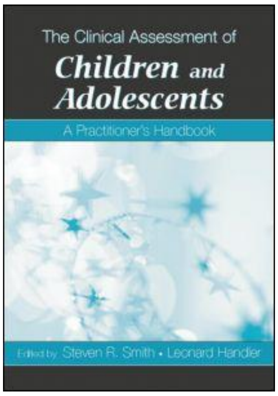

The Clinical Assessment of Children and Adolescents: A Practitioner's Handbook

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Assessing Intellectual Abilities of Children and Adolescents with Autism and Related Disorders

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CHAPTER

29

Assessing Intellectual Abilities of Children and Adolescents with Autism and Related Disorders

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The goal of this chapter is to familiarize the reader with approaches used to assess the intellectual abilities of persons with autism. In order to evaluate the intellectual abilities of persons with autism it is necessary for the clinician to appreciate what is known about the organization of intellectual abilities that are typically associated with the disorder and to understand how to effectively assess mental retardation because it frequently is present as a comorbid condition. Thus, it is critical that clinicians assessing such individuals have both the understanding and the capacity to evaluate across a range of developmental abilities as well as have at their disposal appropriate instruments that can be employed as part of the evaluation.

Another important factor in assessing individuals with autism and related disorders is the examiner's ability to work with behaviors that may interfere in the assessment process. It is important to evaluate whether the individual is actually taking examinations in a manner that truly allows the sampling of behaviors suggestive of intellectual processes. Successful performance on intellectual tests is probably valid. However, poor performance may or may not be reflective of intellectual ability. Failed items can be due to limited skill, an inability to comprehend instructions, poor cooperation, impulsive behavior, variable attention, or a combination of any of these performance issues. The examiner therefore needs to be experienced in evaluating how such behavioral factors might be affecting the evaluation process and make reasonable attempts to accommodate the individual's compromised capacity to take the test.

AUTISM AND INTELLIGENCE

Infantile Autism or Autistic Disorder (AD) was first described by Leo Kanner in 1943 as a severe developmental disorder that includes severe communication, social, and behavioral disturbances. Furthermore, it is now known that persons with AD suffer from atypical brain development (see Courchesne, 1997, review) as well as atypical and uneven patterns of cognitive development (Lincoln, Courchesne, Kilman, & Elmasian, 1988; Lincoln, Allen & Kilman, 1995, review; Siegel, Minshew & Goldstein, 1996). It is likely that the atypical patterns of cognitive development reflect biologically based differences in brain functions, which are secondary to the brain abnormalities as well as the abnormalities of learning and metacognition. In 1979 Michael Rutter stated: "There is good evidence for the existence of a basic cognitive deficit in autism. This deficit generally involves impaired language, sequencing, abstraction and coding functions. It is also associated with abnormalities in language function and usage which are particularly characteristic of the autistic syndrome" (p. 261). Cognitive deficits also may underlie impaired social and emotional behavior, thus affecting the whole spectrum of functioning (Rutter 1983; Tager-Flusberg, 1999; Tager-Flusberg, Joseph, & Folstein, 2001). In contrast, the abilities of perceptual discrimination, rote memory, and visuospatial skills appear to be essentially intact (Lincoln et al., 1988; Lockyer & Rutter, 1970; Rumsey, 1992; Rutter & Schopler, 1988; Lincoln et al., 1995, review).

Distinctive patterns of cognitive strengths and weaknesses have been observed in high-functioning autistic individuals (e.g., Allen, Lincoln, & Kaufman, 1991; Asarnow, Tanguay, Bott, & Freeman, 1987; Goldstein, Beers, Siegel, & Minshew, 2001; Iverson, 1997; Lincoln et al., 1995; Lockyer & Rutter, 1970; Ventor, Lord, & Schopler, 1992). Although there is still some degree of controversy regarding the full nature of the cognitive impairments in persons with AD (Siegel, Minshew, & Goldstein, 1996), there is general consensus that nonretarded persons with AD typically have better visual-spatial ability than verbal comprehension ability (Lincoln et al., 1988, 1995; Siegel, Minshew, & Goldstein, 1996). Lincoln et al. (1988) suggested that the more intact visual-spatial ability in nonretarded persons with AD might reflect relatively intact functions related to fluid intelligence—specifically, functions related to the processing of visual information that is independent of the evaluation of contextually relevant or language-based information. However, Minshew, Goldstein, & Siegel (1997) suggest that it is the relative complexity of intellectual demands that limits the individual with AD such that they demonstrate "impairments in skilled motor, complex memory, complex language and reasoning domains (and are relatively intact with respect to) performance in the attention, simple memory, simple language and visual-spatial domains" (p. 303).

However, this idea of a weak capacity to process complex information and problems does not fit with the relative efficiency of how well nonretarded persons with autism solve complex matrix reasoning tasks. On matrix reasoning tasks, the individual is required to evaluate multiple relationships or dimensions simultaneously and infer how a pattern can best be completed. On such tasks, all of the information necessary to solve the task is available to the examinee, so that previous experiences with the stimuli are not necessary to recall in order to be successful. However, on the types of verbal reasoning tasks typically employed on formal IQ tests, it is necessary to evaluate contextually relevant information and to use previous knowledge and experience to appropriately infer a correct solution.

The errors in solving verbal comprehension tasks made by individuals with autism often reflect their ability to attend to only one of the dimensions of the problem posed to them and their failure to evaluate the broader context. For example, a young man came to a social skill group dressed in a three-piece green suit and carried a birthday cake with a large "16" candle partially embedded in the frosting. The group leader asked another member why the young man was dressed up. The young man replied, "St. Patrick's Day."

SPECIAL CONSIDERATIONS FOR ASSESSING THE INTELLIGENCE OF AN INDIVIDUAL WITH AUTISM

There is good reason to believe that intelligence tests can be useful in ascertaining cognitive strengths and weaknesses. However, in many instances, individuals with autism will be difficult to assess because of the behaviors associated with the autism, such as language impairments, poor motivation, or limited skills. This requires the examiner to be prepared to adjust the testing situation in order to elicit the highest level of cooperation and valid responses from the examinee. It is critical that the examiner be familiar enough with the testing instruments to be able to make individual accommodations while still maintaining the reliability and validity of the test responses. This approach will provide the most reliable test interpretation, which, when combined with additional assessment data and observations, can be invaluable in the development of the most appropriate treatment plan.

There are several types of avoidant behavior that can interfere with the clinical assessment of individuals with autism. Oftentimes the examinee will be unfamiliar with the examiner and/or testing environment. Since encountering new situations and people is often very stressful for individuals with autism, they may try to run away, crawl under the table, lean back in the chair, or push materials away. We have found several strategies that help facilitate the child's engagement with the test and the examiner. One strategy is to structure the position of the testing table against the wall with the examinee's back to an adjacent wall and the examiner sitting directly across from the examinee. If necessary, assistants or parents can position their chair so that the child would have to go past them in order to get away from the testing table. In some cases, we have found it helpful to test the child with the examiner positioned directly behind the child. However, this approach means that the examiner must be prepared to present the materials from an orientation that would be the opposite of the way in which one would normally present them. Additional strategies we have found to be successful include administering the test while sitting on the floor with the examinee, giving frequent and planned breaks, and utilizing meaningful and compelling reinforcers.

Another source of difficulty that can interfere with the testing situation involves the examinee's idiosyncratic self-stimulatory behaviors, repetitive behaviors, and interest or perseveration in parts of objects. For example, an individual might get very excited over the prospect of spinning blocks when the task actually calls for them to match the designs on each face of the block to a template. They may be motivated to look at the edge of the desk with peripheral eye gaze, thus completely failing to attend to the stimuli relevant to the testing. Often such undesired behaviors are a sign that the expectations of the test are inconsistent with the examinees' level of developmental ability or that they simply do not understand what is expected of them. By titrating the level of difficulty of the tasks, one can sometimes circumvent undesired behavior and improve testing compliance.

It is also possible to use such idiosyncratic interests in the test materials or other aspects of the environment as a reward, contingent on the completion of a task that the examinee is expected to do. This works on the basic principle that any behavior that one frequently engages in is likely to be intrinsically reinforcing and, therefore, can be used to reinforce other, more desired behaviors. For example, one child we tested was very interested in pulling the office blinds up and down. He responded quite well to the prompt, "First work, then blinds." One of the core deficits in autism is significant impairments in verbal comprehension. Those who have developed language tend be relatively able to identify and recall content based on their learning and experience, but often fail to understand such content at a deeper level, which involves the integration of other areas of content, experiences, and context relevancy. This can make it difficult for the examinee to understand the verbal instructions necessary to take tests as well as for the examiner to use language in a manner that facilitates their ability to perform. This is why some children with autism can perform relatively well on subtests assessing rote knowledge, such as the WISC-IV Information subtest, but have great difficulty on Comprehension, a subtest that requires a deeper understanding of what is asked and greater verbal reasoning and judgment to produce an effective solution. It is often necessary to supplement standard tests of intelligence with specific language measures that can assess expressive and receptive speech.

It can often be the case that a major source of behavioral resistance to the test is related to selecting measures that might be age appropriate, but not developmentally appropriate. For example, the WISC-IV might be an age-appropriate test for a moderately retarded six-year-old; however, it may be inappropriate with respect to the individual's developmental level. This can also be true with respect to specific cognitive domains. For example, it is often the case that children with autism perform better on nonverbal intellectual tasks than on verbal intellectual tasks. Thus, if a six-year-old received standard scores in the mid-70s in his strongest skill areas, he might have scores below the floor of the test in his weakest skill areas. In such a case, one would have to either disregard the performance on measures that could not be sampled because the skills were too low or administer additional measures that had greater range within the domain being assessed. Therefore, it is advantageous to select measures that give enough range with respect to the domains they assess so as not to encounter a floor effect. At the minimum, one wishes to avoid obtaining raw scores of zero. At least some raw score credit is needed to consider the subtests valid, even if the standardized score is at a floor level. In general, it is recommended, particularly when young children are being assessed, that the examiner have access to test materials that cover developmental levels, from infancy through childhood. This allows the examiner to titrate the level of task demand and evaluate whether behavior compliance changes with such modification.

Similarly, it is sometimes necessary to use infant measures with an adult or adolescent with mental retardation because their developmental level is too low to be evaluated with *age-appropriate* measures. By testing at a more developmentally appropriate level, it is sometimes possible to increase cooperation and valid response. For example, a severely retarded and nonverbal 14-year-old with autism may have the capacity to stack eight cubes and build a three-block bridge, tasks at approximately the 24–30-month level, but may only demonstrate the receptive and expressive language skills at the 6–8-month level. Developmental tests such as the Bayley Scales for Infant Development II (Bayley, 1993) or the Mullen Scales of Early Learning (1995) may be useful in capturing measurable behavior in such a delayed individual. In most cases, it is mental retardation more than autism that limits the functional capacity of the individual.

INTELLIGENCE TESTING AND AUTISM

The assessment of intellectual abilities has a long history and a scientific foundation beginning as early as the late 1800s. The history of the science of intelligence involves various efforts to define the construct as well as the development of methods used to operationalize and measure various specific skills that were believed to be related to higher-order intellectual operations. The important point here is that we never really directly measure intelligence; rather, we measure specific skills that we believe are theoretically related to higher-order intellectual operations. For example, on the Wechsler Adult Intelligence Scale: III, three subtests, Vocabulary (verbal definitions), Similarities (the ability to express abstract verbal concepts), and Information (the ability to recall specific facts), are each administered. Their raw scores are converted to standard scores, the standard scores are summed, and, subsequently, the sum of the standard scores is converted to a Verbal Reasoning Index (VRI) standard score. This VRI score is considered to be a higher-order intellectual operation that is related to Verbal IQ, a still higher-level intellectual operation. We do not directly sample Verbal IQ; rather, we measure it indirectly by having an individual perform various tasks. Thus, the scores on these tasks allow us to operationalize a construct of verbal intelligence. Wechsler made it very clear that intelligence was not simply measured as a sum of various skills, but also as the successful integration of such skills. The so-called idiot savant or autistic savant may have very strong skills in one or more areas such as calendar memory, the ability to solve puzzles, or photographic memory, but if these isolated abilities are not integrated with other skills necessary to support intellectual functions, they may not support successful adaptation and life skill competency.

Most of our understanding about the nature of human intelligence is based on factor analytic studies that have employed a wide range of measures that assess various aspects of information-processing and problem-solving skills. Horn (1991) recently proposed the Cattell-Horn-Carroll (CHC) model (Carroll, 1997), which describes intelligence through a factor analysis that includes at least four relatively independent or orthogonal intellectual domains. These domains or factors include Fluid intelligence (Gf; one's ability to solve novel problems that does not depend on school-acquired knowledge and acculturation), Crystallized intelligence (Gc; one's school-acquired knowledge and acculturation), Broad Visualization (Gv; one's ability to engage in fluent visual scanning, Gestalt closure, rotate figures, and see reversals), and Auditory Processing (Ga; one's ability to process auditory information). These domains are not believed to be inclusive of all aspects of human intelligence. Rather, they represent the best understanding of how various tasks group together through the statistical process of factor analysis. Thus, subtests that have their greatest correlation with one of the above factors tend to correlate more with each other than with subtests that have their greatest correlation on one of the other orthogonal factors.

The current version of the child and adult versions of the intelligence tests originally developed by David Wechsler, the Wechsler Intelligence Scale for Children: IV (WISC-IV; 2004) and the Wechsler Adult Intelligence Scale: III (WAIS-III; 1997), each have a factor structure consistent with CHC model of intelligence. This is also true of the Kaufman Assessment Battery: 2nd Edition (K-ABC–2; Kaufman & Kaufman, 2004) and the Leiter International Performance Scale–Revised. The WISC-IV and the K-ABC–2 include clinical samples of children diagnosed with autism during the standardization and report information on the performance of these children with respect to the distribution of their IQ scores, index scores, and subtest scale scores. The Leiter-R has been independently studied with respect to the performance of children with autism in two separate studies (Hanzel & Lincoln, submitted; Tsatsanis et al., 2003).

The WAIS-III and the WISC-III and WISC-IV

Factor analytic studies of the Wechsler scales have shown that the Block Design and Object Assembly subtests load primarily on a single factor, referred to as the Perceptual Organization factor, and the Vocabulary and Comprehension subtests load on an orthogonal factor, the Verbal Comprehension factor (Wechsler, 1974, 1986, 1991, 1997; Wechsler et al., 2004). It is further believed that the Perceptual Organization Factor is more related to fluid intelligence, which is believed to be more innate and biologically determined, whereas the Verbal Comprehension factor is more related to crystallized intelligence, which is believed to be influenced by learning, culture, and environment (Kaufman, 1994; Wechsler, 1974, 1986, 1991).

There has been consistent replication in the literature regarding intellectual performance on selected subtests of the various versions of the Wechsler Adult Intelligence Scales (WAIS, WAIS-R, and WAIS-III) and the Wechsler Intelligence Scale for Children (WISC, WISC–R, WISC-III, and WISC-IV), demonstrating that groups of AD individuals perform relatively well on Block Design and Object Assembly subtests (Iverson, 1997; Lincoln et al., 1995; Siegel et al., 1996). Those studies also indicate that persons with AD perform relatively poorly on Vocabulary and Comprehension subtests.

Table 29.1 lists WISC-IV global IQ and subtest scale scores reported in the WISC-IV manual for a cohort of children diagnosed with autism (meeting DSM-IV-TR criteria), ages 7 to 16. There were 2 females and 17 males in the sample (Wechsler et al., 2004). The relative discrepancy among these subtests may be less evident, particularly between Comprehension and Block Design relative to other studies employing various versions of the WISC (see Table 29.3).

Thus, in Table 29.1 there is only a 5.5-point difference between the Verbal Comprehension Index (80.2) and the Perceptual Reasoning Index (85.7). In addition, there is only a

TABLE 29.1.
Descriptive Statistics: Mean WISC-IV Index and Subtest Scores and Standard Deviations for Matched Control (MC) and Autistic Disorder (AD) Group

	Autistic disorder		*Matched control*	
Verbal Comprehension Index	80.2	(17.4)	106.1	(12.0)
Perceptual Reasoning Index	85.7	(20.6)	101.6	(12.2)
Working Memory Index	76.9	(16.5)	102.9	(13.1)
Processing Speed Index	70.2	(18.3)	96.8	(12.2)
Full Scale IQ	76.4	(19.5)	103.9	(11.1)
Block design	7.9	(3.5)	10.1	(3.2)
Similarities	7.0	(3.3)	11.5	(2.3)
Digit span	6.2	(3.1)	10.6	(3.2)
Picture concepts	7.4	(4.0)	10.3	(2.3)
Coding	4.0	(3.3)	8.5	(3.3)
Vocabulary	7.2	(3.2)	11.2	(2.2)
Letter-number sequencing	5.5	(3.6)	10.8	(2.0)
Matrix reasoning	7.7	(3.9)	10.4	(3.4)
Comprehension	5.3	(4.0)	11.1	(2.6)
Symbol search	5.2	(3.7)	10.2	(2.5)
Picture completion	6.5	(3.8)	10.0	(3.4)
Cancellation	6.3	(3.6)	8.7	(4.1)
Information	7.1	(3.7)	10.2	(2.5)
Arithmetic	8.2	(4.4)	8.7	(1.2)
Word reasoning	6.8	(3.3)	10.8	(3.1)

2.6-point difference between Block Design (7.9) and Comprehension (5.3) subtests. Furthermore, there is only a 0.7-point difference between Block Design (7.9) and Vocabulary (7.2) subtests. There were no significant differences between the groups. However, a more recent study (Quirmbach & Lincoln, submitted) that included 41 children diagnosed with autism demonstrated significant discrepancies among WISC-IV subtests; this corroborates previous research that indicated performance discrepancies in individuals with autism on the Wechsler Intelligence Scales (e.g., Lincoln et al., 1995). In the current study, the WISC-IV was administered to 41 children aged 6–14 (mean age 9.4 years) who were diagnosed with autism according to the DSM-IV-TR criteria and the Autism Diagnostic Observation Schedule (ADOS). The sample included 3 females and 38 males. Participants ranged in Full Scale IQ between 42 and 122. The results are presented in Table 29.2.

Table 29.2 shows a significant ($p < .05$) 18.5-point difference between the Verbal Comprehension Index (75.4) and the Perceptual Reasoning Index (93.9). In addition, there is a significant ($p < .05$) 6.6-point difference between the Block Design (10.9) and Comprehension (4.3) subtests. Furthermore, there is a significant ($p < .05$) 4.7-point difference between the Block Design (10.9) and Vocabulary (6.2) subtests.

In Table 29.3, mean WISC scores for verbal subtests are significantly lower than Block Design subtests for children with autism. The most significant difference is between the Block Design subtest and the Comprehension subtest.

The sample of children with autism included in the WISC-IV manual (Wechsler et al., 2004) all had a Full Scale IQ above 60. Thus, Quirmbach & Lincoln (submitted) also conducted analyses in which seven children with a Full Scale IQ less than 60 were excluded in order to determine whether discrepancies among subtests would still be evident. When the data were analyzed, which included 34 children with autism with a Full Scale IQ of at least 60, there were still discrepancies across subtests. There is a 16.7-point difference between the Verbal Comprehension Index (81.4) and the Perceptual Reasoning Index (98.1). In addi-

TABLE 29.2.
Descriptive Statistics: Mean WISC-IV Index and Subtest Scores and Standard Deviations for Autistic Disorder (AD) Group

	Autistic disorder	
Verbal Comprehension Index	75.4	(25.4)
Perceptual Reasoning Index	93.9	(15.4)
Working Memory Index	79.4	(22.9)
Processing Speed Index	83.4	(18.7)
Full Scale IQ	79.7	(21.3)
Block design	10.9	(3.2)
Similarities	7.5	(4.9)
Digit span	7.3	(4.7)
Picture concepts	7.2	(3.5)
Coding	6.4	(3.0)
Vocabulary	6.2	(4.9)
Letter-number sequencing	5.8	(4.3)
Matrix reasoning	8.9	(3.3)
Comprehension	4.3	(4.0)
Symbol search	7.7	(4.5)

TABLE 29.3.
Descriptive Statistics: Mean WISC Subtest Scores Comparing Different Samples of Children with Autistic Disorder (AD) and Typically Developing Children

Subtest	*WISC-IV (Quirmbach & Lincoln, submitted)*	*WISC-III (Hanzel et al., submitted)*	*WISC-III (Hanzel et al., submitted)*	*WISC-III (Iverson, 1997)*	*WISC-III (Iverson, 1997)*	*WISC-R (Iverson, 1997)*
N	**41**	**20**	**20**	**20**	**22**	**34**
Ages	**6–14**	**7–14**	**7–13**			
Diagnosis	**Autism**	**Autism**	**Normal control**	**Autism**	**Normal control**	**Autism**
Block design	10.9	11.9	11.4	13.8	9.6	11.1
Comprehension	4.3	2.6	12.2	3.2	9.5	1.7
Vocabulary	6.2	5.9	12.3	4.3	8.5	3.9

tion, there is a 6.3-point difference between the Block Design (11.4) and Comprehension (5.0) subtests, as well as a 4.1-point difference between Block Design (11.4) and Vocabulary (7.3). Although discrepancies are evident in this sample, the children included (aged 6–14) were younger than the WISC-IV manual sample, which included children aged 7–16. High functioning children with autism may tend to improve their verbal skills with age. Thus, perhaps the discrepancy between verbal and nonverbal reasoning skills decreases as children get older. However, findings from Quirmbach & Lincoln (submitted) are very similar to the intellectual profile previously identified, demonstrating that children with autism tend to perform significantly better on nonverbal reasoning tasks (i.e., the Block Design subtest) than on verbal tasks (i.e., the Comprehension and Vocabulary subtests; e.g., Lincoln et al., 1995). In Table 29.3, subtest scores demonstrate the discrepancies between verbal subtests, including Comprehension and Vocabulary, and the Block Design subtest.

The Leiter International Performance Scale and the Leiter International Performance Scale-Revised

Disturbances of speech and language have been observed in individuals diagnosed with autism, regardless of age or developmental stage (Lord & Paul, 1997; Simmons & Baltaxe, 1975; Tager-Flusberg, Joseph, & Folstein, 2001). Even with progress in other impaired areas of functioning, the disabilities of speech and language remain major handicaps in later development, with approximately 50% of the population acquiring no language skills at all (Eisenberg, 1956; Eisenberg & Kanner, 1956; Kanner, 1971; Lord & Paul, 1997; Minshew et al., 1997). Thus, encountering individuals of this population in clinical practice can often require the use of assessment instruments that do not depend on verbal language ability (Marcus, Flagler, & Robinson, 2001).

The Leiter International Performance Scale (1948) was originally intended to be a nonverbal version of the Stanford-Binet scale, following the concept of measuring intelligence in terms of developmental age (Sattler, 1992). However, it had severe psychometric limitations as an objective assessment tool. There is little description of the standardization sample, and there are no reliability or validity statistics reported in the manual. Because the most recent revision was created in 1948, items are outdated and the scores at each level appear to be uneven. In spite of these limitations, it had been recommended for use with language-handicapped (Sattler, 1992), hearing-impaired, and various other groups of children with special needs (Roid & Miller, 1997).

The current revision of the Leiter (Leiter-R; Roid & Miller, 1997) was created in order to update and substantiate this unique and significant assessment instrument. The Leiter-R was standardized on a sample of 2,000 children throughout the United States. Extensive tests of reliability and validity have been performed (Gridley, Bos, & Roid, 1996; Madsen, Roid, & Miller, 1996; McLellan & Walton, 1996; Roid, 1996; Roid & Miller, 1997). In keeping with recent advances in research of intelligence theory by Horn (1988, 1994), Gustaffson (1984), and Carroll (1993, 1997), the individual test items were analyzed and reorganized to match the factors of cognitive ability (Roid & Miller, 1997).

Gf/Gc Theory of Intelligence Supporting the Leiter-R

The Leiter-R was designed around a hierarchical model of intelligence that includes a general intelligence factor (*g*; Gridley et al., 1996). This model includes the theory of fluid (Gf), crystallized (Gc), and broad visualization (Gv) abilities discussed by Horn and Cattell

(Horn & Catell, 1966; Gustafsson, 1984; Carrol, 1993). Extensive factor analyses resulted in the final three-tiered hierarchical model of intelligence: a general (*g*) intelligence factor at the apex; fluid abilities (Gf), crystallized abilities (Gc), and broad visualization (Gv) in the second tier; and numerous smaller factors in the third tier. This model of intelligence provided the theoretical framework for the development of the Leiter-R (Madsen et al., 1996; Roid & Miller, 1997).

Items were designed to measure the primary domains in this theory of intelligence. Fluid reasoning (Gf) tasks included matrix reasoning, sequencing of figural patterns, figural analogy, and functional classification. General visualization (Gv) measures include figural rotation, figural matching, spatial orientation, gestalt closure, and picture completion. Tasks that measure memory (short-term Gsm and long-term Gtsr) include immediate and delayed recognition of pictorial objects, immediate and delayed associative (pictorial) memory, spatial memory (a matrix grid of pictured objects must be recalled in correct spatial order), and memory for sequential orders of pictured objects (the examiner points to the pictures in a prescribed order, and the subject replicates the sequences after a 10-second delay) in both forward and backward sequences. Two subtests were developed to measure attention abilities, one sustained scanning task in which subjects must find all replications of a specific object on a specific page and one divided attention task that requires divided attention between pointing to prescribed objects and concurrently sorting cards. Items and subtests used to measure crystallized ability (Gc) were not included, as it has been defined to measure verbal abilities and knowledge acquired through education (Gustafsson, 1984; Horn, 1994). The Leiter-R was developed as a nonverbal, culture-free battery that did not require the use of verbal skills or skills acquired through verbal ability (Gridley et al., 1996).

Assessment with the Leiter-R

In the original standardization research, 11 categories of atypical children were compared with the standardization sample, including severe speech and language impairment, severe motor delay or deviation, and significant cognitive delay (mental retardation; Roid & Miller, 1997). Since the 1997 release of the Leiter-R, additional research with the Leiter-R has begun to become available on the performance of comparison samples of children in various diagnostic categories as well as children with autism (Hanzel & Lincoln, submitted; Tsatsanis et al., 2003).

Tsatsanis et al. (2003) assessed a "low-functioning" group of children with autism and evaluated their performance on both the current Leiter-R and older version of the Leiter. The sample consisted of 26 children ranging in age from 4 to 16 years. The correlation between the Leiter scales was high ($r = .87$), and there was a difference of 3.7 points between the two mean scores, which is not significant at either the statistical or the clinical level. However, significant intraindividual discrepancies were present in 10 cases, 2 of which were both large (24 and 36 points) and clinically meaningful. The mean profile of performance on Leiter-R subtests is also presented for this sample of children with autism, in order to allow for comparison with other groups. Based on the results of this initial evaluation, together with the current normative data, good psychometric properties, and availability of global and subtest scores with the Leiter-R, the instrument is generally recommended for use with children with autism. However, because of changes in the design of the Leiter-R, there may be greater clinical success with the original Leiter for those children who are very low functioning and severely affected, particularly younger children.

Hanzel and Lincoln (submitted) found similar results with a higher functioning sample of children. The subjects in this study included 20 children with high-functioning Autistic

Disorder (AD-HF), ranging in age from 7 to 14 years, and 20 children without any significant psychological disorders, ranging in age from 7 to 13 years. There were 2 females and 18 males in both the AD-HF group and the Normal Control (NC) group. All subjects were Caucasian. The AD-HF group contained subjects ranging in age from 7 years 8 months to 14 years 4 months, with a mean average of 11 years 3 months. The NC group subjects ranged in age from 7 years 7 months to 13 years 1 month, with a mean average of 10 years 8 months. Subjects in both the AD-HF group and the NC group were from lower-middle-class and middle-class families (see Table 29.4 and Figure 29–1).

Table 29.5 shows correlations among Leiter-R and WISC-III IQ and Index scores. As can be seen in Table 29.5, the significant correlation between the two measures supports the validity of the Leiter-R. The results from this study indicate that the Leiter-R is a valid measure of the domains measured in the more established measures of intelligence and cognitive abilities, with standardization and administration not dependent on any verbal mediation (Roid & Miller, 1997). The strong correlations of the Full Scale and Fluid Reasoning measures with the Full Scale and Performance measures of the WISC-III provide support for its use as an option as a nonverbal measure of cognitive abilities. The confirmatory factor analyses supporting the theoretical model of a hierarchical factor structure of the subtests with single (g) factor and secondary factors of fluid reasoning (Gf) and visualization (Gv) are evidenced in the initial and subsequent validity and reliability research (Bos, Gridley, & Roid, 1996; Bay, 1998).

In general, nonverbal assessment as utilized in the Leiter-R can be particularly important in the assessment of autism. Children with autism have demonstrated unique abnormalities in functions of memory (Ameli, Courchesne, Lincoln, Kaufman, & Grillon, 1988; Lincoln, et al., 1995; Lincoln, Dickstein, Courchesne, Elmasian, & Allen, 1992; Minshew & Goldstein,

TABLE 29.4.
Descriptive Statistics: Leiter-R Visualization & Reasoning Battery Composite Scores and WISC-III Scale and Corresponding Factor Scores Normal Control (NC) Group and High-Functioning Autistic Disorder (AD-HF) Group

Leiter-R Visualization & Reasoning Battery

	NC group		*AD-HF group*	
	Mean	*SD*	*Mean*	*SD*
Fluid reasoning	106.80	15.51	92.10	21.10
Full scale	108.50	16.41	92.15	20.48

WISC-III

	NC group		*AD-HF group*	
	Mean	*SD*	*Mean*	*SD*
Verbal	113.75	13.56	74.85	17.27
Performance	103.00	10.87	93.85	16.67
Full scale	108.95	12.85	82.55	15.67
Verbal comprehension (VC)	113.50	13.48	76.90	17.59
Perceptual organization (PO)	104.00	11.67	98.80	15.92

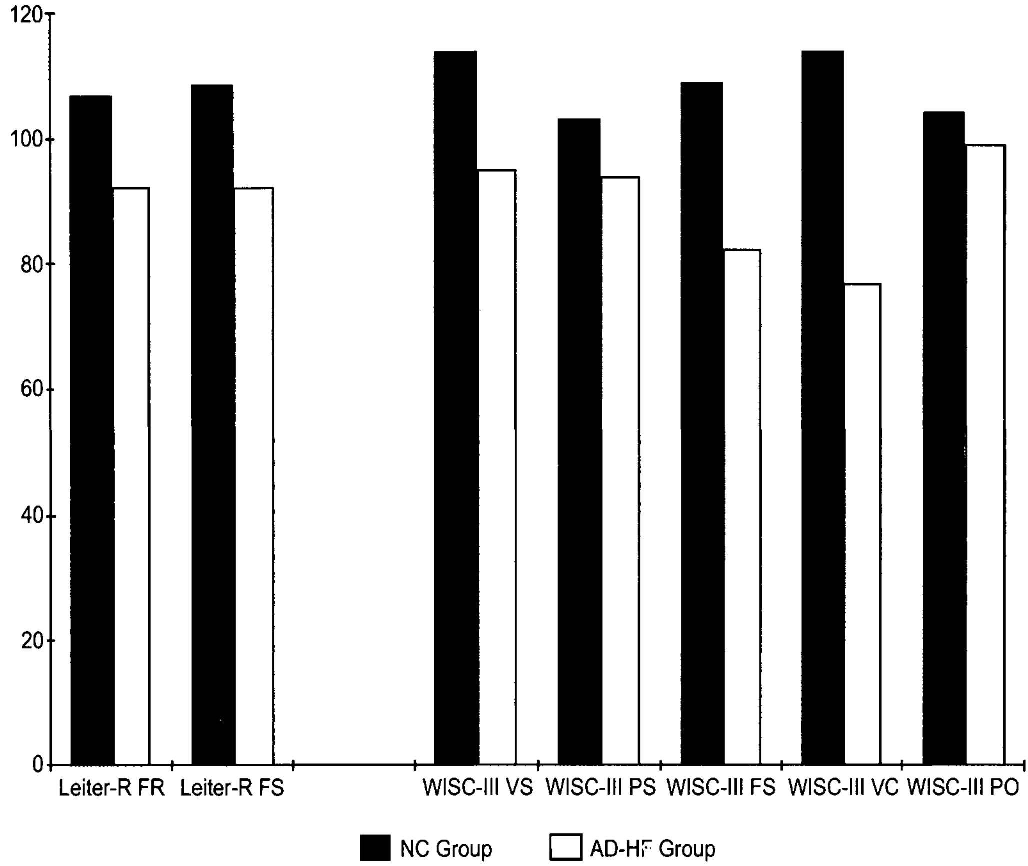

FIGURE 29–1. Leiter-R fluid reasoning and full scale scores, WISC-III scale and corresponding factor scores, normal control (NC) group, and high-functioning autistic disorder (AD-HF) group.

2001; Prior & Chen, 1976) and attention (Allen & Courchesne, 2001; Courchesne, Lincoln, Kilman, & Galambos, 1985; Courchesne et al., 1994; Garretson, Fein, & Waterhoouse, 1990; Goldstein et al., 2001; Minshew & Goldstein, 2001). The Attention and Memory battery of the Leiter-R contains subtests that measure areas of specific weakness for children with AD-HF, including echoic memory, memory of meaningful and meaningless stimuli, short-term and long-term memory, working memory, and sustained and shifting attention. The Visualization and Reasoning battery also includes measures with socially meaningful stimuli (people, animals, and objects in everyday social context) as well as stimuli not dependent on social context and awareness (shapes and sequences). The variety of measures across both batteries allows for detailed and comprehensive focused evaluation of many of the core features unique to autism.

Disadvantages of the Leiter-R

Although a significant advantage of the Leiter-R is its nonverbal standardization, this feature is likewise a disadvantage in its assessment of children with AD-HF. Children with high-

TABLE 29.5.
Correlations between Leiter-R Fluid Reasoning (Gf) and Full Scale Scores and WISC-III Scale and Corresponding Factor Scores Normal Control (NC) Group High-Functioning Autistic Disorder (AD-HF) Group

	NC group		*AD-HF group*	
	Corr	*p value*	*Corr*	*p value*
Leiter-R Fluid Reasoning (Gf) Score				
WISC-III Verbal Scale	.506*	.023	.599**	.005
WISC-III Verbal Comprehension Factor	.533*	.016	.549*	.012
WISC-III Performance Scale	.709**	.000	.587**	.007
WISC-III Perceptual Organization Factor	.706**	.001	.513*	.021
WISC-III Full Scale	.735**	.000	.679**	.001
Leiter-R Full Scale Score				
WISC-III Verbal Scale	.499*	.025	.460*	.041
WISC-III Verbal Comprehension Factor	.549*	.012	.404	.078
WISC-III Performance Scale	.608**	.004	.563**	.010
WISC-III Perceptual Organization Factor	.702**	.001	.496*	.026
WISC-III Full Scale	.695**	.001	.582**	.007

*Correlation is significant at the 0.05 level.
**Correlation is significant at the 0.01 level.

functioning autistic disorder (WISC PIQ > 70) have by definition higher language skills than autistic children with a WISC PIQ < 70 (Bartak & Rutter, 1976). This is especially the case if the more stringent definition of high-functioning autistic disorder is used (WISC VIQ and FSIQ > 70; Minshew, Goldstein, Muenz, & Payton, 1992; Siegel et al., 1996). Therefore, the absence of spoken language in relating directions and requests, as well as communicating responses, is potentially confusing and stressful for children with AD-HF. The Leiter-R administration procedures allow for adjustment of the administration to "combine brief verbalizations with the standardized nonverbal pantomime procedures" (Roid & Miller, 1997, p. 3). However, because the Leiter-R was standardized only on complete nonverbal administration, the authors recommend "caution . . . in using the Leiter-R normative scores if standardized administration instructions are radically changed" (Roid & Miller, 1997, p. 76). No instructions are provided for determining when and how to adapt administration as well as how much the normative scores may be affected.

Other difficulties with the nonverbal nature of the Leiter-R may arise because of the general impairment of nonverbal communication (gestural, affective, and facial) and verbal communication (Bartak, Rutter, & Cox, 1975; Marcus et al., 2001; Ohta, 1987) as seen in individuals with autism. On each subtest, the child uses card selection or points to the test stimulus to communicate responses. Instructions are communicated by the examiner initially by imitation. If the child does not understand the task, then it is suggested that the examiner "gently help the child to point to the correct item" (Roid & Miller, 1997, p. 23). Inasmuch as it is common for children with autism to have the associated feature of "odd responses to sensory stimuli . . . oversensitivity . . . to being touched" (DSM-IV-TR, 2000, p. 72), this alternative can be particularly aversive.

The physical test materials of the Leiter-R can also be difficult to manage, especially when adjustments are needed to engage an examinee. Many of the subtests require the use of cards and an easel. This can quickly become problematic when a child starts losing interest, wants to move quickly, and, for example, begins to throw or mix up the cards. The administration format also requires the examiner to score responses by looking over the top of the easels and viewing the stimulus upside down. This can be particularly difficult when a child points to responses quickly and when the sequencing stimuli are presented by the examiner, such as in Forward Memory and Reverse Memory.

The nonverbal standardized administration of the Leiter-R provides a way to limit the inherent bias of instruments requiring spoken language. Though the verbal abilities of children with autism can vary significantly across IQ levels, the hallmark deviance in communication and use of language appears to be pervasive across all levels of functioning of autistic individuals (Lord & Paul, 1997; Tager-Flusberg, 1999). As a result, even when children have some or even significant speech and vocabulary, relying on verbal mediation to access other cognitive abilities can result in inaccurate and misleading data (Marcus et al., 2001).

CASE STUDY: A 12-YEAR-OLD BOY WITH AUTISTIC DISORDER BASED ON THE WISC-IV

Reason for Referral and Behavioral Observations

Tyler was brought in for an assessment by his parents because of current difficulties with his social and academic functioning. Tyler was originally diagnosed with autism at the age of three. Tyler can be characterized as shy and eccentric. He demonstrates poor eye contact, engages in immediate and delayed echolalia, has difficulty sustaining conversation with others, and engages in self-stimulatory behaviors (such as hand-flapping).

Findings

Tyler was administered the Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV), Autism Diagnostic Observation Schedule (ADOS)–Module 2, and the Reading Recognition and Reading Comprehension subtests of the Peabody Individual Achievement Test–Revised. Tyler's WISC-IV results are presented in the tables.

Tyler's distinctive thinking and reasoning abilities make up an intellectual profile that is difficult to characterize by a single score derived from the WISC-IV. His nonverbal reasoning abilities are much better developed than his verbal reasoning abilities.

Tyler's significant verbal weaknesses include his performance on the Comprehension and Vocabulary subtests. Tyler has difficulty providing oral solutions to everyday problems and explaining the underlying reasons for certain social rules or concepts. For example, when asked, "Why is it important for police to wear uniforms?" Tyler responded, "The police are for to get people when they are bad." Thus, Tyler was unable to answer the question but responded to an association he was familiar with—the importance of having police officers. Similarly, when asked to "Tell me some reasons that you should turn off lights when no one is using them," Tyler responded, "Turn them off." The examiner repeated the question, to which Tyler responded "Turn off the light switch."

Thus, Tyler was unable to answer the question asked; he told the examiner the rule he learned about "turning off the light switch" without understanding the reason behind the rule. Typically, individuals diagnosed with Autistic Disorder have difficulty understanding social situations, comprehending conventional standards of social behavior, and using sound social judgment. In addition, Tyler performed much better on abstract categorical reasoning and concept formation tasks that did not require verbal expression (Picture Concepts) than those that required verbal expression (Similarities).

Tyler performed in the Average range on nonverbal reasoning subtests. His score on Block Design (91st percentile) is a significant strength for Tyler compared with his peers. Thus, Tyler is skilled at mentally organizing visual information and analyzing part-whole relationships when information is presented spatially. It is common for individuals diagnosed with Autistic Disorder to score higher on Block Design than on other subtests. Other strengths for Tyler, compared with his overall mean score on the WISC-IV, include Picture Concepts and Matrix Reasoning. Thus, Tyler demonstrated strengths in fluid visual information processing, fluid reasoning, and abstract reasoning skills.

Tyler had difficulty sustaining attention, concentrating, and exerting mental control, as shown by his performance in the Extremely Low range on the Working Memory Index. This may impede Tyler's performance in a variety of academic areas, but especially on tasks that require him to solve numerical problems in his head. Tyler's ability to process simple or routine visual material without making errors, as measured by the Processing Speed Index, is quite variable. He demonstrated more skill on Symbol Search than Coding. Thus, Tyler demonstrated excellent mental control when information was presented visually (Symbol Search) and had difficulty when asked to complete fine motor tasks (Coding).

Based on the WISC-IV, Tyler's performance demonstrates a profile commonly shown by children diagnosed with autism. His nonverbal skills are significantly better developed than his verbal skills. Specifically, he shows a significant strength on Block Design and significant deficits on the Comprehension and Vocabulary subtests. Similar to his poorly developed verbal skills, Tyler demonstrated reading deficits according to the Peabody Individual Achievement Test–Revised (PIAT–R). Although Tyler is currently in the sixth grade, his reading recognition and reading comprehension are estimated to be at the second-grade level.

Summary and Recommendations

The current evaluation demonstrates that Tyler's overall skills correspond with the profile of autism. He may benefit from social skills interventions, such as social skills groups or social stories, which facilitate improvement in his social awareness and his relationships with others. Based on his intellectual profile, it is very likely that he needs support in academic areas. He may benefit from completing reading comprehension exercises on a regular basis in order to improve his verbal skills. In addition, it is likely that Tyler may benefit from practice with mental arithmetic problems, in order to strengthen his working memory. Thus, a tutor who works with Tyler one on one in the classroom, providing step-by-step instructions through visual means, is likely to benefit Tyler the most. Although it is clear that he is quite capable of effective visual-spatial processing, these abilities are not integrated with his verbal reasoning ability. His significant comprehension deficits and symptoms of autism are likely to be a primary factor in limiting his social adaptation and academic progress.

SUMMARY COMMENTS

The intellectual abilities of individuals with autism can be accurately assessed with standardized tests that are currently available. The current versions of the child and adult Wechsler scales, the Leiter International Performance Test–Revised, and the K-ABC-II are three instruments that have each been researched with respect to the assessment of intelligence in persons with autism. Aside from their excellent psychometric properties, each has a theoretical foundation in the most contemporary theory regarding the nature of human intelligence. A thoughtful and skilled clinician can obtain meaningful data about the individual with autism. This information can be used to describe meaningful individual differences with respect to neurocognitive performance and be useful in the development of treatment and psychoeducational intervention.

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