Using Two WISC-IV Indices to Identify the Gifted

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Whenever a new version of an IQ test is released, it is necessary to determine its effectiveness in identifying gifted students. The *Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV)*, released in August of 2003, is structured in a significantly different manner from its predecessor, the *WISC-III*. The Verbal and Performance sections have been replaced by four indices: Verbal Comprehension, Perceptual Reasoning, Working Memory and Processing Speed. Object Assembly, Picture Arrangement and Mazes have been removed. Word Reasoning, Matrix Reasoning, Picture Concepts, Letter-Number Sequencing and Cancellation have been added. The Arithmetic subtest, which is now a supplementary subtest, has been altered so that subjects are given only 30 seconds to answer each item and none of the items for older children is presented visually. It is clustered with the tests of Working Memory, although it loads heavily on fluid reasoning (Keith, Fine, Taub, Reynolds & Kranzler, 2004).

The *WISC-IV* allows substantially more time for responses than the *WISC-III*, which benefits gifted students but adds administration time. It also has added more difficult items for better differentiation in the higher IQ ranges. There are now 15 subtests: 10 required and 5 optional. Substitutions of optional tests are allowed, which gives the test greater flexibility; however, the long administration time will discourage school psychologists from giving the optional tests.

The norms for 63 gifted students reported in the *Technical Manual* are significantly lower on the *WISC-IV* than on previous IQ tests. The mean Full Scale score of the gifted group was 123.5; Verbal Comprehension Index, 124.7; Perceptual Reasoning Index, 120.4, Working Memory Index, 112.5 and Processing Speed Index, 110.6. Similar discrepancies between the first two and last two indices have been revealed in our sample at the Gifted Development Center in Denver, Colorado. When the 15 subtests are ranked from highest to lowest for the gifted sample, it is apparent that five of the six subtests that produced the lowest scores for the gifted group are required to obtain a Full Scale IQ score, whereas four of the five optional subtests, unlikely to be administered due to time constraints, yield scores among the highest of the gifted group (Flanagan & Kaufman, 2004). The subtests on which the gifted sample scored the lowest make up the Working Memory and Processing Speed Indices.

Should the cutoff scores for gifted programs be reduced when using the *WISC-IV* Full Scale IQ scores for selection? Alternatively, are Verbal Comprehension and the Perceptual Reasoning Indices more appropriate for assessing giftedness than Working Memory and Processing Speed Indices? The purpose of this paper was to address these questions with results of assessments of 103 gifted children.

In a presentation given last year to the Research and Evaluation Division of the National Association for Gifted Children (Falk, Silverman & Moran, 2003), we compared IQ scores on the *WISC-III* and the *Stanford-Binet Intelligence Scale (Form L-M) (SBL-M)* for a stratified random sample of 120 cases in four IQ ranges from the clinical files of the Gifted Development Center. The *SBL-M*, which has a higher ceiling, generated significantly higher scores than the *WISC-III*, particularly in the highest IQ ranges. In that study, any inflation caused by the Flynn Effect (Flynn, 1999) was corrected at the rate of 0.3 per year for an estimated 3 decades; a total of 9 points was subtracted from each SBL-M score. Based on this analysis, we recommended the continued use of the *SBL-M* as a supplemental test for children who attain scores near the ceiling of the Wechsler scales, in order to be able to identify children in the highly, exceptionally, and profoundly gifted ranges.

In the past year, we administered the *SBL-M* to children who obtained 2 or more scores of 17, 18 or 19 on the *WISC-IV*. At the time of writing the proposal for this presentation, we anticipated that at least 100 children would take the *WISC-IV* and that 40% of our sample would be given the *SBL-M* as a supplemental test. The data on 103 cases were analyzed to determine the rank order of indices and subtests of the *WISC-IV*.

Research Questions

1. Which indices of the *WISC-IV* are the best measures of giftedness?
2. Which subtests of the *WISC-IV* predict higher performance on the *SBL-M*?
3. What cutoff scores should be used for entrance into gifted programs?
4. What cutoff scores should be used for entrance into highly gifted programs?

Research Hypotheses

1. The Verbal Comprehension Index will provide the highest score among the indices.
2. The Perceptual Reasoning Index will provide the second highest score among the indices.
3. Subjects with Verbal Comprehension Indices in the gifted range (130 or above) will have Working Memory and Processing Speed scores below the gifted range.
4. Vocabulary, Similarities and Comprehension will predict *SBL-M* Formula IQ scores.
5. Block Design, Matrix Reasoning and Picture Concepts will be the second best set of predictors of *SBL-M* Formula IQ scores.
6. Digit Span and Arithmetic will be the third best set of predictors of *SBL-M* Formula IQ scores.
7. Coding and Symbol Search will be unrelated to *SBL-M* Formula IQ scores.

Methodology

Sample

The Gifted Development Center is a nonprofit, tax exempt agency, which originated in June, 1979, and is now in its 25th year. It is completely supported by fees for services. Most of the families represented are from Caucasian middle and upper-middle class urban backgrounds. Approximately 55% of the clients are from Colorado, 40% are from other states and 5% are from other countries. Parents seek assessment at the Center to determine if their children are eligible for acceptance in special programs for the gifted and to assist them in understanding their children so that they can meet their needs at home and at school. The age range of the children served is 4 through 16; services are also available for adults. The number of children assessed annually ranges between 220 and 450. Several different instruments are used for assessing intelligence.

This study concentrated on the assessment results of 103 children, aged 6-14, who were administered the *WISC-IV*. In addition, a substantial number were administered the *SBL-M* as a supplemental test. When children attained 2 subtest scores at or above the 99th percentile, it was generally recommended that the *SBL-M* be administered as a supplemental test. While we anticipated that at least 40% of the sample would be administered the *SBL-M*, in fact we only have 36 subjects reflecting 35% of the sample.

Data Analysis

The first three hypotheses were answered with descriptive statistics, using rank ordering and tests of mean differences. We had hoped to examine hypotheses 4 through 7 with first order correlations and linear regression analyses, but the results were unstable. Instead, descriptive graphs are used to depict trends.

Results

Research Hypotheses

1. The Verbal Comprehension Index will provide the highest score among the indices.
2. The Perceptual Reasoning Index will provide the second highest score among the indices.

Friedman's test of rank differences for multiple dependent samples and Wilcoxon's Sign Rank Matched Pairs test support these two hypotheses. The results show the mean and rank order differences for all four index scores.

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Verbal Comprehension Index Composite Score	103	131.69	13.924	85	155
Perceptual Reasoning Index Composite Score	103	126.42	11.666	100	149
Working Memory Index Composite Score	103	117.65	11.842	94	144
Processing Speed Index Composite Score	103	104.33	14.148	73	147

Ranks

	Mean Rank
Verbal Comprehension Index Composite Score	3.48
Perceptual Reasoning Index Composite Score	3.01
Working Memory Index Composite Score	2.22
Processing Speed Index Composite Score	1.29

Test Statistics[a]

N	103
Chi-Square	172.909
df	3
Asymp. Sig.	.000

a. Friedman Test

The Friedman test shows that there is an overall difference between the four indices. To test for the individual differences the Wilcoxon test is reported below. Here we see that the Verbal Comprehension Index Score is significantly higher than the Perceptual Reasoning, Working Memory, and Processing Speed Indices. The Perceptual Reasoning Index Score is significantly higher than the Working Memory and Processing Speed Indices, and the Working Memory Index Score is significantly higher than the Processing Speed Index.

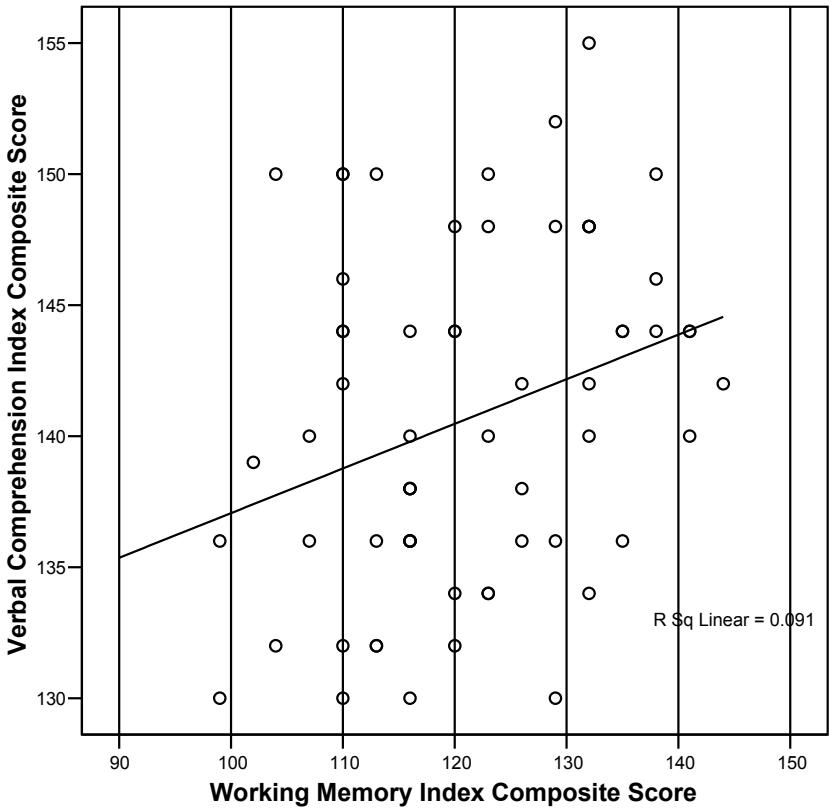
Test Statistics[b]

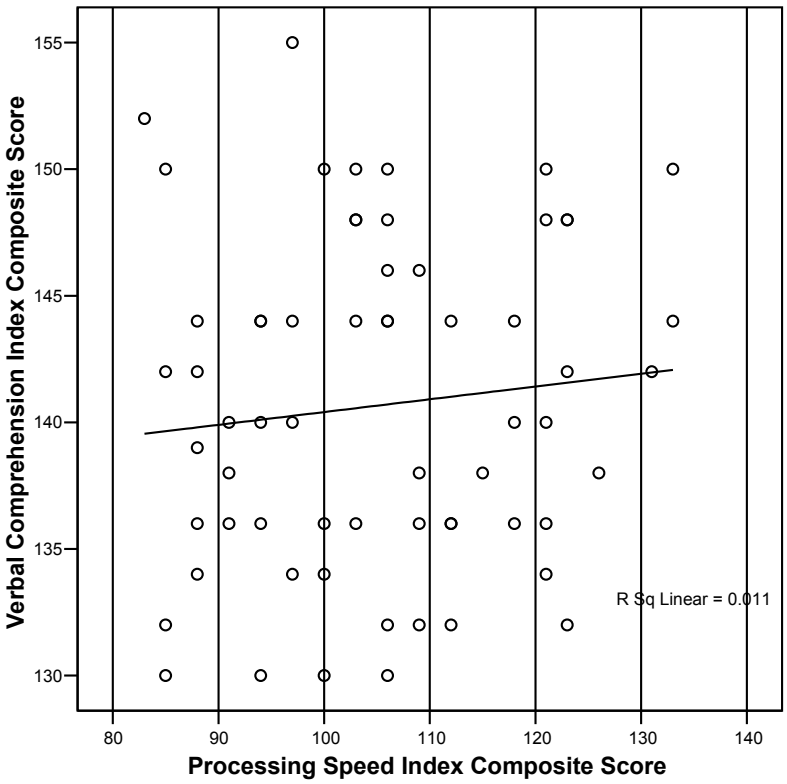
	Perceptual Reasoning Index Composite Score - Verbal Comprehension Index Composite Score	Working Memory Index Composite Score - Verbal Comprehension Index Composite Score	Processing Speed Index Composite Score - Verbal Comprehension Index Composite Score	Working Memory Index Composite Score - Perceptual Reasoning Index Composite Score	Processing Speed Index Composite Score - Perceptual Reasoning Index Composite Score	Processing Speed Index Composite Score - Working Memory Index Composite Score
Z	-3.649[a]	-7.375[a]	-8.353[a]	-6.083[a]	-8.414[a]	-6.911[a]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Hypothesis 3 states that subjects with Verbal Comprehension Indices in the gifted range (130 or above) will have Working Memory and Processing Speed scores below the gifted range. The following two graphs vividly portray the empirical support for this hypothesis.





Chi-square analyses for the 63 subjects with Verbal Comprehension indices in the gifted range clearly support the third hypothesis. In the following tables, the value 1 reflects index scores below 130 and value 2 reflects index scores at 130 and above. As can be clearly seen, subjects who scored in the gifted range on the Verbal Comprehension index often did not score in the gifted range on the Working Memory or Processing Speed Indices.

Nongifted/Gifted Working Memory Index

	Observed N	Expected N	Residual
1	46	31.5	14.5
2	17	31.5	-14.5
Total	63		

Test Statistics

	Nongifted/Gifted WMI
Chi-Square(a)	13.349
Df	1
Asymp. Sig.	.000

Nongifted/Gifted PSI

	Observed N	Expected N	Residual
1	60	31.5	28.5
2	3	31.5	-28.5
Total	63		

Test Statistics

	Nongifted/Gifted PSI
Chi-Square(a)	51.571
Df	1
Asymp. Sig.	.000

For the following research hypotheses we have too few cases to establish stable predictions and rather than present data which could be misleading we have chosen not to report regression results. In all cases, the standard errors for the unstandardized regression coefficients were too large to establish any significant results.

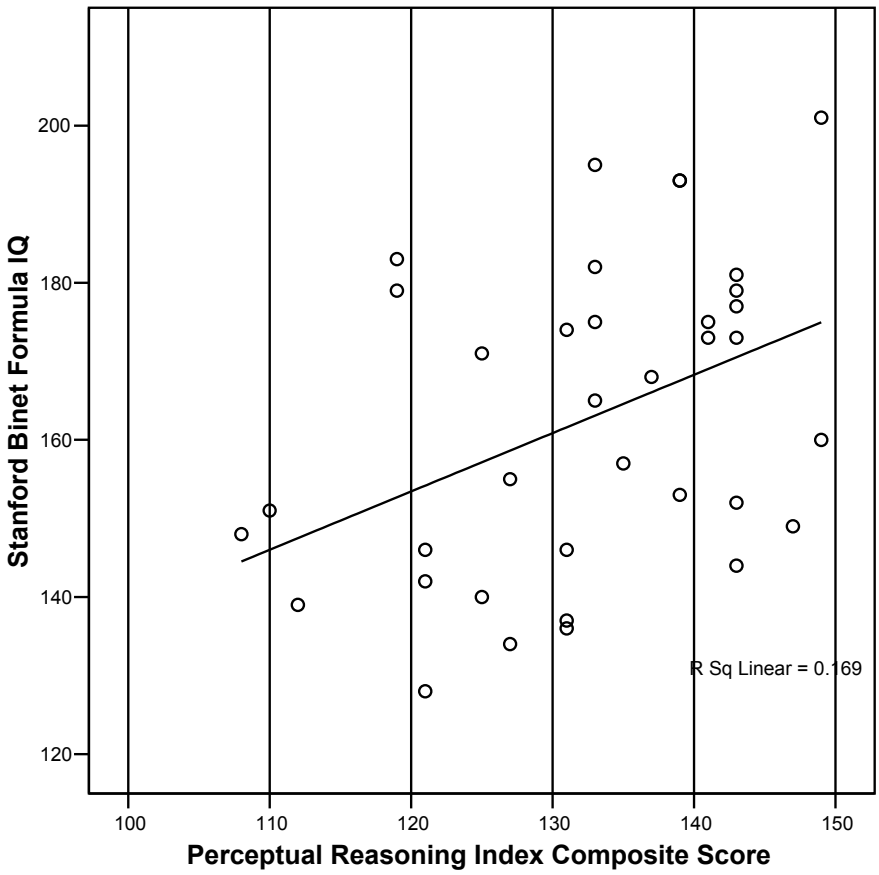
4. Vocabulary, Similarities and Comprehension will predict *SBL-M* Formula IQ scores.
5. Block Design, Matrix Reasoning and Picture Concepts will be the second best set of predictors of *SBL-M* Formula IQ scores.
6. Digit Span and Arithmetic will be the third best set of predictors of *SBL-M* Formula IQ scores.
7. Coding and Symbol Search will be unrelated to *SBL-M* Formula IQ scores

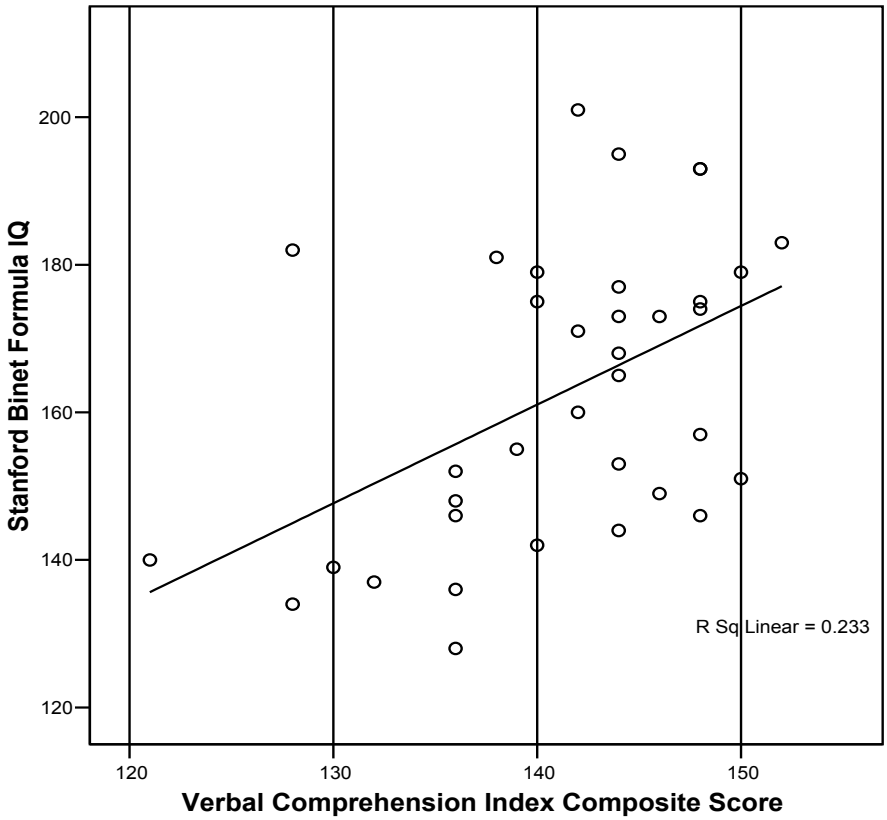
Research Questions

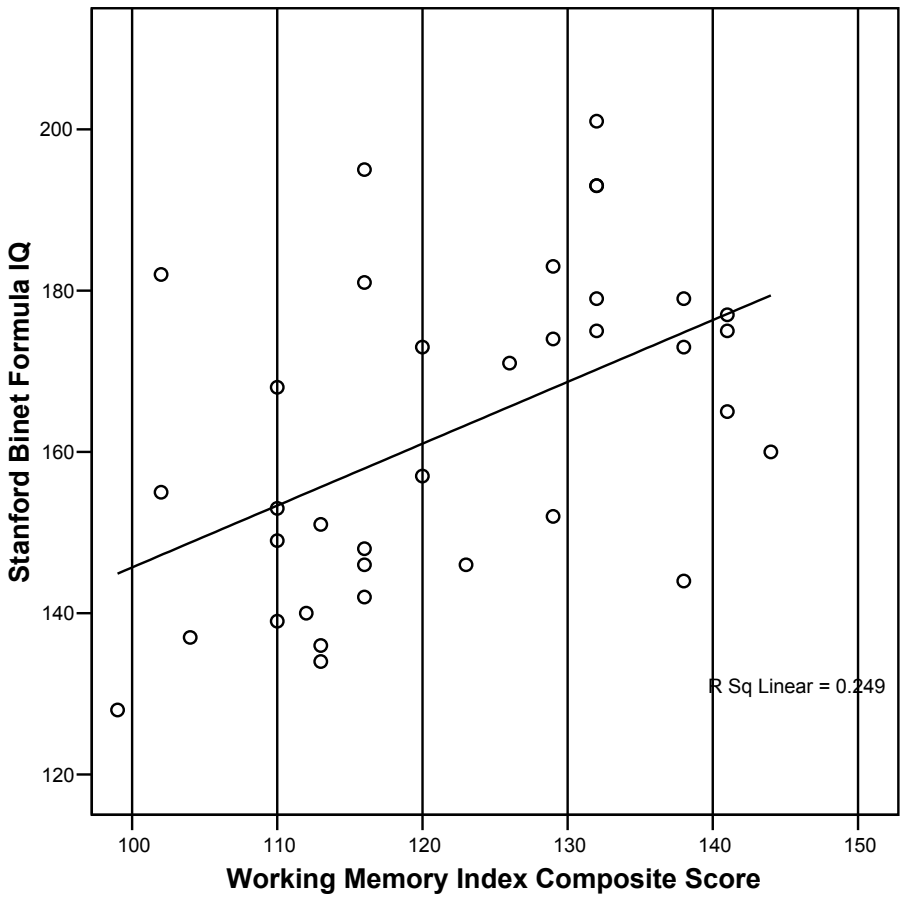
For our first two research questions:

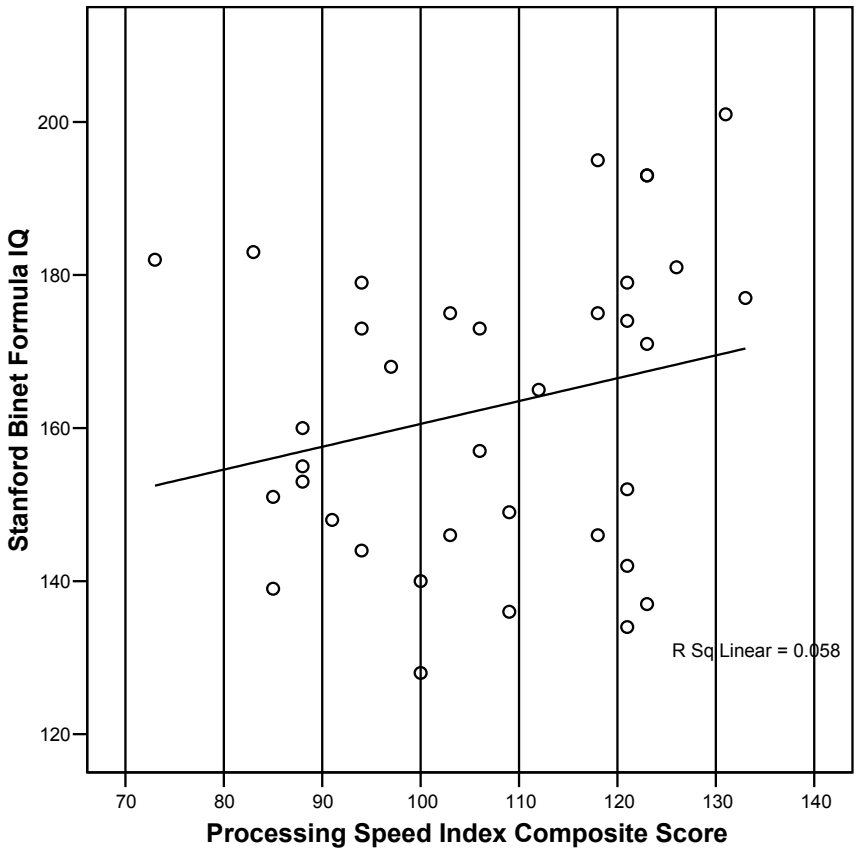
1. Which indices of the WISC-IV are the best measures of giftedness?
2. Which subtests of the WISC-IV predict higher performance on the *SBL-M*?

We can provide some visual graphic information that is suggestive of some answers, but again these are based on only 36 cases. The graphs show the relationship between *Stanford-Binet Intelligence Scale* Formula IQ score (Form L-M) and the Index Scores for the WISC-IV. The answer to the first research question appears to be the Verbal Comprehension Index.


Stanford Binet Formula IQ
200
180
160
140
120
R Sq Linear = 0.169
100
110
120
130
140
150
Perceptual Reasoning Index Composite Score


Stanford Binet Formula IQ
200
180
160
140
120
R Sq Linear = 0.233
120
130
140
150
Verbal Comprehension Index Composite Score


Stanford Binet Formula IQ
200
180
160
140
120
R Sq Linear = 0.249
100
110
120
130
140
150
Working Memory Index Composite Score



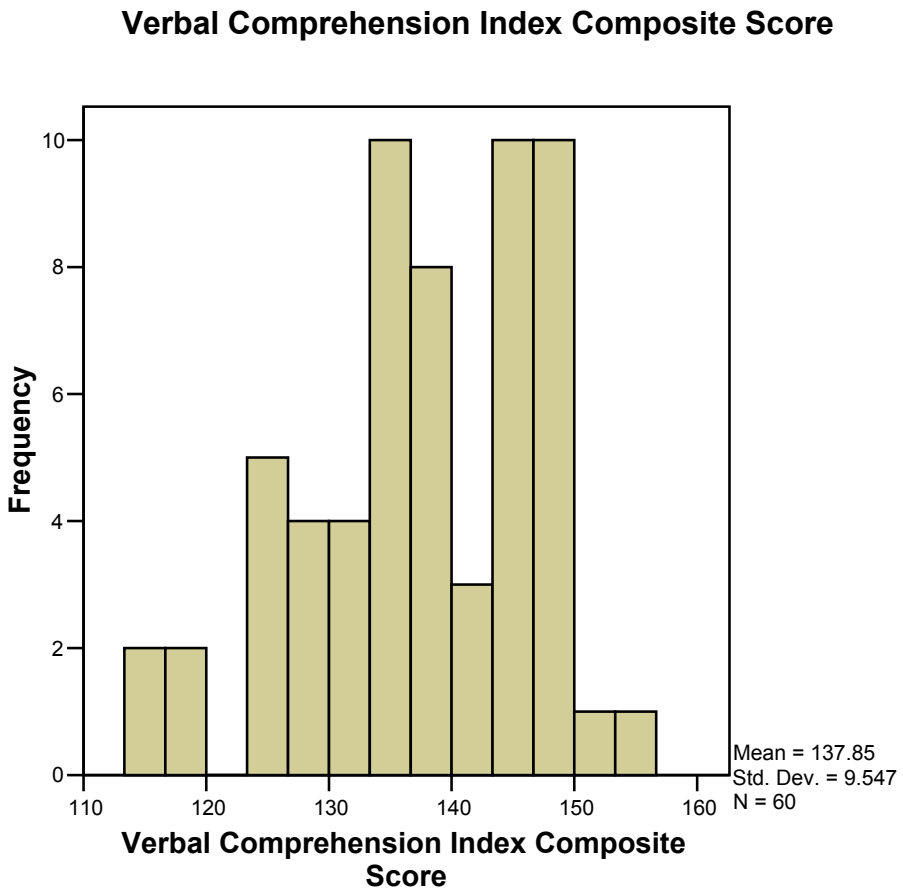
The answer to the first research question appears to be that the Verbal Comprehension Index is the best of the four indices for predicting giftedness.

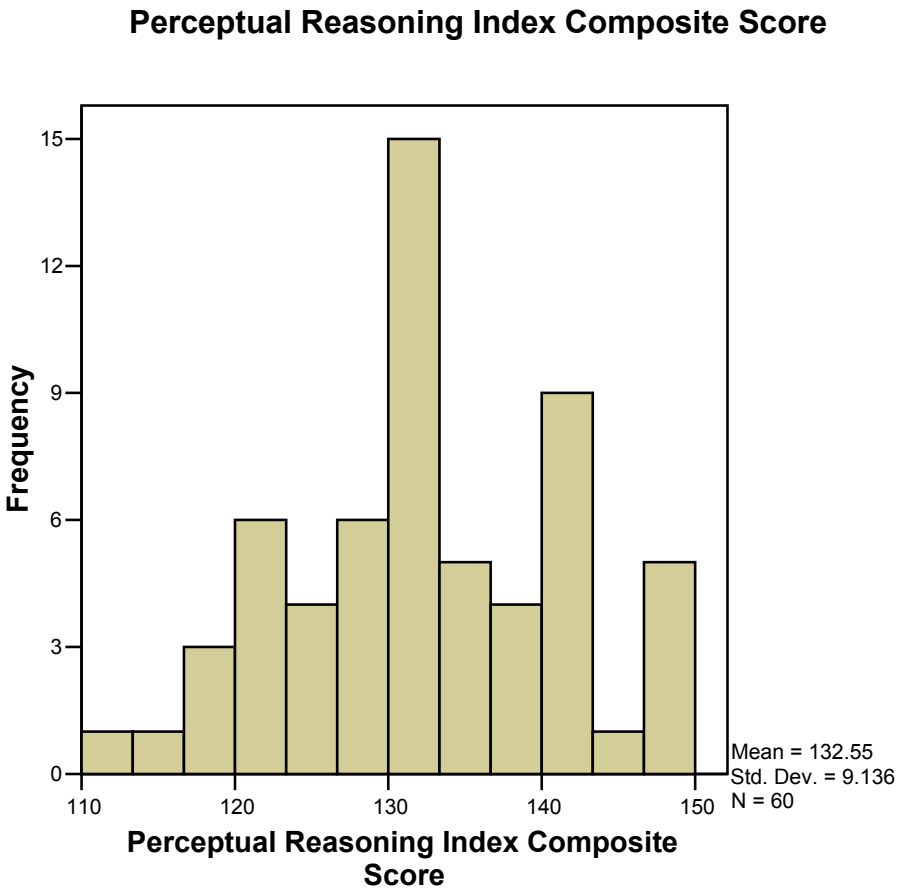
With regard to the second research question preliminary analyses suggest that Arithmetic, Comprehension, Digit Span and Matrix Reasoning appear to predict higher performance on the *SBL-M*. These initial findings, based on only 36 subjects, are necessarily quite tentative. As they are not consistent with the rank order of subtest performance of the full sample, they are likely to be modified considerably when more cases are available. At this time, we have decided to not report actual results, which could be illusory. The last two research questions are still to be resolved with more data:

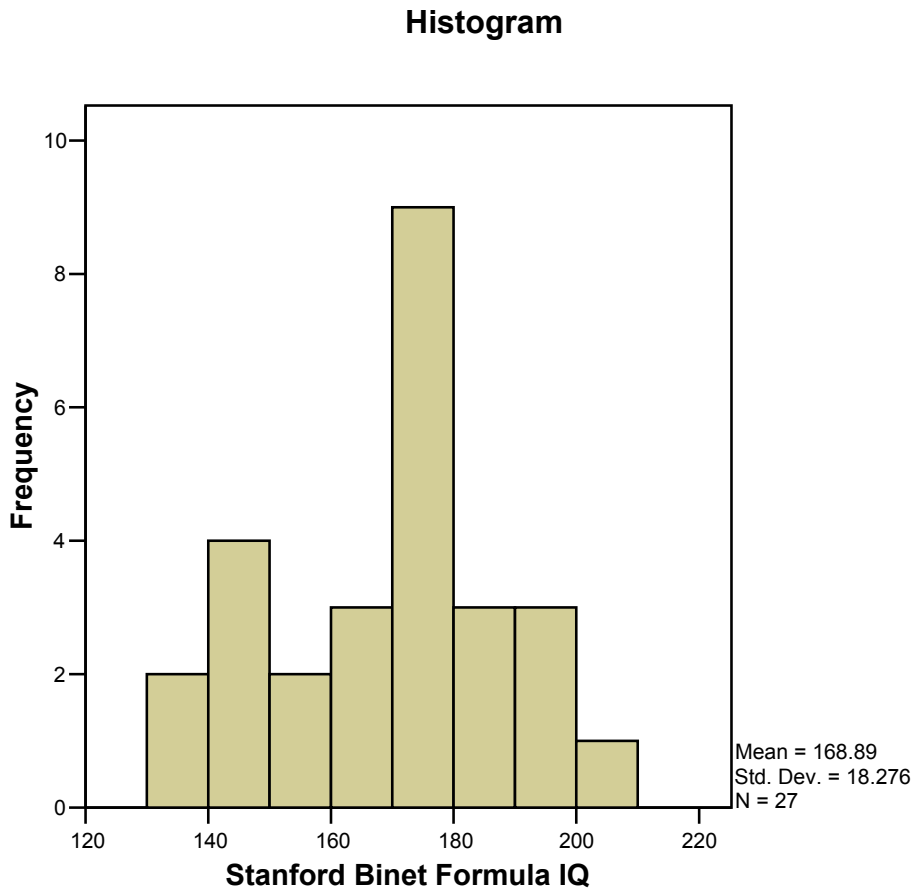
3. What cutoff scores should be used for entrance into gifted programs?
4. What cutoff scores should be used for entrance into highly gifted programs?

However, the following graphs suggest that using the Full Scale IQ Score of 123 on the *WISC-IV* may be a reasonable alternative to using the Verbal Comprehension Index or the Perceptual Reasoning Index. These three graphs demonstrate that when you select subjects with a Full Scale IQ Score of 123.5 and above, the distribution of VCI and PRI scores goes well below the score of 130. Additionally, the Full Scale IQ Score of 123 and above picks up 75% of the subjects who had *SBL-M* Formula Scores of 130 and above.

For those children who had a Full Scale IQ of 123.5 or above:




Perceptual Reasoning Index Composite Score
Frequency
15
12
9
6
3
0
110
120
130
140
150
Mean = 132.55
Std. Dev. = 9.136
N = 60
Perceptual Reasoning Index Composite Score



Conclusion

The *WISC-IV* is a useful test for the gifted population due to its strengths in measuring verbal and visual reasoning; however, it does have drawbacks that adversely affect its ability to adequately locate gifted children for special programs. If the Verbal Comprehension Index and the Perceptual Reasoning Index are combined into a General Ability Index, as suggested by Flanagan and Kaufman (2004) and by recent information from the publisher, Psychological Corporation (Harcourt Assessments), the test increases in power to select gifted students. Alternatively, if the Full Scale IQ requirement for gifted programs is reduced to 123, the test can also find most of the students who would have been selected by either a *WISC-III* or an *SBL-M*. Other measures with higher ceilings, such as the *Stanford-Binet Intelligence Scales*, will need to be administered to locate children for highly gifted programs. These measures, too, will probably require modifications in scoring practices to be fully applicable.

References

Falk, R. F., Silverman, L. K., & Moran, D. M. (2003, November). *WISC-III and Stanford-Binet L-M Scores for gifted children*. Paper presented at the 50th Annual Convention of the National Association for Gifted Children, Indianapolis, IN.

Flanagan, D. P., & Kaufman, A. S. (2004). *Essentials of WISC-IV assessment.* Hoboken, NJ: John Wiley & Sons.

Flynn, J. R. (1999). Searching for justice: The discovery of IQ gains over time. *American Psychologist, 54,* 5-20.

Keith, T. Z., Fine, J. G., Taub, G. E., Reynolds, M. R., & Kranzler, J. H. (2004). *Hierarchical multi-sample, confirmatory factor analysis of the Wechsler Intelligence Scale for Children-Fourth Edition: What does it measure?* (Manuscript submitted for publication)