Q-interactive

Q-interactive® Special Group Studies: The WISC®–V and Children with Intellectual Giftedness and Intellectual Disability

Q-interactive Technical Report 9

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Introduction

Q-interactive®, a Pearson digital system for individually administered tests, is designed to make assessment more convenient and accurate, provide practitioners with easy access to a large number of tests, and support new types of tests that cannot be administered or scored without computer assistance.

With Q-interactive, the examiner and examinee use wireless tablets that are synched with each other, enabling the examiner to read administration instructions, time and capture response information (including audio recording), and view and control the examinee's tablet. The examinee tablet displays visual stimuli and captures touch responses.

In the initial phase of adapting tests to the Q-interactive platform, the goal has been to maintain raw-score equivalence between standard (paper) and digital administration and scoring formats. This goal is facilitated to the extent that the effects of examinee–tablet interaction and assessment in the digital environment can be minimized, and that response capture and scoring remains accurate. If equivalence is demonstrated, then the norms, reliability, and validity information gathered for the paper format can be applied to Q-interactive results. To date, equivalence has been evaluated and demonstrated for the *Wechsler Intelligence Scale for Children–Fourth Edition* (WISC–IV; Wechsler, 2003), *the Wechsler Intelligence Scale for Children–Fifth Edition* (WISC–V; Wechsler, 2014), the *Wechsler Adult Intelligence Scale–Fourth Edition* (WAIS–IV; Wechsler, 2008), and a number of other cognitive, achievement, and language tests (Daniel, 2012a, 2012b, 2012c, 2013a, 2013b, 2013c; Daniel, Wahlstrom, & Zhang, 2014; Daniel, Wahlstrom, & Zhou, 2014).

As noted in the WISC–V equivalence study technical report (Daniel, Wahlstrom, & Zhang, 2014), the Q-interactive equivalence studies have used samples of nonclinical examinees to maintain focus on estimating the presence and size of any effects of the digital administration format. These studies were designed to show equivalence of the normative data, and therefore focused on non-clinical cases to establish that the paper normative data apply equally well to the test when it is administered in a digital format. After normative equivalence was established, focus could shift to providing evidence of performance consistency in clinical conditions and special groups of interest who were administered the test in a digital format.

Given that the impact of computer-assisted administration on individuals with particular clinical conditions is not known, further research was required to demonstrate whether similar results would be obtained when varying the administration format from paper to digital for special populations or with various clinical conditions.

Understanding the interaction of administration format for examinees with clinical conditions or from other special populations (e.g., gifted and talented) is ultimately of importance for clinical applications of Q-interactive. In the *Standards for Educational and Psychological Testing* (*Standards*; American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014), Standard 4.5 describes collecting and presenting evidence of how a target construct is or is not altered by allowable variations in administration conditions, such as paper and digital formats of the same test. Accordingly, this technical report describes the results of two special group studies of children tested on the

WISC–V digital version on Q-interactive: Children identified as intellectually gifted and children with intellectual disability. Other special group study results are forthcoming in future reports.

The WISC–V equivalence study found there was virtually no effect of format by ability level. These results are relevant to the current work, as the special groups studied in this report (i.e., intellectually gifted and intellectual disability) represent the extremes of high and low ability, respectively.

Children Identified as Intellectually Gifted

Children identified as intellectually gifted demonstrate high performance on measures of intellectual functioning, cognitive flexibility, creativity, and/or other specific cognitive ability areas (Geake, 2008; Koziol, Budding, & Chidekel, 2010; Munro, 2013; Valdés, Vera, & Carlos, 2013). They obtain mean cognitive ability scores that are significantly higher than children in the general population; moreover, these children tend to obtain higher scores on all composite measures in comparison to same-age peers (Rimm, Gilman, & Silverman, 2008; Rowe, Kingsley, & Thompson, 2010; Sweetland, Reina, & Tatti, 2006; Wechsler, 2002, 2003).

Although gifted individuals perform well on all of the traditional Wechsler intelligence scale subtests, some gifted individuals show unusually large discrepancies between their verbal and nonverbal scores (Sweetland et al., 2006). Children with intellectual giftedness typically show particular strengths in the areas of verbal comprehension, visual spatial ability, and fluid reasoning. Although their working memory and processing speed performance is generally higher than in the general population (Elliot, 2007; Kaufman & Kaufman, 2004; Wechsler, 2003, 2008, 2012, 2014), it typically is lower than their performance on verbal comprehension, visual spatial, and fluid reasoning measures (Raiford, Weiss, Rolfhus, & Coalson, 2005; Rimm et al., 2008; Rowe et al., 2010).

Because of the evidence that children who are intellectually gifted show intra-individual weaknesses in the areas of working memory and processing speed, some have advocated that both the WISC–IV Full Scale IQ and the WISC–IV General Ability Index are useful for gifted admissions evaluations if cognitive ability scores are used as a criteria (Rimm et al., 2008). The Full Scale IQ, however, appears to be a better predictor of academic achievement, including reading comprehension and math, in children identified as intellectually gifted (Rowe, Miller, Ebenstein, & Thompson, 2012). Among the WISC–IV index scores, the Verbal Comprehension Index and the Working Memory Index are also strong predictors of achievement in children identified as intellectually gifted (Rowe et al., 2010). The *WISC–V Technical and Interpretive Manual* indicates that both the FSIQ and the GAI can be useful for evaluation of intellectual giftedness (Wechsler, 2014).

There are a number of factors that can affect the results obtained in studies of intellectual giftedness. First, various intellectual ability measures produce highly correlated, yet different, estimates of cognitive ability. Second, the criteria for identifying children as intellectually gifted vary from site to site, as well as from state to state (Pfeiffer, 2013). Third, children enrolled in gifted and talented programs are occasionally admitted on the basis of achievement scores, and high achievement scores are not always associated with high intellectual ability. Because of these factors, the results of studies with children identified as intellectually gifted vary slightly across samples.

To date, there are few studies of digital assessment conducted with intellectually gifted children; however, in general, the use of digital technology in assessment and instruction is viewed positively by gifted children, and a synthesis of the literature indicates that digital technology can be utilized with gifted individuals to produce comparable or superior assessment and instruction results relative to traditional paper delivery (Periathiruvadi & Rinn, 2012). One study investigated use of a fluid reasoning task, with both paper and digital formats, for assessing intellectual giftedness (Preckel & Thiemann, 2003). Results suggested that valid and reliable data were obtained using both formats. A direct comparison of the results from the two format conditions was not considered appropriate, however, because administration of the digital format was not proctored. Furthermore, the digital format had a much higher dropout rate than the paper format, so motivation may have been a factor for those who completed it. Other studies involving the assessment of gifted children for related constructs, such as strategic thinking (Steiner, 2006) and self-regulation (Calero, García-Martín, Jiménez, Kazén, & Araque, 2007), indicate that assessment in paper or digital formats with gifted children produced comparable results.

Children with Intellectual Disability

According to criteria specified in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM–5*; American Psychiatric Association, 2013), a child diagnosed with intellectual disability must demonstrate deficits in both intellectual functions and adaptive functioning in at least one activity of daily living across multiple settings. The deficits must be confirmed by both clinical assessment and individual standardized intellectual testing, and have an onset in the developmental period. According to the American Association on Intellectual and Developmental Disabilities (AAIDD), intellectual disability originates before the age of 18 and is characterized by significant limitations in both intellectual functioning and adaptive behavior expressed as conceptual, social, and practical skills (AAIDD, 2010). In both the *DSM–5* and AAIDD definitions, significantly low performance on a test of general intellectual ability, such as the WISC–V, is a necessary, but not sufficient, criterion; adaptive functioning must also be assessed.

Both the *DSM–5* and the AAIDD criteria emphasize the need to consider the degree of measurement error in a scale when interpreting scores, thus reemphasizing the requirement to consider multiple sources of information and to exercise careful clinical judgment in identifying children with intellectual disability. In the normal distribution of IQ scores, about 2.2% of individuals obtain scores at least 2 standard deviations below the mean (e.g., IQ ≤70). The prevalence of intellectual disability in the population varies from study to study. A large meta-analysis indicated an overall prevalence in the general population of 10.37 per 1,000 (Maulik, Mascarenhas, Mathers, Dua, & Saxena, 2011) or approximately 1%. This lower percentage occurs because the diagnostic criteria require low intellectual ability **and** adaptive functioning.

Many studies have been conducted to evaluate the performance of individuals with intellectual disability on previous editions of the Wechsler intelligence scales. The prevalence of large and unusual discrepancies between verbal and nonverbal composite scores has been shown to decrease with decreasing levels of ability (Gordon, Duff, Davidson, & Whitaker, 2010; Spruill, 1998; Wechsler, 2002, 2003). In some studies, verbal comprehension and working memory performance are lower than perceptual reasoning performance (Gordon et al., 2010). In addition, standard deviations of subtest and composite scores are smaller for individuals with intellectual disability than for individuals in the general population (Nunes et al., 2012; Wechsler, 2002, 2003, 2008, 2012, 2014). Thus, there appears to be less variability in performance at both the subtest and composite levels for individuals with intellectual disability than for individuals in the general population.

Research using auditory and visual working memory tasks with children with mild to borderline intellectual disability by Van der Molen, Henry, and Van Luit (2014) suggests lower scores on auditory working memory tasks relative to visual working memory tasks may be observed. The WISC–V complementary subtests are not designed to measure intellectual disability but may be used in a general assessment for learning difficulties of children with intellectual disability. Research on tasks similar to the Symbol Translation subtests (Kaufman & Kaufman, 2004) found that children with intellectual disabilities scored lower than matched controls.

Research indicates that assessments and interventions conducted with individuals with intellectual disability or other neurodevelopmental disorders that utilize a digital format are equally or more effective relative to their paper counterparts (Bosseler & Massaro, 2003; Denaes, 2012; Fletcher-Flinn & Gravatt 1995; Hetzroni & Tannous, 2004). Furthermore, tablet technology has been used effectively with individuals with intellectual disability and other neurodevelopmental disorders for a variety of purposes related to learning and assessment (Bouck, Savage, Meyer, Tager-Doughty, & Hunley, 2014; Burton, Anderson, Prater, & Dyches, 2013; Kagohara et al., 2013; Murdock, Ganz, & Crittendon, 2013). The use of tablet technology is thought to increase motivation and attention for children in special education settings and for children with intellectual disability (Bruttin, 2011; Flewitt, Kucirkova, & Messer, 2014).

WISC–V Special Group Studies

Method

Measures

The WISC–V is an individually administered, comprehensive clinical instrument for assessing the intelligence of children aged 6 years 0 months through 16 years 11 months (6:0–16:11). The WISC–V provides primary index scores that represent intellectual functioning in specified cognitive areas (i.e., Verbal Comprehension Index [VCI], Visual Spatial Index [VSI], Fluid Reasoning Index [FRI], Working Memory Index [WMI], and Processing Speed Index [PSI]), a composite score that represents general intellectual ability (i.e., Full Scale IQ [FSIQ]), ancillary index scores that represent the cognitive abilities in different groupings based on clinical needs (i.e., Auditory Working Memory Index [AWMI], Quantitative Reasoning Index [QRI], Nonverbal Index [NVI], General Ability Index [GAI], and Cognitive Proficiency Index [CPI]), and complementary index scores that measure additional cognitive abilities related to academic achievement and learning-related issues and disorders (i.e., Naming Speed Index [NSI], Symbol Translation Index [STI], and Storage and Retrieval Index [STI]).

All of the WISC–V subtests from the standardization edition on Q-interactive were administered for these special group studies. Digital versions of the three Processing Speed subtests (i.e., Coding, Symbol Search, and Cancellation), in which the child responded by touching or drawing on the tablet, were also administered. It was assumed that the paper and digital versions would not be raw-score equivalent because of the difference in response mode. The data from standardization indicated, however, that the correspondence between the paper and digital versions was not yet sufficient to support the use of these experimental digital versions. Further design and development work on these subtests is underway. Therefore, the initial release of the WISC–V continues to use paper response booklets for the Processing Speed subtests, with a Q-interactive examiner interface for timing and recording that is similar to the one that has been shown to be equivalent to the paper format in the studies of the WISC–IV (Daniel, 2012a) and the WAIS–IV (Daniel, 2012b). Hence, no special group study results are available for these subtests, or for any composite score that requires these subtests for the corresponding sum of scaled scores (i.e., the PSI, FSIQ, NVI, and CPI scores). Results for all other subtests and composite scores are available. For special group study results relevant to the Processing Speed subtests as they are currently administered for Qi (i.e., using paper response booklets), see the special group studies in Chapter 5 of the *WISC–V Technical and Interpretive Manual* (Wechsler, 2014).

Participants

The special group samples consisted of children, aged 6–16, identified as intellectually gifted, and noninstitutionalized children, aged 7–16, with intellectual disability-mild severity. The matched control samples were drawn from the pool of nonclinical children aged 6–16 who were participating in the equivalence study of the WISC–V paper and digital versions. Pearson's Field Research staff recruited the participants and compensated the children from all samples (i.e., their parents/guardians) for their participation. Participants for the samples of nonclinical children were screened for general exclusion criteria used for the WISC–V normative sample listed in Appendix A. Potential participants for the Intellectually Gifted and Intellectual Disability-Mild Severity samples were screened for general inclusion criteria listed in Appendix B.

The children identified as intellectually gifted had an existing full-scale score on a standardized, individually administered measure of cognitive ability that was at least 2 standard deviations above the mean and were receiving services for intellectual giftedness in school. The children with intellectual disability-mild severity had an existing full-scale score on a standardized, individually administered measure of cognitive ability that was 2–3 standard deviations below the mean (e.g., FSIQ = 55–70) or met *DSM–5* criteria for a current diagnosis of intellectual disability-mild severity. These criteria were the same as the analogous studies conducted with the WISC–V paper version.

Examiners participating in these studies were trained in WISC–V paper administration procedures. The examiners also received training in Q-interactive administration, conducted practice administrations, and were provided with feedback on any administration errors. Examiners who were not Pearson employees were compensated for their participation.

Procedure

This study was carried out during the WISC–V standardization phase. All administrations occurred in April and May, 2014. Examiners captured response information in the standard manner used for norming, which includes writing the complete verbatim response to each Verbal Comprehension subtest item, and scored all items.

A team of several scorers at Pearson scored all protocols. For each protocol, two independent scorers reevaluated all subjectively scored items using the final scoring rules, and an expert scorer or a member of the research team resolved any discrepancies between the two scorers as needed. All subtest raw scores were calculated by Pearson staff using the keyed item scores and the final scoring rules. The final subtest and composite norms were then applied.

Results

Children Identified as Intellectually Gifted

The demographic data for the group of children identified as intellectually gifted (i.e., the Intellectually Gifted group) appear in Table 1.

Table 1. Demographic Data for the Intellectually Gifted Group

N	24
Age	
Mean	11.5
SD	2.9
Sex	
Female	45.8
Male	54.2
Race/Ethnicity	
Asian	4.2
Hispanic	8.3
White	70.8
Other	16.7
Parent Education	
12 years	8.3
13–15 years	4.2
≥16 years	87.5

Note. Except for sample size (*N*) and age, data are reported as percentages. Total percentage may not add up to 100 due to rounding.

The demographic characteristics of this sample are similar to those of the intellectually gifted special group study that was conducted with the WISC–V paper version. Table 2 presents the mean subtest and composite scores for the Intellectually Gifted and matched control groups.

Table 2. Mean Performance of Intellectually Gifted and Matched Control Groups

	Intellectually Gifted		Matched Control						
Subtest/ Composite Score	Mean	*SD*	Mean	*SD*	*n*	Difference	*t* value	*p* value	Standard Difference[a]
SI	15.1	3.1	11.5	2.6	24	-3.67	-4.33	<.01	-1.28
VC	14.8	2.7	10.4	2.7	24	-4.33	-5.83	<.01	-1.60
IN	14.8	2.7	11.3	2.8	24	-3.50	-6.00	<.01	-1.27
CO	13.2	3.2	10.0	2.3	24	-3.13	-4.17	<.01	-1.12
BD	13.8	2.3	11.3	2.3	24	-2.54	-4.91	<.01	-1.10
VP	13.8	2.5	11.3	2.3	24	-2.50	-3.46	<.01	-1.04
MR	13.0	2.6	11.4	2.5	24	-1.63	-2.00	.06	-.64
FW	14.4	2.9	11.1	3.0	24	-3.29	-4.70	<.01	-1.12
PC	13.6	2.7	11.3	2.4	24	-2.25	-2.73	.01	-.88
AR	13.7	3.3	10.4	2.0	24	-3.29	-5.07	<.01	-1.21
DS	14.3	2.5	12.5	2.6	24	-1.75	-2.22	.04	-.69
PS	14.0	2.8	11.4	3.3	24	-2.58	-3.62	<.01	-.84
LN	14.5	2.8	11.8	1.8	24	-2.75	-4.81	<.01	-1.17
VCI	127.6	15.5	105.2	13.1	24	-22.38	-5.46	<.01	-1.56
VSI	121.9	12.3	107.2	11.7	24	-14.71	-4.66	<.01	-1.23
FRI	121.3	12.1	107.2	13.3	24	-14.04	-3.76	<.01	-1.10
WMI	122.9	12.5	111.0	13.7	24	-11.92	-3.48	<.01	-.91
QRI	123.9	17.4	104.4	11.5	24	-19.50	-5.93	<.01	-1.32
AWMI	124.5	13.9	111.8	9.9	24	-12.63	-3.56	<.01	-1.05
GAI	127.1	11.8	107.4	11.0	24	-19.67	-6.33	<.01	-1.72
NSL	115.8	14.1	107.8	13.3	24	-7.96	-1.87	.07	-.58
NSQ	115.3	12.6	104.8	11.1	24	-10.50	-2.98	<.01	-.88
IST	116.0	13.3	102.3	12.3	24	-13.63	-3.93	<.01	-1.06
DST	115.4	14.8	104.7	13.3	22	-10.68	-2.54	.02	-.76
RST	109.0	10.1	103.8	12.4	22	-5.23	-1.70	.10	-.46
NSI	119.0	15.2	106.9	12.8	24	-12.13	-2.76	.01	-.86
STI	115.1	14.6	103.7	13.6	22	-11.41	-2.88	<.01	-.81
SRI	121.2	16.4	106.8	14.5	22	-14.41	-3.37	<.01	-.93

[a] The Standard Difference is the difference of the two test means divided by the square root of the pooled variance, computed using Cohen's (1996) Formula 10.4.

WISC–V abbreviations are: SI = Similarities, VC = Vocabulary, IN = Information, CO = Comprehension, BD = Block Design, VP = Visual Puzzles, MR = Matrix Reasoning, FW = Figure Weights, PC = Picture Concepts, AR = Arithmetic, DS = Digit Span, PS = Picture Span, LN = Letter–Number Sequencing, VCI = Verbal Comprehension Index, VSI = Visual Spatial Index, FRI = Fluid Reasoning Index, WMI = Working Memory Index, QRI = Quantitative Reasoning Index, AWMI = Auditory Working Memory Index, GAI = General Ability Index, NSL = Naming Speed Literacy, NSQ = Naming Speed Quantity, IST = Immediate Symbol Translation, DST = Delayed Symbol Translation, RST = Recognition Symbol Translation, NSI = Naming Speed Index, STI = Symbol Translation Index, SRI = Storage and Retrieval Index.

The mean composite scores for the intellectually gifted group are significantly higher than those obtained in the matched control group. The mean primary index scores range from 121.3 (FRI) to 127.6 (VCI), and the mean GAI is 127.1. Effect sizes for all primary index score differences are large, with the smallest effect size on the WMI. The ancillary index scores range from 123.9 (QRI) to 127.1 (GAI), and all effect sizes for the ancillary index scores are large. On the analogous study with the paper version, the mean GAI score was also 127.1 (Wechsler, 2014).

Additional analysis indicates that 75% of the children identified as intellectually gifted receive WISC–V GAI scores of 120 points or higher, as compared with only 13% of children in the matched control group. These results are very similar to those of the WISC–V paper version (Wechsler, 2014).

All mean primary and secondary subtest scaled scores are significantly higher than those of the matched control group, with the exception of Matrix Reasoning. All subtest comparisons produced moderate to large effect sizes with the exception of Recognition Symbol Translation. The largest subtest effect sizes are for Vocabulary, Similarities, Information, and Arithmetic, consistent with results of prior studies (Wechsler, 2003, 2008), including those of the WISC–V paper version (Wechsler, 2014).

The complementary index scores range from 115.1 (STI) to 121.2 (SRI). The complementary index scores and subtests were not designed to measure dimensions of intelligence, but instead, skills associated with learning difficulties. Nevertheless, the mean scores for the complementary subtest and index scores are all significantly higher than matched controls, with the exception of Naming Speed Literacy and Recognition Symbol Translation. All mean complementary subtest and index score differences produced moderate to large effect sizes, with the exception of a small effect size on Recognition Symbol Translation.

Children With Intellectual Disability-Mild Severity

The demographic data for the group of children diagnosed with intellectual disability-mild severity (i.e., the Intellectual Disability-Mild Severity group) appear in Table 3.

Table 3. Demographic Data for the Intellectual Disability-Mild Severity Group

N	22
Age	
Mean	11.8
SD	3.2
Sex	
Female	36.4
Male	63.6
Race/Ethnicity	
African American	13.6
Asian	4.5
Hispanic	18.2
White	59.1
Other	4.5
Parent Education	
≤11 years	27.3
12 years	9.1
13–15 years	18.2
≥16 years	45.5

Note. Except for sample size (*N*) and age, data are reported as percentages. Total percentage may not add up to 100 due to rounding.

The demographic characteristics of this sample are generally similar to those of the intellectual disability-mild severity special group study that was conducted with the WISC–V paper version (Wechsler, 2014); however, the current sample had a greater proportion of children with a parent education level of ≥16 years, and a somewhat smaller proportion of children with a parent education level of 12 years. Table 4 presents the mean subtest and composite scores for the Intellectual Disability-Mild Severity and matched control groups.

Table 4. Mean Performance of Intellectual Disability-Mild Severity and Matched Control Groups

	Intellectual Disability		Matched Control						
Subtest/ Composite Score	Mean	*SD*	Mean	*SD*	*n*	Difference	*t* value	*p* value	Standard Difference[a]
SI	3.3	2.1	9.8	2.9	22	6.50	7.04	<.01	2.57
VC	3.2	1.9	9.3	3.0	22	6.09	7.88	<.01	2.43
IN	3.3	2.1	9.8	2.5	22	6.50	9.39	<.01	2.82
CO	3.1	1.9	9.0	2.4	22	5.91	8.10	<.01	2.73
BD	5.0	2.2	10.5	2.6	22	5.59	6.83	<.01	2.32
VP	3.6	1.7	9.7	3.1	22	6.14	7.76	<.01	2.46
MR	4.0	2.4	9.7	2.6	22	5.68	7.24	<.01	2.27
FW	4.6	1.8	11.3	2.9	22	6.64	10.84	<.01	2.75
PC	4.0	2.4	10.0	2.9	22	6.00	6.74	<.01	2.25
AR	2.9	1.5	10.3	2.6	21	7.43	11.19	<.01	3.50
DS	3.0	1.9	11.1	2.6	22	8.14	10.75	<.01	3.57
PS	4.3	2.1	11.3	3.1	22	7.00	9.96	<.01	2.64
LN	3.7	2.0	11.0	2.0	21	7.29	10.40	<.01	3.65
VCI	62.3	10.3	97.8	14.9	22	35.45	7.94	<.01	2.77
VSI	67.6	10.6	100.8	14.7	22	33.18	7.69	<.01	2.59
FRI	67.9	10.3	103.0	14.8	22	35.09	9.65	<.01	2.75
WMI	64.5	9.1	106.8	14.3	22	42.32	11.79	<.01	3.53
QRI	64.7	8.5	104.1	14.4	21	39.48	12.40	<.01	3.34
AWMI	61.6	11.4	105.5	11.4	21	43.95	11.04	<.01	3.86
GAI	63.7	8.0	100.9	14.2	22	37.14	9.71	<.01	3.22
NSL	72.4	19.5	101.1	11.9	22	28.73	6.57	<.01	1.78
NSQ	73.4	19.1	104.5	9.2	22	31.14	7.04	<.01	2.08
IST	75.2	11.7	97.5	13.6	22	22.36	5.39	<.01	1.76
DST	77.3	12.4	101.2	14.2	20	23.90	6.25	<.01	1.79
RST	79.3	10.6	107.6	12.9	17	28.29	5.66	<.01	2.40
NSI	74.0	17.0	102.7	11.2	22	28.73	6.93	<.01	2.00
STI	77.4	8.7	104.3	13.1	17	26.88	6.35	<.01	2.42
SRI	73.3	8.8	104.2	11.8	17	30.94	7.59	<.01	2.97

[a] The Standard Difference is the difference of the two test means divided by the square root of the pooled variance, computed using Cohen's (1996) Formula 10.4.

WISC–V abbreviations are: SI = Similarities, VC = Vocabulary, IN = Information, CO = Comprehension, BD = Block Design, VP = Visual Puzzles, MR = Matrix Reasoning, FW = Figure Weights, PC = Picture Concepts, AR = Arithmetic, DS = Digit Span, PS = Picture Span, LN = Letter–Number Sequencing, VCI = Verbal Comprehension Index, VSI = Visual Spatial Index, FRI = Fluid Reasoning Index, WMI = Working Memory Index, QRI = Quantitative Reasoning Index, AWMI = Auditory Working Memory Index, GAI = General Ability Index, NSL = Naming Speed Literacy, NSQ = Naming Speed Quantity, IST = Immediate Symbol Translation, DST = Delayed Symbol Translation, RST = Recognition Symbol Translation, NSI = Naming Speed Index, STI = Symbol Translation Index, SRI = Storage and Retrieval Index.

Mean primary index scores for the Intellectual Disability-Mild Severity group range from 62.3 (VCI) to 67.9 (FRI), and the mean GAI is 63.7. Mean ancillary index scores for the Intellectual Disability-

Mild Severity group range from 61.6 (AWMI) to 64.7 (QRI). On the analogous study with the paper version, the mean GAI score was 63.5. All primary and ancillary index scores are significantly lower than the corresponding means of the matched control group, and all effect sizes are large. These results are similar to those of the WISC–V paper version (Wechsler, 2014).

Additional analysis indicates that 91% of the children identified as intellectual disability-mild severity have GAI scores of 75 points or lower versus only 5% of children in the matched control group.

The complementary index scores are also significantly lower in the intellectual disability-mild severity group than in the matched control group. However, performance is relatively higher on these index scores than on the primary and ancillary index scores.

The variability in performance on the primary and ancillary index scores is generally smaller than in the matched control group for all domains. The standard deviations for the primary index scores range from 9.1 (WMI) to 10.6 (VSI), and the standard deviations for the ancillary index scores range from 8.0 (GAI) to 11.4 (AWMI). A similar pattern is noted for the *SD*s of the primary and secondary subtests.

The Intellectual Disability-Mild Severity group scores significantly lower on all subtests than the corresponding matched control group. Among the primary and secondary subtests, the largest effect sizes are on Letter–Number Sequencing, Digit Span, Arithmetic, Information, Figure Weights, Comprehension, Picture Span, and Similarities.

Discussion

The scores obtained by children in the special group studies are consistent with their previous group identifications, as well as with the results of other comparison studies between children from these special groups and matched controls (Rimm et al., 2008; Rowe et al., 2010; Wechsler, 2002, 2003, 2008, 2012), including those of the WISC–V paper version (Wechsler, 2014). The similarities in results observed across the WISC–V digital version and previous Wechsler intelligence scales with Intellectually Gifted and Intellectual Disability-Mild Severity groups indicates that the tests are assessing similar constructs. The consistency of results obtained across the WISC–V digital and paper versions suggests that the target construct is not altered by varying the administration format.

Taken together, these results provide evidence that the WISC–V digital version produces scores that are useful in the assessment of intellectual giftedness and intellectual disability. The intellectual giftedness study was limited to children who had been identified as intellectually gifted, and therefore, the results should not be generalized to children who are gifted in other domains.

Appendix A. Exclusion Criteria for the Nonclinical Sample

Children were excluded from participation if any of the below criteria were met:

- primary language is not English;
- primarily nonverbal or uncommunicative;
- disruptive behavior or insufficient compliance with testing to ensure a valid assessment;
- tested on any intelligence measure in the previous 6 months;
- close friend, relative, or ward of the examiner, or a child with whom the examiner lives;
- identical sibling of another child in the sample;
- uncorrected visual impairment;
- uncorrected hearing loss;
- upper extremity disability that would affect motor performance;
- currently admitted to hospital or psychiatric facility;
- currently taking medication that might impact cognitive test performance (e.g., anticonvulsants, antipsychotics, some antidepressants and anxiolytics);
- history of electroconvulsive therapy or radiation treatment of the central nervous system;
- period of unconsciousness not related to surgery or greater than 20 minutes related to a medical condition; or
- previously or currently diagnosed with any physical condition, neurological condition, psychological condition, or illness that might depress test performance, such as epilepsy, traumatic brain injury, or mood disorder.

Appendix B. Inclusion Criteria for Special Groups

General Inclusion Criteria

Children were eligible for inclusion if they met all of the following criteria:

- age 6–16;
- primary language is English;
- able to communicate at a level commensurate with age and diagnosis, and not completely uncommunicative;
- normal hearing and vision (with aid);
- normal fine and gross motor ability (with the exception of mild motor impairment occurring in the Intellectual Disability-Mild Severity group);
- no physical conditions, illnesses, or impairments that could impact cognitive functioning or test performance (with the exception of conditions or impairments associated with intellectual disability in the Intellectual Disability-Mild Severity group);
- no diagnosis of a neurological condition (e.g., seizure disorder, epilepsy, encephalitis, brain surgery, brain tumor) other than intellectual disability in the Intellectual Disability-Mild Severity group;
- no period of unconsciousness not related to surgery or greater than 20 minutes related to a medical condition;
- no diagnosis of a pervasive developmental disorder;
- no diagnosis of a psychiatric disorder (e.g., psychotic disorders, mood disorders) other than intellectual disability in the Intellectual Disability-Mild Severity group;
- not currently admitted to a hospital, inpatient treatment, or psychiatric facility (with the exception of state schools or placements for intellectual disability in the Intellectual Disability-Mild Severity group);
- not currently taking medication that might impact test performance;
- dual diagnoses of ADHD or disruptive behavior secondary to intellectual disability are acceptable for the Intellectual Disability-Mild Severity group; and
- has not completed the WISC–IV or any other measure of cognitive ability in the 6 months prior to the testing date.

Specific Inclusion Criteria

Intellectually Gifted

Participation criteria included:

- full scale score ≥2 standard deviations above the mean on a standardized, individually administered measure of cognitive ability (e.g., FSIQ ≥ 130);

  AND

- receiving services for intellectual giftedness in school.

Intellectual Disability-Mild Severity

Participation criteria included:

- meets *DSM–5* criteria for a current diagnosis of intellectual disability, mild severity;

  OR

- full scale score 2–3 standard deviations below the mean on a standardized, individually administered measure of cognitive ability (e.g., FSIQ = 55–70).

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