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# Research in Autism Spectrum Disorders

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## Differences in verbal and nonverbal IQ test scores in children with autism spectrum disorder

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### ABSTRACT

**Background:** Intelligence tests are a fundamental component of diagnostic assessments for children with suspected autism spectrum disorder (ASD). There are many assessments available, but scores across tests may not be comparable in children with ASD.

**Method:** Eighty children (68 boys) age 4–14 years with ASD completed the Stanford-Binet Intelligence Scales, 5th Edition (SB5), a verbal measure of intelligence, and the Leiter International Performance Scale – Revised (Leiter-R), a nonverbal measure of intelligence.

**Results:** Although discrepancies went in both directions, we found significantly higher mean scores on the Leiter-R than SB5 (9.6 point difference). Children younger than 8 years had more pronounced discrepancies (13.8 points vs. 3.5 points for > 8 years), and children with less-developed language skills had greater discrepancies (13.1 points vs. 5.8 points for higher language skills).

**Conclusion:** This suggests these IQ tests are not interchangeable and language demands may produce different results that could impact clinician interpretation. Both clinicians and researchers should be aware of the likely impact of adopting primarily verbal vs. nonverbal tests when assessing children with ASD, especially those with less language.

### 1. Introduction

Autism spectrum disorder (ASD) is a heterogeneous disorder with about 50% classified as having below average intellectual functioning (Centers for Disease Control & Prevention, 2014). Because intellectual ability is highly predictive of long-term outcomes in children with ASD, IQ testing is a fundamental component of assessment in this population (Klaiman, Fernandez-Carriba, Hall, & Saulnier, 2015). The Diagnostic and Statistical Manual for Mental Disorders, 5th edition (DSM-5; American Psychiatric Association, 2013) requests that clinicians document the presence or absence of intellectual disability (ID) in the diagnostic evaluation of children and adults with ASD. Knowledge of the person's IQ is also often helpful both in clinical care and in research.

Results of IQ testing for children with ASD provide a baseline measurement for future comparisons, may be essential to determine

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appropriate school placement, and often inform treatment planning. For example, test results may guide clinical decisions on the selection of treatment programs and advise parents and educators on supports needed for the child. Intelligence tests may be based on different theories of intelligence and thus vary in their focus, degree of dependence on language, and target age group. Further, core symptoms of ASD, such as restricted and repetitive behaviors, can impede administration of the test, making testing challenging and limiting the utility of the result (Baum, Shear, Howe, & Bishop, 2015). Because of this variability, available IQ tests may not produce congruent results; further, scores may be impacted by child characteristics and symptomatology that are independent of intelligence.

Most intelligence tests (e.g., Wechsler Intelligence Scales for Children, 5th edition [WISC-V]; Wechsler, 2014; Stanford-Binet Intelligence Scales, 5th edition [SB5]; Roid, 2003) include assessment of multiple domains (e.g., quantitative, working memory, processing speed) in order to evaluate several aspects of intelligence. Scores in these different areas are combined to produce composite indices of intellectual ability. Questions on these types of IQ tests are usually verbally administered and answers are either verbal or involve task completion. Implicit in the ASD core symptom of social communication deficits (DSM-5; American Psychiatric Association, 2013) is the frequent co-occurrence of language problems. Language difficulties may range from relatively mild, with delays in meeting language milestones, to as severe as being functionally nonverbal (American Psychiatric Association, 2013; Tager-Flusberg, 2015). Thus, reliance on language for assessing IQ may be problematic and could potentially result in underestimation of the individual's cognitive abilities. This was demonstrated in a report by Coolican et al. (2008) that children with ASD had weaker verbal performance compared to nonverbal sections on the SB5 (2012), and by findings of other researchers (Mayes & Calhoun, 2003) using different intelligence assessments. Nonverbal IQ tests, such as the Leiter International Performance Scale–Revised (Leiter-R; Roid & Miller, 1997) and the Test of Nonverbal Intelligence, Fourth Edition (TONI-4; Brown, Sherbenou, & Johnsen, 2010), offer viable alternatives to verbal IQ tests. These tests do not require verbal answers, are less reliant on verbal instructions, and can provide reliable and valid results on cognitive performance across a variety of domains (Roid & Miller, 1997).

Intelligence tests are designed to be interchangeable because the tests strive to measure general cognitive abilities, albeit not always using identical approaches. This reciprocal element is for ease of comparison and to prevent retest effects from overexposure to a single instrument. While results on different IQ tests may be interchangeable in typically developing children, they may not be equivalent in children with ASD. For example, Nader, Courchesne, Dawson, & Soulières (2016) compared the WISC-IV (Wechsler, 2003) with Raven's Progressive Matrices (Raven et al., 1998) and found no difference in performance for typical children. However, in children with ASD, scores on Raven's Progressive Matrices were significantly higher than on the WISC-IV full scale.

The Stanford-Binet Intelligence Scales (SB) and Leiter International Performance Scale (Leiter) have also been compared in this respect. In 1983, Reeve, French, & Hunter (1983) compared the Leiter (Leiter, 1979) and the SB Form L-M (Terman & Merrill, 1972). No significant discrepancies were found in typically developing children. Conversely, Grondhuis and Mulick (2013) evaluated the SB5 and Leiter-R in children between 3 and 12 years of age with autistic disorder or pervasive developmental disorder not otherwise specified (PDD-NOS). They found substantial differences between tests. Children in their sample scored higher (by 21.91 points) on the Leiter-R than on the SB5 ( $SD = 15.72$ ); children younger than 6 years displayed greater discrepancies between tests ( $M = 28.56$  points) than those 6 years and older ( $M = 16.58$  points). The sample was small ( $N = 47$ ), and it only included children with two of the DSM-IV-TR subtypes (autistic disorder or PDD-NOS), warranting further study.

The current study used data from a randomized trial of risperidone alone versus risperidone plus parent training in children with ASD conducted by the Research Units on Pediatric Psychopharmacology (RUPP) Autism Network (Aman et al., 2009; Scahill et al., 2012). Here, we compare the SB5 and the Leiter-R, two IQ assessments frequently used in children with ASD, and we also explore differences across age, sex, and communication ages. Our hypotheses included:

1. Mean Leiter-R IQs will be significantly higher than SB5 IQs for these participants.
2. Younger children will display greater differences between Leiter-R and SB5 IQ, as their ASD-related communication deficits will be relatively more pronounced than in older participants.
3. Division by Communication age on the Vineland Adaptive Behavior Scales (Vineland; Sparrow, Balla, & Cicchetti, 1984) will show greater discrepancies between IQ tests, favoring the Leiter-R for children having lower communication ages.

## 2. Methods

### 2.1. Background

The three-site study of 124 children was conducted by the RUPP Autism Network between 2004 and 2007. The Institutional Review Boards at Indiana University, Ohio State University, and Yale University approved the study and written informed consent was obtained from parents prior to participation. Eligible subjects were randomly assigned in a 2:3 ratio to risperidone alone or to combined treatment (risperidone plus parent training) for 24 weeks (Aman et al., 2009; Scahill et al., 2012). Subjects were required to be healthy and medication-free by baseline of the study (Scahill et al., 2009). Participants were 4 to 14 years of age, had DSM-IV-TR (American Psychiatric Association, 2000) diagnoses of autistic disorder, Asperger's disorder, or PDD-NOS, IQs  $\geq 35$ , and displayed severe disruptive behavior ( $18 \geq$  on the Irritability subscale of the Aberrant Behavior Checklist and a Clinical Global Impression – Severity score  $\geq 4$ ). Although these children were diagnosed using DSM-IV-TR criteria, for ease of communication we shall refer to their diagnoses as ASD.

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