Asperger Syndrome:
A Study of the Cognitive Profiles of 37 Children and Adolescents

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This article reports the results of an analysis of Wechsler IQ scores of children and youth diagnosed with Asperger syndrome. The data revealed cognitive patterns dissimilar to those of children with other autism-related disorders and similar to many typically developing and achieving individuals. These findings are discussed in reference to identification and intervention issues related to students with Asperger syndrome, a diagnostic group that has been especially difficult to identify and provide with effective interventions.

A variety of systems for the diagnosis of autism are available, including the original Kanner (1943) criteria, Rutter's (1978) definition, the *International Classification of Diseases* (ICD-10; World Health Organization, 1992) diagnostic manual, and the *Diagnostic and Statistical Manual of Mental Disorders–4th Edition* (*DSM-IV;* American Psychiatric Association, 1994) criteria. Although widely used for clinical diagnosis and research, these and other systems are far from infallible. Indeed, there is general agreement that the differential diagnosis of autism is a daunting challenge characterized by subjective professional clinical judgment (Olley & Gutentag, 1999). This challenge has been heightened with recent recognition and expansion of the autism spectrum and formal acceptance of broadened autism-related subclassifications. In this context, Asperger syndrome (Asperger, 1944/1991; Ehlers et al., 1997), characterized by absent or mild global intellectual impairment, social deficits, and intact language (Ramberg, Ehlers, Nyden, Johansson, & Gillberg, 1996; Wing, 1981), is particularly difficult to differentiate from other exceptionalities such as learning disabilities, certain psychiatric conditions, and other autism-related disorders.

Related to differential diagnosis, the cognitive profiles of individuals with autism spectrum disorders (ASD) have been a subject of considerable interest to practitioners and researchers. Both groups have recognized the diagnostic import of identifying unique and distinguishing ASD characteristics. Thus, several researchers have attempted to determine whether the profiles obtained from the Wechsler scales (Wechsler, 1974, 1981, 1991) could discriminate among Asperger syndrome, autism, and other conditions such as attention disorders, head injury, schizophrenia, and dyslexia (Asarnow, Tanguay, Bott, & Freeman, 1987; Dennis, Lockyer, Lazenby, Donnelly, Wilkinson, & Schoonheyt, 1999; Ehlers et al., 1997; Rumsey & Hamburger, 1990). Lincoln, Courchesne, Kilman, Elmasian, and Allen (1988) found a consistent, uneven pattern in the cognitive profiles of individuals with high-functioning autism, including a significantly higher Performance IQ when compared to Verbal IQ scores. Individuals with high-functioning autism obtained their highest scores on Block Design and Object Assembly and their lowest scores on Comprehension and Vocabulary. Lincoln et al. (1988) inferred that the pattern of subtest scale scores they identified was reliable and robust enough to assist in correctly making a diagnosis in children, adolescents, and adults without mental retardation who are suspected of having autism. However, they advised professionals not to exclusively use the pattern of Wechsler subtest scale scores as diagnostic criteria for autism. Ehlers et al. (1997) also interpreted the results of their research to preclude using only a Wechsler profile to make a diagnosis of Asperger syndrome.

More than 20 studies to date have reported an unusually uneven Wechsler subtest scale profile among individuals with ASD of varying ages and ability levels. The 22 studies, summarized in Table 1, reveal a relatively consistent pattern: strong performance on the Block Design subtest of the Performance scale, and relatively weak performance on the Comprehension subtest of the Verbal scale. The Block Design subtest of the Performance scale is considered a nonverbal concept formation task that requires perceptual organization, spatial visualization, and abstract conceptualization (Sattler, 1988). It is believed to be the best measure of *g*, Spearman's (1927) general mental energy factor. The Comprehension subtest is designed to assess an individual's understanding of social mores and interpersonal situations. Success on this task implies that the individual has good social judgment, common sense, and a grasp of social conventionality (Sattler, 1988).

Only 4 of the 22 studies specifically included individuals diagnosed with Asperger syndrome (Bowler, 1992; Dennis et al., 1999; Ehlers et al., 1997; Szatmari, Tuff, Finlayson, & Bartolucci, 1990), and the results of these studies revealed inconsistent psychometric assessment findings. Dennis et al. (1999) and Szatmari et al. (1990) found no obvious differences in IQ subtest scaled scores between individuals with high-functioning autism and individuals with Asperger syndrome. However, a statistical comparison could not be made in Dennis et al.'s (1999) study because the number of children was too small (Asperger, *n* = 4; high-functioning autism, *n* = 4). Ehlers et al.'s (1997) study reported that individuals with Asperger syndrome demonstrated good verbal ability and weaknesses on Object Assembly and Coding. The lowest scoring verbal subtest for the individuals with Asperger syndrome and autism was Arithmetic, not Comprehension, as was characteristic of almost all of the other 21 studies. As an explanation for these findings, Ehlers et al. (1997) indicated that many of Wolff and Barlow's (1979) "schizoid" children fit the Asperger syndrome phenotype and demonstrated the peaks and troughs seen in individuals with autism. On the other hand, Pomeroy and Friedman (1987) found that individuals with Asperger syndrome demonstrated weaknesses mainly in visuospatial ability (cited in Ehlers et al., 1997).

Klin, Volkmar, Sparrow, Cicchetti, and Rourke (1995) suggested that individuals with Asperger syndrome demonstrated a cluster of neuropsychological assets and deficits seen in cognitive profiles of individuals with nonverbal learning disabilities. However, Bowler (1992) and Szatmari et al. (1990) did not find a significant difference between Verbal IQ and Performance IQ in individuals with Asperger syndrome. On the other hand, Ozonoff, Rogers, and Pennington (1991) reported that the large discrepancy found between the Verbal IQ and Performance IQ—in favor of the Verbal IQ—in 10 individuals diagnosed with Asperger syndrome was not found in the 13 individuals with high-functioning autism in their study. Individual subtest scores were not reported in their research.

Several theories have been proposed to explain the uneven cognitive performance among individuals with autism spectrum disorders and to serve as possible guideposts for assisting diagnosticians to discriminate among individuals with Asperger syndrome and those with high-functioning autism. Theory of mind deficits (Baron-Cohen, Leslie, & Frith, 1985), weak central coherence (Happe, 1994), and executive dysfunction (Ozonoff, Pennington, & Rogers, 1991) theories have received mixed results. Most research has found evidence of problems in all three of these areas among individuals with autism and evidence of executive dysfunction in individuals with Asperger syndrome (Ehlers et al., 1997). Ehlers et al. (1997) concluded that Asperger syndrome appears to share some neuropsychological dysfunction commonalities with autism, as well as deficits in attention, motor control, and perception.

As shown in Table 1, a relatively strong performance on the Block Design subtest and a significantly weaker performance on the Comprehension subtest is a consistent pattern among most individuals with high- and low-functioning ASD. However, a specific, characteristic cognitive profile pattern among individuals with Asperger syndrome has not been established. The purpose of this study is to expand the current literature base by examining the cognitive profiles of individuals with Asperger syndrome. Specifically, this study was undertaken in order to determine if there is a characteristic cognitive profile among children and youth with Asperger syndrome that may aid in diagnosis and in the subsequent development of appropriate interventions.

Method

Participants were identified from a database of children and adolescents with Asperger syndrome maintained by a nonprofit autism/Asperger syndrome resource center associated with a large Midwestern university. Parents provided their children's cognitive profiles as part of the demographic information requested when they sought services and participation in the resource center's programs. A total of 37 participants who had a diagnosis of Asperger syndrome rendered by a physician, psychologist, or psychiatrist and who had completed one of the Wechsler intelligence scales as part of an individual or school evaluation were included in this study. At the time of testing, the ages of the 35 boys and 2 girls ranged from 3 years 2 months to 14 years 9 months (mean age = 9 years 8 months). One of the girls was blind; therefore, she only completed the Verbal IQ portion of the Wechsler scale.

All participants were tested individually by psychologists or other professionals who were qualified to administer the Wechsler scales. Based on their chronological age, 2 participants completed the *Wechsler Preschool and Primary Scale of Intelligence–Revised* (WPPSI-R; Wechsler, 1989); 33 completed the *Wechsler Intelligence Scale for Children–Third Edition* (WISC-III; Wechsler, 1991); and 2 completed the *Wechsler Intelligence Scale for Children–Revised* (WISC-R; Wechsler, 1974).

The Wechsler IQ tests contain two groups of subtests, Verbal and Performance. The Verbal subtests common to the WPPSI-R, WISC-III, and WISC-R are Information, Similarities, Arithmetic, Vocabulary, and Comprehension. The Performance subtests common to these three instruments are Picture Completion, Block Design, and Object Assembly. The supplementary subtests of the Wechsler scales were not included for analysis because they had not been completed by the majority of the participants.

Results

The following are descriptive statistics showing the participants' Wechsler IQ scores. Verbal IQ (VIQ) mean scores (M = 99.32, SD = 21.55; minimum score = 55, maximum score = 146), Per-

TABLE 1
Wechsler IQ Profiles in Previous Studies on Autism

Study	Sample characteristics			Test	Profile characteristics						
		Age (yrs)						Verbal scale subtests		Performance scale subtests	
	n	Range	*M*		VIQ	PIQ	FSIQ	Highest	Lowest	Highest	Lowest
Dennis et al., 1999	4 4[a]	NR	9.9	WISC-III/ WISC-R	94[b]	100[b]	96[b]	Comprehension	Block design		
Ehlers et al., 1997	40[a]	5–15	9.8	WISC-R	108	96	103	Similarities	Arithmetic	Picture Completion	Coding
	40	6–15	9.9	WISC-R	81	80	79	Similarities	Arithmetic	Block Design	Coding
Siegel et al., 1996	45 36	6–16 16–51	10 26.53	WISC-R WAIS-R	96 95	97 89	96 92	Information/Similarities Digit Span	Comprehension Comprehension	Block Design Block Design	Coding Digit Symbol
Shah & Frith, 1993 (data from Shah, 1988)	18	6–25	NR	WISC-R/ WAIS	73[c] 57[c]	97[c] 71[c]	83[c] 62[c]	Similarities	Comprehension	Block Design	Coding
Bowler, 1992	15[a]	NR	26.67	WAIS	87	88	87	Digit Span	Comprehension	Block Design	Digit Symbol
Minshew, Goldstein, Muenz, & Payton, 1992	15	15–40	21.3	WAIS-R	99	93	96	NR	NR	NR	NR
Venter, Lord, & Schopler, 1992[d]	52	10–37	14.69	WISC-R/ WAIS-R	80	83	79	Similarities	Comprehension	Block Design	Picture Arrangement
Allen, Lincoln, & Kaufman, 1991	20	6–12	10.25	WISC-R	57	85	68	Digit Span	Comprehension	Block Design	Picture Arrangement
Rumsey & Hamburger, 1990	10	18–39	26	WAIS	96	96	96	Digit Span	Comprehension	Block Design	Picture Arrangement
Szatmari et al., 1990	17	7–32	22.8	WISC-R/ WAIS-R	85	81	82	Digit Span	Similarities	Block Design	Coding
	26[a]	8–18	14.3	WISC-R/ WAIS-R	86	88	87	Similarities	Comprehension	Block Design	Coding
Lincoln et al., 1988	33	8–29	17.5	WISC-R/ WAIS-R	71	83	76	Digit Span	Comprehension	Block Design	Coding/Digit Symbol
Lincoln et al., 1988	13	8–12	NR	WISC-R	60	84	69	Digit Span	Comprehension	Block Design	Picture Arrangement
Rumsey & Hamburger, 1988	10	18–39	26.4	WAIS	103	104	104	Digit Span	Comprehension	Block Design	Picture Arrangement
Asarnow et al., 1987	23	NR	10.4	WISC-R	85	99	91	Similarities	Comprehension	Block Design	Coding
Narita & Koga, 1987	45	10	NR	WISC	61	78	66	Digit Span	Comprehension	Block Design	Picture Arrangement

(table continues)

(Table 1 continued)

Study	Sample characteristics				Profile characteristics						
		Age (yrs)						Verbal scale subtests		Performance scale subtests	
	n	Range	*M*	Test	VIQ	PIQ	FSIQ	Highest	Lowest	Highest	Lowest
Ohta, 1987	16	6–14	10.16	WISC	65	85	72	Digit Span	Comprehension	Block Design	Picture Arrangement
Schneider & Asarnow, 1987	15	NR	10.71	WISC-R	80	94	86	NR	NR	NR	NR
Freeman et al., 1985	21	6–12	8.80	WISC-R	90	105	97	Similarities	Comprehension	Block Design	Coding
Tymchuk et al., 1977	20	NR	15.75	WISC/ WAIS	90	81	88	Digit Span	Comprehension	Block Design	Coding
Bartak et al., 1975	9	4–12	NR	WISC	67	97	NR	Digit Span	Comprehension	Block Design	Coding
Lockyer & Rutter, 1970[e]	19, 21 27	NR	15.58	WISC/ WAIS	74	71	75	Digit Span	Comprehension	Block Design	Coding/Digit Symbol
Wassing, 1965	4	7–13	10.42	WISC	59	88	71	Arithmetic	Comprehension	Block Design	Coding

Note. VIQ = Verbal IQ; PIQ = Performance IQ; FSIQ = Full Scale IQ; NR = not reported; WISC = Wechsler Intelligence Scale for Children; WISC-R = Wechsler Intelligence Scale for Children–Revised; WISC-III = Wechsler Intelligence Scale for Children–Third edition; WAIS = Wechsler Adult Intelligence Scale; WAIS-R = Wechsler Adult Intelligence Scale–Revised.
[a]Participants were diagnosed with Asperger syndrome. [b]Results combined for autism and Asperger syndrome participants. [c]The participants were divided into 2 groups based on Performance IQ > 85 and < 85. [d]Information and Coding subtests not administered. [e]Information subtest was not reported.

formance IQ (PIQ) mean scores (M = 96.72, SD = 20.58; minimum score = 59, maximum score = 137), and Full Scale IQ (FSIQ) mean scores (M = 98.20, SD = 21.23; minimum score = 66, maximum score = 144) fell within the average range. However, the range of IQs was from Intellectually Deficient to Very Superior.

Comparisons of participants' VIQ and PIQ revealed that 23 (64%) participants scored higher on VIQ, whereas 12 (33%) scored higher on PIQ. One participant performed equally on both VIQ and PIQ. The mean VIQ scores were slightly higher than the PIQ scores, although a t-test comparison indicated nonsignificant statistical differences, $t(35) = 1.10$, $p > .05$.

Table 2 shows a frequency distribution of participants' VIQ and PIQ performance when categorized by qualitative descriptions described in the WISC-III manual (Wechsler, 1991). The left and middle columns of Table 2 indicate the percentages of the participants in the study who scored within each range; percentages in the right column are based on normal curve distributions. The histograms shown in Figure 1 are a visual representation of Table 2 findings. Visual analysis of the VIQ and the PIQ frequency distribution reveals a somewhat normal curve. That is, distribution is platikurtic, with 62% of participants' VIQ scores and 63% of PIQ scores falling within the Low Average and High Average ranges. Furthermore, a relatively large percentage of the participants scored in either the Superior or the Very Superior range (VIQ, 21.64%; PIQ, 16.67%), and approximately the same percentages of participants were categorized in either the Borderline or the Intellectually Deficient range (VIQ, 16.22%; PIQ, 18.95%).

Table 3 presents participants' mean VIQ and PIQ scaled scores and associated standard deviations. As shown, the means of all subtests except Coding fell in the Average range. The Block Design subtest scaled score mean was the highest (M = 11.03, SD = 4.34) whereas Coding was the lowest (M = 7.00, SD = 3.03). Similar to VIQ and PIQ, the participants' subtest scaled scores were widely distributed. The Friedman two-way analysis of variance by ranks indicated that there was significant difference among participants, ($\chi^2 = 46.20$, $p < .0001$. A post hoc pairwise comparison analysis among these subtests (Siegel & Castellan, 1988) revealed significant differences ($p < .05$) between Coding and Picture Completion, Information, Similarities, Block Design, Vocabulary, Object Assembly, and Comprehension, respectively.

Discussion

The results of the present study are only partially consistent with the findings of the previous 22 studies listed in Table 1. Perhaps most significantly, there was no statistically significant difference between the VIQ and PIQ among the participants with Asperger syndrome. Therefore, a cognitive profile similar to individuals with nonverbal learning disabilities and ASD cannot be inferred from this research. Indeed, based on the scores of the 37 participants, there does not appear to be a distinct cognitive profile indicating higher or lower VIQ or PIQ scores in individuals with Asperger syndrome. Furthermore, the frequency distribution of the VIQ and PIQ of the participants in this study was similar (albeit platikurtic) to the distribution of IQ scores in the general population. These

TABLE 2
Frequency Distribution of VIQ/PIQ Categorized by Qualitative Descriptions

	Percentage		
Category	VIQ	PIQ	Normal curve
Very Superior	10.82	11.11	2.2
Superior	10.82	5.56	6.7
High Average	5.41	11.11	16.1
Average	35.14	33.33	50.0
Low Average	21.62	19.44	16.1
Borderline	8.11	16.67	6.7
Intellectually Deficient	8.11	2.28	2.2

Note. VIQ = Verbal IQ. PIQ = Performance IQ.

TABLE 3
Descriptive Statistics of Subtests

Subtest	*M*	*SD*	Minimum	Maximum
Picture Completion	10.14	3.73	1	17
Information	10.75	3.92	3	17
Coding	7.00	3.03	1	15
Similarities	10.25	4.31	1	19
Picture Arrangement	9.06	3.74	3	15
Arithmetic	8.94	4.23	2	18
Block Design	11.03	4.34	3	19
Vocabulary	10.14	4.00	2	19
Object Assembly	9.63	3.70	1	18
Comprehension	9.06	4.59	1	18

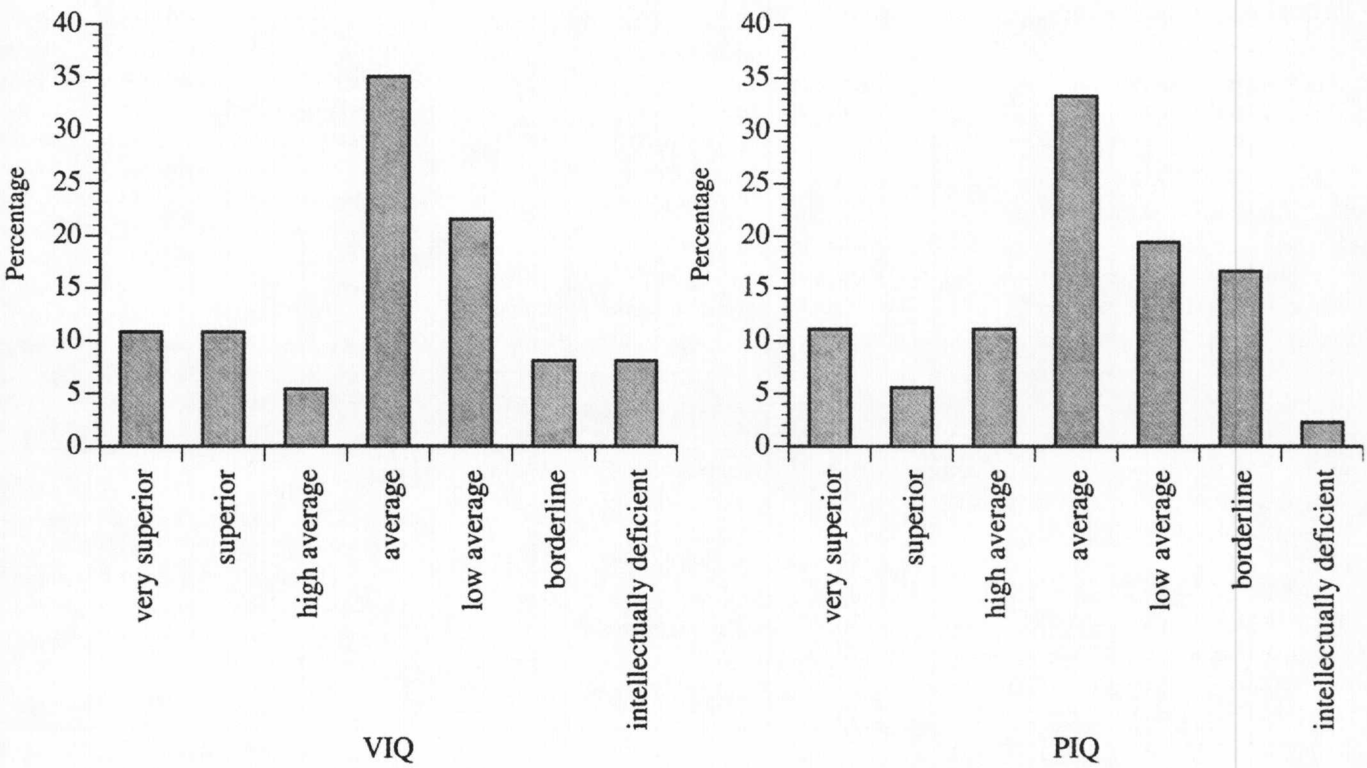

FIGURE 1. Histogram of VIQ/PIQ categorized by qualitative descriptions.

data suggest that the salient factors associated with the diagnosis of Asperger syndrome may not be found in the cognitive profile but, rather, in other behavioral or academic characteristics.

The results of this study concurred with the results of the majority of previous studies that have reported that, as a group, individuals with ASD score the lowest on the Coding/Digit Symbol subtest of the Performance scale (Digit Symbol is the subtest on the adult Wechsler scale similar to Coding on the other Wechsler scales; Asarnow et al., 1987; Bartak, Rutter, & Cox, 1975; Bowler, 1992; Ehlers et al., 1997; Freeman, Lucas, Forness, & Ritvo, 1985; Lincoln et al., 1988; Lockyer & Rutter, 1970; Shah & Frith, 1993; Siegel, Minshew, & Goldstein, 1996; Szatmari et al., 1990; Tymchuk, Simmons, & Neafsey, 1977; Wassing, 1965). This study also concurred with previous Performance scale findings that high Block Design scores are the norm for individuals with ASD. These results suggest that participants had relatively good nonverbal reasoning ability or good visual–motor spatial integration.

Coding and Block Design both require visual–motor coordination. Thus, the high scores on Block Design appear to rule out visual–motor coordination as the primary area of difficulty. Sattler (1988) suggested several other possible explanations of low scores on Coding: distractibility, poor pencil control, disinterest in a school-like task, lethargy, or excessive concern for detail in reproducing symbols exactly. It would have been valuable to have anecdotal notes from the examiners in order to better hypothesize the reasons for the low Coding scores in this study. Lincoln et al. (1988) cited Ameli (1986) and Ameli, Courchesne, Lincoln, Kaufman, and Grillon (1988) as suggesting that the poor performance on Coding in individuals with autism may suggest the possibility of some impairment in their visual memory ability. Individuals who quickly remember the association between the number and the symbol with which it is matched on the Coding subtest are usually more effective with this task, especially given the time constraints. This is an important consideration in curriculum planning for these individuals. Considering Myles and Simpson's (1998) assertion that students with Asperger syndrome benefit when information is presented visually rather than auditorily, these students may need direct instruction on problem-solving skills that would help them effectively use and retain visual information. Furthermore, they may need to be given more time to complete written tasks, and they may need to have written material that has less visual stimuli than the Coding subtest has in order to be successful.

Previous studies (e.g., Ehlers et al., 1997) revealed that the highest Verbal scores for individuals with ASD were obtained on Similarities or Digit Span. The current study did not include Digit Span in the analysis because many of the participants had not completed that supplementary subtest. Future investigations should include Digit Span in the test administration, because it may provide valuable information regarding the short-term auditory sequential memory and purported strong rote memory of individuals with Asperger syndrome.

Results from the current study indicated that the Verbal subtests with the highest mean scores were Information, Similarities, and Vocabulary. High scores on these subtests could reflect a good range of knowledge or information, as well as a good memory, according to Sattler (1988). This explanation appears consistent with the characteristics of individuals with Asperger syndrome. However, because these subtests were not determined to be significantly different from any of the other subtests except Coding, this assumption must be validated.

Overall, the participants in this study obtained lower, although not statistically significant, Verbal scores on the Arithmetic and Comprehension subtests. The 40 participants with Asperger syndrome in Ehlers' et al. (1997) study also obtained the lowest scores on Arithmetic, whereas all of the other studies that reported subtest results found that Comprehension yielded the lowest score for individuals with ASD. Ehlers et al. (1997) suggested that low scores in Arithmetic might be due to distractibility. However, it is not prudent to make this inference without the results from the Digit Span subtest. We suggest that mental math may be more difficult for individuals with Asperger syndrome because there are no visual supports to assist in problem solving. Further research could test the limits by providing visual supports during mathematics testing to determine if these individuals perform better with visual supports than without them.

Low scores on the Comprehension subtest may reflect poor social judgment; failure to take personal responsibility because of overdependency, immaturity, or limited involvement with others; or overly concrete thinking (Sattler, 1988). All these hypotheses appear to be relevant for individuals with Asperger syndrome, given the definition of this condition (e.g., developmental disability with significant social and communication impairments). However, the mean Comprehension subtest score in this study was not significantly different from the other subtest scores except Coding. It is possible that the mean subtest Comprehension score obtained in this study was elevated by some individuals who obtained high scores on this subtest due to their strong rote memory skills. Moreover, given the social impairments of individuals with Asperger syndrome, a high Comprehension subtest score would not necessarily reflect the ability to apply this rote knowledge in practical, everyday social situations.

It is recommended that future studies examine the individual Wechsler protocols of individuals with Asperger syndrome and conduct an item analysis to determine specifically which items are answered correctly, which items are given partial credit, and which items are answered incorrectly. These data, along with anecdotal information regarding behavior and comments made by the participants during testing, may provide valuable information as to areas of strength and weakness. More research is critically needed in the area of social comprehension skills in order to design appropriate interventions for individuals with Asperger syndrome. Furthermore, the Digit Span subtest should be administered in future research with individuals with Asperger syndrome in order to investigate their short-term auditory, sequential memory.

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