSIQ (M = 72 min) versus the six core tests for the GAI (M = 56 min). The difference represents an approximate 22% decrease in administration time. Second, twice-exceptional learners, or gifted children who also have a co-occurring disability, may have a better chance of being identified as gifted using the GAI. Children with specific learning disabilities and attention disorders often earn lower scores on working memory and speed of processing tasks (Saklofske, Prifitera, Weiss, Rolfhus, & Zhu, 2005). As a result, the GAI would tend to be higher than the FSIQ.

Although recommendations for calculating the GAI have appeared in several sources (Dumont & Willis, 2004; Flanagan & Kaufman, 2004; Raiford, Weiss, Rolfhus, & Coalson, 2005; Saklofske et al., 2005), there is little published research on the GAI. Raiford et al. (2005) provide tables for determining a statistically significant difference between the GAI and FSIQ as well as percentages of children evidencing various discrepancies in FSIQ and GAI scores, but this information was obtained with the standardization sample and not with gifted students. Saklofske et al. (2005) published a table with predicted achievement scores, given a certain GAI score, but this information was also based on a normative sample. In fact, we found no peer-reviewed research examining the degree to which the GAI predicts achievement among a sample of high-achieving students.

Related to the issue of the GAI is the question of the extent to which the individual WISC–IV index scores uniquely predict achievement above the predictive power of the remaining scores among high-achieving students. If, for example, the WMI and PSI scores do not predict achievement test scores above and beyond the VCI and PRI, their use (independently or in the FSIQ score) seems redundant. Again, there appears to be no research addressing this question. With a linked standardization sample, Konold (1999) found that WISC–III VCI, the Freedom From Distractibility Index (FDI), and the PSI all predicted reading achievement scores. In addition, all four WISC–III index scores predicted math achievement scores. At the same time, the incremental variance that the PSI contributed in both sets of equations was less than 2%, and the WISC–IV is a substantially different test from the WISC–III. Thus, the predictive power of the WISC–IV WMI and PSI scores with high-achieving students remains unknown.

Goals of Current Study

The current study, then, had two objectives. The first was to compare the degree to which the FSIQ and GAI predict academic achievement in math and reading among a group of children referred for cognitive testing. All students received testing as part of the application process for gifted and talented (GT) programming in their schools, and all evidenced significant variability among their index scores on the WISC–IV. The lack of such a comparison seems an oversight, given the frequent recommendations for use of the GAI in the identification of gifted students (e.g., National Association for Gifted Children, 2008b; Rimm et al., 2008). Because of the emphasis in the literature on verbal and reasoning skills in the assessment of gifted children (Rimm et al., 2008; Sparrow, Pfeiffer, & Newman, 2005) and findings of lower mean scores for processing speed and working memory (Hagmann-von Arx et al., 2008; Rimm et al., 2008; Wechsler, 2003b), we expected that the GAI would be the better predictor of achievement scores. A second goal was to examine the extent to which each of the four index scores on the WISC–IV uniquely predicts math and reading achievement for these students. This would answer the question of whether or not the WMI and PSI contribute to the prediction of achievement above and beyond the VCI and PRI.

Method

Participants

The participants in this study were 88 elementary-age children who received individual, cognitive evaluations at a university training clinic during the previous year. The university training clinic is located in the suburbs of a metropolitan area in the mid-Atlantic region of the United States. The clinic typically conducts roughly 500 cognitive evaluations a year as part of the application process for GT programming in the local schools.

Children were selected to participate if the index scores on their cognitive evaluation with the WISC–IV met the criteria set forth by Flanagan and Kaufman (2004) for interpretation of the GAI instead of the FSIQ score. These criteria include substantial variability (>23 points) between the lowest and highest index scores and no substantial difference (<23 points) between the VCI and PRI. These criteria match those in Raiford et al. (2005).

We initially identified 185 students who met criteria for inclusion in the study, and we reached 120 parents. Nine parents declined to have their children participate, and we were unable to schedule testing with 23. Thus, our participation rate from those we contacted was 73%.

The participating children were between the ages of 6 and 12 years old. The mean age of the participants was approximately 8 years 8 months. Of the 88 participants, 59 were boys and 29 were girls, which is 67% and 33%, respectively. Parents provided information about their child's race or ethnicity. Sixty-six percent indicated Caucasian, 18% Asian, 2% Hispanic, 1% African American, and 5% other. The remaining 8% did not answer the questions about race or ethnicity. In addition, 25% of parents indicated that a language other than, or in addition to, English was spoken at home. Russian, Tamil, Korean, Spanish, and Urdu were among the languages listed. Ninety-four percent of parents responded to questions about their own level of education. Of the 94%, all households had at least one parent who attended college. The average parental education was 17.9 years. The most common parental occupation was engineer (16%), and the second most common was attorney (14%). Therefore, this sample was a high socioeconomic status sample, but the demographic data are representative of the surrounding counties. In the proximal county, 68% of the residents are Caucasian, non-Hispanic, and a total of 38% of residents speak a language at home other than English (Fairfax County, VA, Government, n.d.). In addition, 78% of the county's residents have attended some college.

Instruments

The WISC–IV is an individually administered measure for the assessment of children's cognitive ability or abilities (Wechsler, 2003a). Information supporting the reliability and validity of the WISC–IV is available in the *WISC–IV Technical and Interpretative Manual* (Wechsler, 2003b). Briefly, the overall internal consistency of the FSIQ score with the normative sample was .97. The overall internal consistency values for the four index sores with the normative data were .94 (VCI), .92 (PRI), .92 (WMI), and .88 (PSI). The confirmatory factor analyses supported the four-factor structure of the instrument (root mean square error of approximation = .04, Tucker–Lewis index = .98). The high correlations with other measures of intelligence also supported the validity.

The WISC–IV consists of 10 core subtests and provides a FSIQ score, four composite index scores, and the possibility of calculating the GAI. The four composite scores are the VCI, the PRI, the WMI, and the PSI. For this study, the FSIQ and index scores were calculated in the traditional manner recommended in the *WISC–IV Administration and Scoring Manual* (Wechsler, 2003a). The GAI was derived using the procedure and tables provided in Raiford et al. (2005).

Achievement was measured with the Wechsler Individual Achievement Test—Second Edition (WIAT–II; Psychological Corporation, 2001). The WIAT–II is an individually administered achievement test. The nine subtests combine to yield four composite scores. To minimize the time for study participants, we decided to administer an abbreviated achievement battery. As a result, only subtests contributing to the reading and mathematics composites were administered. We selected these two composites as math and reading are universally recognized by educators as key academic areas. Information supporting the reliability and validity of the WIAT–II is provided in the examiner's manual for the WIAT–II (Psychological Corporation, 2001). The average split-half reliability for the reading and math composites were .98 and .95, respectively. The WIAT–II also evidenced high correlations with other achievement measures.

Procedure

Cognitive testing had already taken place at parents' request by trained graduate students or clinic staff at the university training clinic within the previous year. At the time of cognitive testing, potential participants' parents signed a consent form for the cognitive assessment as well as for their child's results to be used in possible future research. All files over the previous year with consent for research participation were reviewed, and the parents of children whose results met criteria for interpretation of the GAI were contacted. We then attempted to schedule the WIAT–II achievement testing with interested parents. Achievement testing took place at the university training clinic with trained current and former graduate students in school psychology. All student examiners had completed graduate-level training in assessment. Administration of the reading and math sections of WIAT–II took approximately 45 min. The time between the cognitive and achievement testing ranged from 4 to 15 months.

Data Analysis

For the initial analyses, we conducted a series of four simple regressions. The first regression analyses determined the degree to which the FSIQ or the GAI score predicted achievement scores. Thus, the FSIQ and GAI served as the independent variables, and WIAT–II reading and mathematics composite scores were the dependent variables. We also examined the interaction of the FSIQ and the GAI with sex for both dependent variables. Following those initial regression analyses, we conducted a set of sequential regression analyses with the four factor index scores of the WISC–IV as predictors. We sought a sample of approximately 84 students to meet Cohen's (1992) recommendation for statistical power to detect a medium effect size in a regression with four predictors. Given the limitations of power due to our sample size, we did not consider the interaction of the four index scores by sex. All analyses were calculated using SPSS 15.

Results

The basic descriptive statistics for each measure are presented in Table 1. As indicated in Table 1, the means for the VCI and PRI fall within the Superior range. The WMI mean is in the High Average range, and the PSI mean is in the Average range.

We also computed the correlations among the WISC–IV and WIAT–II composite scores (see Table 2). As the correlation values reveal, the VCI, PRI, and WMI were all significantly correlated with both reading and math scores on the WIAT–II. For this sample, the only WISC–IV index that was not significantly correlated with achievement was the PSI. Examination of Table 2 also shows that, among the WISC–IV index scores, Working Memory had the highest correlation with the WIAT–II reading and math scores.

We next calculated the regression equations with the FSIQ score as the predictor. In the first regression, the FSIQ score significantly predicted reading achievement, $\beta = .59$, $t(86) = 6.74$, $p < .01$. The interaction between the FSIQ and sex was not significant, $\beta = -.07$, $t(85) = -.80$, $p = .43$. As noted in Table 3, the FSIQ also explained a significant proportion of variance in reading scores, $R^2 = .35$, $F(1, 86) = 45.43$, $p < .01$. In the second regression, the FSIQ score significantly predicted math achievement scores, $\beta = .47$, $t(86) = 4.95$, $p < .01$. Likewise, the FSIQ explained a significant proportion of the variance in math scores, $R^2 = .22$, $F(1, 86) = 24.54$, $p < .01$ (see Table 3). Again, the interaction with sex was not significant, $\beta = -.04$, $t(85) = -0.38$, $p = .71$.

Using the GAI as the predictor resulted in a similar pattern. The GAI scores significantly predicted reading scores, $\beta = .50$, $t(86) = 5.32$, $p < .01$, and explained a significant proportion of variance in reading scores, $R^2 = .25$, $F(1, 86) = 28.30$, $p < .01$. GAI scores also significantly predicted math scores, $\beta = .43$, $t(86) = 4.40$, $p < .01$, and explained a significant proportion of the variance in math scores, $R^2 = .18$, $F(1, 86) = 19.36$, $p < .01$. The interaction of the GAI by sex was not significant for either reading, $\beta = -.03$, $t(85) = -0.35$, $p = .73$, or math scores, $\beta = -.002$, $t(85) = -0.02$, $p = .98$.

Thus, both the FSIQ and GAI scores significantly predicted reading and math scores on the WIAT–II, and the interactions with sex were not significant. Both scores also accounted for a significant proportion of the variance in achievement scores. However, the R^2 values presented in Table 3 reveal that the FSIQ accounted for a greater proportion of the variance in both reading and math scores.

The second goal of this study was to determine the extent to which each of the individual index scores on the WISC–IV uniquely predicted reading and math achievement scores for this sample. To do this, we used sequential regression equations to ascertain how the addition of each WISC–IV index score affected the prediction of the dependent variable, first for reading and then for math. The index scores were entered into the regression equations based on their correlation with the dependent variable. The order was the same for both reading and math scores (WMI, VCI, PRI, and PSI). Table 4 displays the results of the regression equations for reading achievement.

As indicated in Table 4, the WMI and VCI accounted for significant, unique variance in reading achievement scores, even with all WISC–IV index scores in the regression equation. Together, these two sets of scores ac-

Table 1
Descriptive Statistics for WISC–IV and WIAT–II Composites

Composite	Mean	*SD*	Skew	Kurtosis
WISC VCI	127.00	9.43	−.20	−.48
WISC PRI	123.53	9.99	−.35	.61
WISC WMI	111.38	11.26	.14	.28
WISC PSI	100.97	11.20	.10	.11
WISC FSIQ	122.44	8.38	−.37	.21
WISC GAI	129.67	9.35	−.05	.20
WIAT Reading	121.30	11.01	−.22	.49
WIAT Math	125.95	15.32	.12	.03

Note. WISC–IV = Wechsler Intelligence Scale for Children–Fourth Edition; WIAT–II = Wechsler Individual Achievement Test—Second Edition; VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; FSIQ = Full Scale IQ; GAI = General Ability Index.

Table 2
Correlations Among Composite Scores

Variable	VCI	PRI	WMI	PSI	Reading	Math	GAI	FSIQ
VCI	1.00							
PRI	.28**	1.00						
WMI	.25*	.31**	1.00					
PSI	.34**	.36**	−.12	1.00				
Reading	.46**	.37**	.57**	.16	1.00			
Math	.36**	.35**	.39**	.14	.58**	1.00		
GAI	.77**	.82**	.32**	.47**	.50**	.43**	1.00	
FSIQ	.71**	.78**	.53**	.59**	.59**	.47**	.93**	1.00

Note. VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; GAI = General Ability Index; FSIQ = Full Scale IQ.
* $p < .05$. ** $p < .01$.

counted for 45% of the variance in reading scores. Between the two, WMI scores accounted for 32% of the variance, and the addition of VCI scores resulted in an increase of 11%. The addition of PRI and PSI scores accounted for only an additional 2% of the variance, and the increase in R^2 was not significant for either the PRI or the PSI.

We employed a similar set of analyses for the prediction of math scores. Table 5 displays the results of the regression equations for math. Again, the WMI and the VCI were the two index scores that significantly predicted achievement scores in math. As the R^2 values indicate, WMI scores accounted for 15% of the variance and the VCI scores for 8%. The PRI scores accounted for an additional 3% of the variance, but this increase was not significant. The variance accounted for did not increase substantially with the addition of PSI scores.

Discussion

Although the present sample consisted of students referred for GT testing, and all students were not identified as gifted, the pattern of cognitive scores is relatively similar to that of other samples of cognitively gifted students (Hagmann-von Arx et al., 2008; Wechsler, 2003b). The current finding of lower means for the WMI and PSI is consistent with the sample of children identified as intellectually gifted in the *WISC–IV Technical and Interpretive Manual* (Wechsler, 2003b), as well as with other published scores for samples of gifted children (Rimm et al., 2008). In the WISC–IV sample, however, the mean for the PSI was 110.6, whereas the mean for our sample was 100.97.

Table 3
Variance Accounted for by Full Scale IQ (FSIQ) and General Ability Index (GAI)

	R^2	
Predictor composite	Reading composite	Math composite
FSIQ	.35**	.22**
GAI	.25**	.18**

** $p < .01$.

Table 4
Sequential Regression of Reading Achievement Scores on WISC–IV Index Scores

Model	β	R^2	R^2 change
Step 1			
WMI	.57**	.32	.32**
Step 2			
WMI	.48**		
VCI	.34**	.43	.11**
Step 3			
WMI	.45**		
VCI	.31**		
PRI	.15	.45	.02
Step 4			
WMI	.47**		
VCI	.28**		
PRI	.12		
PSI	.08	.45	.00

Note. WISC–IV = Wechsler Intelligence Scale for Children–Fourth Edition; WMI = Working Memory Index; VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; PSI = Processing Speed Index.
** $p < .01$.

Table 5
Sequential Regression of Math Achievement Scores on WISC–IV Index Scores

Model	β	R^2	R^2 change
Step 1			
WMI	.39**	.15	.15**
Step 2			
WMI	.32**		
VCI	.28**	.23	.08**
Step 3			
WMI	.27**		
VCI	.24*		
PRI	.20	.26	.03
Step 4			
WMI	.27*		
VCI	.23*		
PRI	.20		
PSI	.02	.26	.00

Note. WISC–IV = Wechsler Intelligence Scale for Children—Fourth Edition; WMI = Working Memory Index; VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; PSI = Processing Speed Index.
* $p < .05$. ** $p < .01$.

At the same time, it is important to note that our sample was specifically selected because of the variability in their index scores, as all met criteria for interpretation of the GAI. Thus, the finding of a lower score on the PSI is not surprising. Moreover, Rimm et al. (2008) presented mean scores for a sample of 103 students from the Gifted Development Center, and the mean PSI score for that sample was 104.3.

The results of the initial regression analyses revealed that both the FSIQ and GAI significantly predicted scores in reading and math, and the slopes of the regression lines for all four regressions were the same for boys and girls. However, examination of the R^2 values showed that the FSIQ accounted for more of the variance in both reading and math. This finding was contrary to our expectation that the GAI would be a better predictor for students with significant variability in their scores because it reduces the impact of working memory and processing speed.

Examination of the correlations among the variables, however, provided further information about the relationships among the cognitive variables and reading and math scores. The VCI, PRI, and WMI were all significantly correlated with achievement scores, whereas the associations of the PSI and achievement scores were not significant. Given the lack of significant correlations for the PSI, it follows that the PSI added nothing to the prediction of reading and math scores in the sequential regression analyses. These findings, then, support the contention that processing speed may not be an important indicator of cognitive ability for high-achieving students, particularly for those with significant variability among their index scores.

Another finding from the correlation matrix was that the WMI had a higher correlation with reading and math scores than either the VCI or the PRI. In fact, for both of the sequential regressions, the PRI did not significantly predict reading or math scores over and above the contribution of the WMI and the VCI. On the other hand, working memory scores explained 32% of the variance in reading scores and 15% of the variance in math scores. These results explain the finding that the FSIQ predicted achievement scores better than the GAI. Calculation of the FSIQ includes the WMI and PSI scores. Whereas the PSI did not significantly predict either reading or math, inclusion of WMI scores appears to account for the finding of the FSIQ as a better predictor. It is also interesting to note that the correlation between the WMI and the PSI scores was not significant. Thus, although composite scores for working memory and processing speed tend to be lower than those for verbal and reasoning abilities among gifted students (Wechsler, 2003b), in this sample, they did not vary together.

The connections between working memory and achievement in reading and math have been documented in other samples of children (e.g., Evans, Floyd, McGrew, & Leforgee, 2001; Floyd, Evans, & McGrew, 2003; Swanson & Jerman, 2006; Swanson, Zheng & Jerman, 2009). For example, Swanson and Jerman (2006) found differences in verbal working memory between students with math disabilities and average-achieving students. In addition, Swanson et al. (2009) highlighted the fact that working memory problems often differentiate students with reading difficulties from students without reading problems. Among students of varying abilities from the Woodcock–Johnson III (Woodcock, McGrew, & Mather, 2001) standardization sample, Evans et al. (2001) examined the relationship between cognitive abilities and reading achievement, and Floyd et al. (2003) investigated the relationship of cognitive abilities and math achievement. In these two studies, measures of working memory evidenced moderate to strong relationships with reading and math achievement. Thus, it is not completely unexpected that working memory was a strong predictor of reading and math achievement in the current sample.

Implications

The present findings clearly have implications for the criteria used to select students for GT programming in schools, but at the same time, the criteria for choosing students for GT programming also depend on the goals of the assessment. If the goal is simply to identify cognitively gifted children, then the criteria could be a score above a certain threshold on a composite measure of intelligence. In this case, the composite used could be the FSIQ, the GAI, or any of the four individual index scores. Rimm et al. (2008), for instance, recommend that either the FSIQ or the GAI should be accepted for application to gifted programs. They go on to say that either the VCI or the PRI could also be used separately, given the emphasis on reasoning abilities and strong loadings on *g*, the general intelligence factor, for these two index scores. However, if the goal is also to identify children who would be predicted to best meet the challenge of advanced or accelerated programming in reading or math, then the results of this study imply slightly different criteria for students with significant variability among their index scores. In terms of prediction, our results suggest use of a composite that includes at least the VCI and WMI. In spite of the potential advantages of the GAI, the FSIQ was the better predictor of achievement in this sample. At the same time, for students with significant variability among their index scores, the PSI does not appear to be linked with measures of achievement in math or reading.

It should be noted that we are not advocating the use of a single criterion or score for the identification of gifted students. Like the National Association for Gifted Children (2008a), we feel that multiple sources of information provide a more comprehensive view of a child. What we suggest is that if scores from a cognitive test are among the criteria used to identify students for advanced or accelerated academic programming, the scores that best predict academic achievement seem the most appropriate candidates.

Limitations of the Study

There are aspects of this study that limit the generalizability of the findings. To begin, we reiterate that our sample consisted only of students with significant variability among their index scores who met the criteria for calculation of the GAI (Flanagan & Kaufman, 2004). Thus, the extent to which these findings apply to students assessed for GT programming who do not demonstrate significant variability among their index scores is unknown. Second, although the students in our sample ranged from 6 to 12 years old, the majority were tested with a cognitive measure in second grade and an achievement measure in third grade. As a result, it is unclear whether the findings apply equally to younger students and older students. An additional limitation was in the “giftedness” of the sample. The students included in the study were referred for testing as part of an application for gifted programming, but this did not necessarily mean they were, in fact, gifted. Both the mean FSIQ and mean GAI for the current sample were below or slightly below the generally accepted IQ score for giftedness, which is 2 standard deviations above the mean (Wechsler, 2003b; Winner, 2000).

A final limitation of the study concerns twice-exceptional learners. As numerous writers have observed (e.g., Morrison & Rizza, 2007; Nielsen, 2002), the identification of twice-exceptional learners is complex. Part of the complexity arises from the fact that twice-exceptional learners can have abilities or develop competencies that mask their disability, and they can have disabilities that mask their giftedness. Moreover, the aggregation of test scores can result in an average profile (Nielsen, 2002; Rimm et al., 2008). Because participants in our study did not undergo a comprehensive evaluation, we do not know how many, if any, were twice-exceptional. At this point, then, we are unable to make conclusions based on empirical findings about how our results apply to twice-exceptional learners.

Future Research

Although these limitations exist, they also provide potential directions for future studies. For example, we plan to investigate the predictive power of the four index scores among a sample of students referred for GT programming who do not demonstrate significant variability among their index scores on the WISC–IV. Two important questions in such a study would be whether or not the WMI continues to be the strongest predictor and whether or not the PSI is significantly associated with achievement scores for these students. We would also like to collect further data for separate samples of younger and older students who do demonstrate variability in their scores. One of the major findings of this study was the importance of working memory in predicting reading achievement. Reading, however, typically varies drastically based on the age of the student. With samples of different ages, we could determine whether the current results apply equally to younger and older students. A final possibility would be to replicate the study with students who were designated as gifted.

Conclusions

In the current study we sought to answer several questions about the degree to which comprehensive scores or measures of cognitive abilities predict skills in reading and math for high-achieving students who evidence significant variability among their index scores on the WISC–IV. We found that between the FSIQ and the GAI, the FSIQ is the better predictor. One could argue, however, that neither the FSIQ nor the GAI is the best option to summarize the intelligence of gifted students with significant variability in their scores. Given that the PSI was not associated with scores in reading or math, it seems as though individual index scores or a summary score that includes at least measures of verbal comprehension and working memory would actually be the most succinct and powerful predictors. Despite the inherent limitations, we feel that the current study makes an important contribution to the literature regarding the assessment of cognitive abilities with high-achieving students.

More important, we believe that the results have implications for professionals and parents alike who are involved in the GT selection process. For school psychologists, in particular, data-based decision making is the guiding principle of our profession. The results from this study, then, can assist school psychologist in interpreting results for individual students and their parents, as well as in making policy recommendations to the school districts for which they work and with which they consult.

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