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Assessing the Minimally Verbal School-Aged Child with Autism Spectrum Disorder

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Abstract

This paper addresses the issue of assessing communication, language, and associated cognitive and behavioral abilities of minimally verbal children with Autism Spectrum Disorder (ASD), presenting a summary of a year-long series of meetings held by a group of experts in the field of ASD and NIH staff. In this paper, our goals were to first define the population and then present general guidelines for optimizing assessment sessions for this challenging population. We then summarize the available measures that can be used across a variety of behavioral domains that are most directly relevant to developing language skills, including: oral motor skills, vocal repertoire, receptive and expressive language, imitation, intentional communication, play, social behavior, repetitive and sensory behaviors, special interests, atypical behavior and nonverbal cognition. We conclude with a discussion of some of the limitations in the available measures and highlight recommendations for future research in this area.

In April 2010, the National Institutes of Health (NIH) convened a multidisciplinary workshop to discuss the state of the empirical knowledge about, and research opportunities regarding the substantial subgroup of children with autism spectrum disorder (ASD) who have not developed spoken language by five years of age. The participants reviewed the current state of scientific knowledge, highlighted critical gaps in our knowledge, and identified research opportunities to address knowledge gaps addressing three main topics: (1) Who are these children and what do we know about their developmental trajectories? (2) How can we assess their skills and knowledge across different domains, with special reference to those abilities relevant to language acquisition? and (3) What treatments or interventions are effective in improving spoken language and communication in these children? More detailed information about the workshop can be found at http://www.nidcd.nih.gov/funding/programs/10autism/detail.

Following the workshop, a small group of NIH staff and ASD experts convened to focus on one of the key workshop topics: how can we best assess this population? In the subsequent

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year, our group dealt with particular areas of assessment important for this population, and identified currently available appropriate assessment approaches and tools as well as the gaps in the current literature on this topic. This paper summarizes the recommendations of the group.

Although numerous publications have addressed the broad range of issues related to assessing children with ASD (e.g., Goldstein, Naglieri & Ozonoff, 2009), none focuses explicitly on the minimally verbal older child. There are particular challenges in identifying appropriate tests and measures for this population for whom there are few instruments that meet standard psychometric criteria of reliability or validity. Moreover, there are unique difficulties in evaluating the strengths and limitations of the children in this group because of the particular nature of their wide-ranging behavioral challenges and spoken language limitations. This paper is directed primarily toward researchers who conduct basic and treatment studies with this population, however, clinicians whose goals are to evaluate and design appropriate interventions and strategies tailored to the specific profile of each child may also find the paper useful. We begin by defining the population under consideration; the second section covers the assessment recommendations including both guidance in how to optimize testing for this population and potential measures for a range of behavioral domains; and in the final section recommendations for future research are discussed.

I: Defining the Minimally Verbal Child With Autism

A minority of children with ASD fails to acquire spoken language skills beyond a minimal level, despite access to intervention from an early age. Little is known about this group because they are rarely the focus of research. For the purpose of this report, our working group defined this population in the following way.

The minimally verbal child has a very small repertoire of spoken words or fixed phrases that are used communicatively. The exact number of words may vary across children, from no spoken words or phrases to perhaps 20 or 30, depending on a range of factors including age, intervention history, and access to alternative/augmentative communication (AAC) systems. The spoken words or phrases that a child uses will often be restricted to limited contexts and may only be used to communicate one or two functions (e.g., requests with familiar adults). Moreover, the rate of spoken language is usually very low and may include scripted phrases that have been highly trained (e.g., *I want X*). In some cases, the minimally verbal child may also use echolalic or stereotyped language that does not appear to be functionally communicative. Although from a clinical/educational perspective, the exact number of words used does not matter that much, researchers may want to impose a quantitative definition for this population (e.g., fewer than 20 functional words).

This definition of minimally verbal children does not address the question of: 1) receptive language skills or 2) alternative communication modes. First, there are anecdotal reports that some children understand a considerable amount of spoken language although they remain essentially nonverbal. Second, many minimally verbal children are able to communicate using a larger vocabulary, even using simple sentences, perhaps expressing a wider range of functions when they are capable of using alternative means instead of spoken language, for

example Picture Exchange Communication System, AAC devices, signed language and written language. For our purposes, the term minimally verbal includes this group.

II: Assessing the Minimally Verbal Child

Setting the Stage for Assessment

Assessments of children with minimal verbal skills should include a combination of standardized and experimental measures. Standardized assessments allow comparison to norms or to other samples for research purposes. Experimental measures, or more individualized approaches can address the specific needs of individual children, and these measures may be directly related to the proposed research study goals. For example, standardized assessments may provide little variation in a sample of children with few words, and children may not be able to perform well under standardized testing conditions. That is, minimally verbal children with ASD frequently show floor effects on standardized direct assessments, despite showing evidence of skills in other, non-testing, contexts. Research measures may yield more information on core areas of impairment (language, social behavior, repetitive behaviors) and assessments of related areas of impairment may provide important insight into children's language ability, including nonverbal cognition and prelinguistic abilities such as imitation, intentional communication (especially joint attention) and play skills.

In preparation for an assessment there are a number of steps that clinicians and researchers can take to make assessments more meaningful and the process more pleasant for everyone involved. Important considerations include goal setting and the assessment environment.

First, goal setting is one important factor in deciding on the choice of assessments, whether for clinical or research purposes. For research studies assessments may be included that are standardized (e.g., IQ tests) as well as developed for a specific study question. Both are important. Consideration of the use of these measures (e.g., for descriptive purposes or outcome measures) will inform when these assessments are given and who administers the assessments. An important consideration is the level of expertise of the testing team. While research studies often use assessors who are blind to research purposes and who have expertise in evaluation *per se*, it is equally important to have assessors with experience testing children with ASD who are older, and minimally verbal as these children present with complex needs.

Second, the assessment environment should be carefully planned. The child and parent should know what to expect. It may be helpful for the parent and child to have a pictorial sequence of the assessment events as well as the people that they will meet (perhaps via a social story). Parents can often provide necessary information about materials for reinforcement, primary mode of communication and need for break times. This information is critical in order to obtain reasonably accurate assessment results.

Recommended assessments and practices

We reviewed assessments of core domains for ASD, language, social behavior, repetitive behaviors and nonverbal cognition. In our review we also included assessments of common

early developmental skills that are associated with spoken language in young preverbal children including imitation, intentional communication (joint attention and requesting skills) and play. These early developmental skills may be important to the assessment of older minimally verbal children since absence of these skills may provide some insight into children's limited spoken language. A review of standardized and experimental assessment measures is listed with current recommendations in Tables 1 to 5. Both direct observational and parent report assessments are included in these tables. Information about the validity of assessments is included when available. For the most part, published assessments reported validity coefficients, but validity information on experimental measures is more limited.

1) Medical and Intervention History—Before assessing any child, obtaining as complete a history as possible is a critical first step in the evaluation process. Obtaining a history at the beginning of an assessment is recommended in order to guide the rest of the assessment protocol (Paul & Lewis, 2008). The primary purposes of a history are to gather information about previous medical and behavioral assessments and their results, prior interventions and their outcomes, and parent concerns and preferences. A common method for obtaining the history is to provide a questionnaire to a parent or other familiar caregiver. A sample questionnaire that could be used to obtain a child's developmental history, including medical history and family environment is provided in http://ndar.nih.gov/ndarpublicweb/DataStructures.go?short_name=mv_demo_intake01. This questionnaire includes questions about general health and specifics about speech and hearing status. Depending on the answers to these questions, further observations or assessments may be warranted to rule out hearing impairment or structural defects as a contributing factor to minimal verbal status.

2) Speech sound production—Intervention research for minimally verbal children may focus on increasing speech production thus evaluating speech production at various points in intervention may be desirable. Evaluating speech abilities includes assessing the oral mechanism and abilities to produce different speech sounds. Given the difficulties with spoken language development for this population, evaluation of the integrity of the oral and vocal tract is indicated in order to rule out any peripheral structural abnormalities that could be limiting verbal and vocal productions. However, assessing oral and vocal function may be difficult for minimally verbal children because many tasks involve hard-to-follow instructions such as "pucker your lips" or "say puh puh puh as fast as you can". Therefore parent report is often the best alternative. For example, Gernsbacher, Sauer, Gey, Schweigert and Goldsmith (2008) used a parent interview that included items such as blowing kisses and blowing raspberries to assess oral motor skills in children with autism.

Obtaining an inventory of speech sounds may also be difficult because most minimally verbal children do not readily respond to a traditional assessment of speech sound production. Traditional assessment formats requires the child to name pictures or repeat words composed of the various speech sounds in different word placements (initial, medial, final). When it is not possible to conduct a traditional evaluation, a spontaneous speech sound sample may be recorded during various activities and used to determine an inventory of sounds in a child's repertoire.

3) Language Assessments

Overview/Rationale for Assessment: The NIDCD working group on defining and measuring spoken language benchmarks for children with ASD recommended that at least two types of measures be used to assess language drawn from parent report, natural language samples or direct assessment (Tager-Flusberg et al., 2009). Although the goals and target population of that working group were not focused on minimally verbal school-aged children, collecting information from multiple sources, when possible, will also provide a more complete picture of the language skills of this population.

By definition, language is an especially challenging domain to assess in minimally verbal children. Nevertheless, it is important to collect information about both receptive and expressive abilities with special attention to the modality that a child may use for communication purposes. Many minimally verbal children may communicate via sign language, AAC (augmentative and alternative communication) systems, or through written language, and their ability to understand and communicate through these alternative modalities should be included in the assessment of language skills. A comprehensive evaluation will consider the range of words, phrases, and language functions that are used and understood in both spoken language as well as in the child's preferred communicative modality (see also, Mirenda, 2003). In some cases, children who have minimal spoken language nevertheless use speech as a form of repetitive behavior, often referred to as echolalia. Echolalic speech may either be immediate (repetition of an utterance just heard) or delayed, as for example in scripted speech, repetition of television commercials or other seemingly meaningless repetitions. Assessment of echolalia is discussed further in Section 4on Repetitive Behaviors.

Summary of Tests and Measures: Table 1 summarizes the major language assessment measures that may be most useful for this population including caregiver report and direct assessments. Among the caregiver report measures, only the Vineland is designed to cover a broad age range (birth to adulthood). Parent report measures are often favored in research because some minimally verbal children may not comply with test directions and hence fail to achieve a basal score. In addition, parent report allows knowledgeable informants to relate performance under more varied conditions including the child's familiar environment, rather than relying on results from clinical settings that may promote anxiety. Measures should be adapted to incorporate different communication modalities and to allow caregivers to indicate the modality in which a child understands or expresses a word or phrase in order to obtain a more accurate evaluation of the child's language repertoire.

Each of the standardized language tests reports high validity, based largely on comparisons of performances on other standardized tests, by children without autism. Some research has also considered validity of some of these measures specifically for children with autism, although most were obtained from a younger age group. For example, Charman, Taylor, Drew, Cockerill, Brown, Baird (2005) found that receptive and expressive scores on the MacArthur-Bates Communicative Development Inventory (MCDI; Fenson, Marchman, Thal, Reznick, & Bates, 2006) obtained at 2–3 years of age were positively associated with Vineland scores at age 7. The content validity of the MCDI for children with autism was

assessed by Bruckner, Yoder, Stone and Saylor (2007), who found that 25 of the 394 items were not appropriate for use with children with autism. Children in the Bruckner et al. (2006) study had developmental ages of 18 months but presumably many were in the school-age range, although information on chronological information is not available.

Language Sampling: Language sampling is widely regarded as an excellent method to obtain information about how a child communicates in natural contexts (Tager-Flusberg et al., 2009). The procedure entails recording the child communicating and then later documenting the amount and types of expressive communication recorded during the sample. Variables to consider in language sampling include the communicative partner(s), the context, and length of session (Kover et al., 2012). For example, a longer sample with familiar communication partners in authentic contexts would be most representative of everyday communication. Language sampling has been used extensively to obtain useful measures of expressive language such as mean length of utterance (MLU) and number of different words (NDW) in verbal children. For children with minimal verbal skills, information such as the overall rate of communication (both verbal and nonverbal) can be obtained to provide information about their communicative repertoire(Brady, Marquis, Fleming, & McLean, 2004; Fey et al., 2006).

Language samples yield measures that are considered to be highly valid because they are derived from actual communication interactions. In fact, measures obtained from language samples are frequently the gold standard against which test scores are compared (e.g., Feldman, et al., 2005). Validity of language sampling has been established for children without autism (Rice, Redmond & Hoffman, 2006) and verbal children with autism (Tager-Flusberg, et al., 2009). As in these other populations, the validity of language samples obtained for children with minimal verbal skills will be affected by the quality of the sample and the accuracy of recording and transcription. Quality of the sample is related to contextual variables and length. Accuracy of the recording can be verified by completing inter-observer reliability measures.

Interpreting Measurement Results: The most useful scores on standardized language tests may be raw scores (e.g., estimated number of words understood). Meaningful changes in the raw score values can be charted over time and as a child experiences different interventions. Age equivalent (AE) scores may be derived from many standardized measures, however they only provide descriptive information. AE scores are generally inappropriate for statistical analyses and hence of limited value to researchers (Maloney & Larrivee, 2007; Mervis & Klein-Tasman, 2004). None of the measures listed in Table 1 address the issue of how to interpret scores if measures were adapted for use with children who have little or no spoken language, but who do communicate using alternative modalities. Therefore, if a researcher or clinician uses adapted procedures the adaptations need to be clearly stated and considered in interpreting results. In addition, none of the listed assessments specifically included children with autism in standardization samples, therefore additional consideration should be given to the validity of the results for children with autism.

4) Social Behavior

Overview/Rationale for Assessment: Social deficits are core features in the diagnosis of ASD. Because children learn language within a social context, social behavior is an important area to assess for children who are minimally verbal. While there is a considerable amount of research documenting the social characteristics of children with ASD, there is little consensus about how to organize this information either to compare findings across studies or to guide further research. The social domain includes wide ranging abilities from social attention to prosocial overtures to friendship development. The focus of this section is on measures of social relationships as well as community adaptive skills. There is some overlap with the area of repetitive behaviors, as adaptive behaviors also address issues of emotion and behavior regulation.

Summary of Tests and Measures: Table 2 summarizes tests that are available to assess social behaviors in minimally verbal children with ASD. In most cases, social domains are part of larger, more comprehensive measures. Some tests are specifically intended for ASD while other are intended for broader populations with developmental disabilities. Many scales that provide practical ways of measuring social adaptation are available.

Creating a clear picture of how a child is functioning within these areas requires information across contexts, from caregivers, teachers and other people with whom the child regularly interacts. Some scales listed in Table 2 identified as “social” scales include a range of behaviors associated with ASD beyond social behaviors (e.g., language ability). Other scales, intended primarily for other purposes, such as diagnoses, identification of psychopathology or measurement of adaptive function, contain subscales assessing social development. Scores are often affected by the severity of general behavior problems and by expressive language level.

Interpreting Measurement Results: ASD involves differences in both the quality and quantity of social behaviors. Prosocial behaviors may be present, but not used in the variety of contexts and/or with the timing and flexibility seen in typical children. Consequently, the presence or absence or frequency of a certain behavior is sometimes less important than the circumstances in which it occurs. Assessments should consider both positive and negative aspects of social behaviors, as both may be contributing to or hampering children’s language development

Developmental changes within a child and developmental differences across children affect the ability to carry out behaviors, the contexts in which behaviors can or should occur, and the expectations of others about these behaviors. All these issues affect the assessment of social behaviors in ASD. Minimally verbal children present particular challenges because expressive language is often taken for granted in assessing social skills, especially in questionnaire measures.

Few of the social measures listed have been specifically validated with children with autism, particularly minimally verbal school age children with autism. However, the ADI-R has undergone extensive validation. Lord, Rutter, and LeCourteur (1994) reported significantly different ADI-R scores for children with autism compared to children without autism.

Moreover, ADI-R has been tested against different social measure in many studies. For example, Charman, et al., (2005) compared scores from the ADI-R to scores from the Autism Diagnostic Observation Schedule (ADOS), and Vineland Adaptive Behavior Scales-II. Constantino et al., (2003) found significant correlations between the ADI-R and the Social Responsiveness Scale. Like the ADI-R and ADOS, the Social Communication Questionnaire (SCQ) was developed specifically for children with autism and extensive data exists concerning the validity of the SCQ for screening for autism symptoms (e.g., Chandler, et al., 2007). Content validity has been established through comparisons to other measures, including the ADI-R and ADOS (Berument, Rutter, Lord, Pickles & Bailey, 1999). The validity of any of these measures for describing relevant social behaviors of minimally verbal children requires further study.

5) Repetitive Behaviors/Restricted Interests, and Atypical Behaviors

Overview/Rationale for Assessment: Repetitive behaviors and restricted interests (RBRI) are also among the core symptoms of ASD. A detailed assessment of the type and frequency of RBRIs, as well as other atypical and challenging behaviors may help in estimating the extent to which they interfere with evaluation protocols. For example, there is some evidence that differences in the types of repetitive behaviors exhibited by a child (motor, behaviors on objects, or repetitive speech) may differentially predict developmental outcomes such as language (Watt, Wetherby, Barber & Morgan 2008). RBRIs overlap with sensory responses and form part of the same diagnostic domain (see DSM5 criteria for ASD, APA 2013).

Summary of Tests and Measures: Table 3 summarizes the tests that are currently available. We include here scales for assessing sensory profiles in school-aged children and adolescents as well as measures of atypical behavior or psychopathology. As noted earlier, since challenging behaviors may pose significant barriers in the ability to conduct assessments, it might be helpful to collect data on some of the measures summarized here prior to bringing the child into the lab or clinic.

The measures in Table 3 are almost all parent/caregiver or teacher checklists or questionnaires. However, one example of a direct observation measure is the ADOS. As part of this diagnostic evaluation, the ADOS provides opportunities to score a child's atypical behaviors and responses to sensory stimuli. This information may be a useful complement to parent report measures for these domains. While direct observation of a child may reveal some examples of RBRIs, it may be that in a clinic or lab setting the full range of RBRIs is not evident. For these reasons, one direct observation measure(DORBA; Boyd et al., no date) attempts to address this gap by requiring recording of the child's behavior in different contexts (i.e. in both the home and the clinic settings).

Interpreting Measurement Results: RBRI measures often include multiple subscales to address the various types of RBRIs. Subscale scores may provide more specific information than the overall or total score. While questionnaires may be useful in providing information about a parent's knowledge of a child's RBRI, clinical interviews with parents (and teachers/therapists) can provide important additional information about the functional

significance of each behavior to a child; the extent to which the behaviors may interfere with other activities, or how, for example, circumscribed interests might reveal special strengths or talent in an individual.

The measures listed in Table 3 have been used in studies of children with autism and many have been compared to each other in order to demonstrate validity. In a recent review of challenging behavior in children with autism, Matson stated that there is a lack of consensus on how best to measure challenging behaviors such as RBRIs (Matson 2007). One method that can be used to support the validity of a rating scale such as the Repetitive Behavior Scale (Bodfish et al., 1995), is to verify reported behaviors with direct observation. For example, in a study that included adults with autism, Bodfish and colleagues confirmed that items endorsed by responders were validated by research assistiants' observations (Bodfish, Symons, Parker & Lewis, 2000). Much of the research on RBRI measures has focused on adults (e.g., Rojan et al., 2001); and additional studies are needed to validate these measures with school-age children, as this is often an age when RBRIs first emerge as an area of concern.

4) Nonverbal Cognitive Abilities

Overview/Rationale for Assessment: For children with ASD, nonverbal cognition is an important predictor of language development (e.g., Pickett et al., 2009) and is therefore a key area to evaluate. Nonverbal cognitive abilities are part of all IQ assessments. This domain encompasses a wide range of skills including: nonverbal reasoning skills, symbolic skills, memory, attention, processing speed and fine motor skills. Each standardized test taps a different subset of these areas of functioning, though it is not clear from current research which of these cognitive processes are the most significant for consideration in relation to language and communication skills.

Summary of Tests and Measures: Table 4 summarizes currently available tests that could be used for testing nonverbal cognitive abilities in children with ASD. Based on currently available cognitive assessments and what is known about the general relative strengths and interests of minimally verbal children with ASD, the following considerations should be kept in mind when deciding which tests should be utilized. Untimed tests are more likely to provide a better estimate of the child's abilities; some children take far longer to respond even though they know the correct answer. Typically, (though not in all cases), visually-based tests of perceptual or matrix reasoning yield higher estimates of a child's cognitive ability than other types of tests (Dawson et al., 2007). The most widely used tests of nonverbal cognitive skills for children with ASD are the Leiter International Performance Scale, and the Raven's Colored Progressive Matrices.

Interpreting Measurement Results: It is important not to place too much emphasis on the standard scores obtained in an evaluation. For many minimally verbal children with ASD it may not always be clear whether a specific test captures their abilities. For example, some children may participate more readily on the Leiter especially if they have had ABA type interventions in which matching is taught. The Leiter involves a series of cards to match or sequence, and some children may be more successful with this format than others. The

Raven's Progressive Matrices, also a nonverbal test, involves somewhat more complex verbal instructions; thus, its utility may be more appropriate for older or higher cognitive level children. Despite widespread use of measures on non-verbal cognition, only a few studies have observed the validity of these measures with school-aged children with autism.

5) Imitation, Intentional Communication and Play Abilities

Overview/Rationale for Assessment: Several skills are viewed as foundational prelinguistic skills for all children, including children with ASD. Imitation, intentional communication behaviors (e.g., joint attention and requesting skills), and play abilities are all important skills for children learning language (Kasari, 2005). Generally the assessments used to measure these skills have been appropriate for toddlers and preschoolers who are mostly preverbal; they have rarely been applied to school aged children. Given the association of joint attention and play to language abilities in ASD, however, assessing these skills in older, minimally verbal children may be appropriate. To address these skills in older children, most measures need adaptation. At times the adaptation may need to be in format (e.g. structure of the assessment), but more often in terms of materials.

Summary of Tests and Measures: There are no standardized measures of imitation, intentional communication or play skills. Rather, researchers use measures that are observational or experimenter- led. Many of these are similar in format and scoring within the domain. For example, several imitation assessments have been used with young children with ASD. These typically include gross motor and fine motor actions across different body parts (e.g., hands, legs, mouth); actions with and without objects; sequences of actions; meaningful action sequences; oral motor and vocal imitations. Assessment may either focus on direct assessment of elicited imitation or on spontaneously generated imitations during observation. It should be noted that the majority of measures focus on only one or two specific types of imitation such as body movements and functional imitation of actions with objects and gestures. Only one of the measures listed in Table 5 covers adolescents and young adults (Freitag et al., 2006), which is an adaptation of a measure from the adult apraxia literature. There are currently no imitation measures that have been developed for older children between 6 and 14 years of age. However, some the currently available measures of imitation developed for very young children could be used and/or adapted for use with older individuals.

Predictive validity of imitation measures has been demonstrated for young children with autism (Stone, Ousley, Littleford, 1997; Rogers, Hepburn & Stackhouse, 2003; Thurm, Lord, Lee & Newschaffer, 2007), however little information is available that specifically focusses on school age children. Imitation skills may be equally important and valid predictors for these slightly older children as imitation is important for children's continued language development (Siller & Sigman, 2008). Therefore, additional research is needed to examine the importance and validity of imitation assessments for this group.

Play and intentional communication skills are also assessed via observational or experimenter led measures. Impoverished play skills are common among children with ASD. Typically, functional play skills (e.g., rolling a car on the floor) are more intact than

symbolic play skills (e.g., placing a doll in a car, and then driving it; using a block as if it was a car) but among children who are the most severely affected by autism, interest in play objects may be limited or objects are used only in repetitive and nonfunctional ways (Ungerer & Sigman, 1981). The assessment of play skills with objects, social play with others, and leisure activity all yield information on how children are engaged with their environment.

Validity studies have documented the importance of play in relation to social behaviors. Sigman and Ruskin (1999) found that higher- level play skills measured during preschool were associated with better peer relationships in school-aged children with autism. The predictive validity of early play skills has also been demonstrated in numerous studies linking play to social and communication outcomes for young children with autism (Kasari, Freeman, Paparella, 2006; Toth, Munson, Meltzoff & Dawson); however more research is needed validating the importance of play for school-age children.

Intentional communication includes nonverbal gestures and vocalizations that are used to signal communicative intent. Several measures used with young children specifically attempt to elicit both responses and initiations of nonverbal gestures in an experimenter – child semi-structured interaction (e.g, Early Social Communication Scales, ESCS, Mundy et al, 2003). Form and function, responses and initiations are coded separately. One drawback of most measures of intentional communication is that scoring typically requires videotaped coding that can be labor-intensive. For all measures in Table 5, the outcome variables are typically frequency counts, proportion of correct responses, or categorical classification of skills.

Another potential issue is that measures are limited in the specific forms and functions of intentional communication that they address (e.g., only eye contact or response to joint attention). These limitations in form and function are especially important since older children may be proficient using some functions (e.g., requesting—take someone's hand to get what they want, or vocally express "*I want X*") but very poor at other functions that appear autism specific, such as a paucity of joint attention gestures that are used to initiate social attention and sharing. Some measures may be appropriate for older minimally verbal individuals but require high levels of expertise to code and interpret.

Although most of the measures of intentional communication listed in Table 7 are described as informal and nonstandardized, some have been validated by comparison to other measures. For example, Brady et al., (2012) demonstrated concurrent validity between the Communication Complexity Scale (CCS) obtained from school-age children with autism to scores from the Communication Matrix (Rowland, 2009) as well as raw scores from the Preschool Language Scale-4 (Zimmerman, Steiner & Pond, 2002) and Mullen Scales of Early Learning (Mullen, 1995). Internal consistency was demonstrated for the Checklist of Communicative Competencies (Iacono, Bloomberg & West, 2005), however the participants in this study were all adults, 20 years old or older. Validity and reliability for the Social Orienting Continuum and Response Scale (Mosconi, Reznick, Mesibov & Piven, 2009) was reported, however the participants in this study were between 2 and 4 years of age.

Therefore, as with most of the other measures discussed, validity for school age children with autism is lacking.

Interpreting Assessment Results: The assessment context should be selected with care as children may perform differently in familiar and unfamiliar settings, and with familiar and unfamiliar examiners. Care also needs to be taken when children are prompted to respond as this could contaminate opportunities for them to spontaneously initiate play, imitation or intentional communication. However, prompting may be helpful to determine performance potential versus skill deficits. We note that it may also be important to consider a child's skills within the context of their overall motor abilities. A child with significant motor impairment will have difficulty with performance on several of these measures, and may need adaptations to respond (e.g, positioning considerations, increased structure, increased time to respond).

In reporting scores it may be important to differentiate between form and function of different skills, similar to what had been reported for younger children. For example, intentional communication requesting skills are often more common among children with ASD whereas joint attention gestures are infrequent. Children with ASD may also respond to joint attention or requesting elicitations by the tester but not initiate gestures spontaneously. Summing across forms and functions may obscure certain skills that are more important for language abilities in this population. Thus, in reporting scores, researchers should be mindful of how behaviors are coded (e.g., initiation or response) and summed (across form and function).

Reliability and Validity: Generally, the psychometrics of the different measures have not been established for the minimally verbal school aged child. Each of the standardized tests report high validity, based largely on comparisons of performances on other standardized tests, by children without autism. However, in most cases, test-retest reliability has not yet been established, which is important if the intention is to use the measure for treatment outcome. Scores have a variety of different meanings including simple counts of behaviors, combinations of frequency counts and severity ratings, age equivalents, and standardized norms for chronological age or language level. Future studies need to establish reliability and validity of measures for use with the minimally verbal school aged population.

III: Summary and Recommendations

The assessment needs of minimally verbal school-aged children with ASD have been ignored for too long. This has contributed to our limited understanding of abilities in this population. In this paper we identified the current best alternatives in terms of assessing a child's vocal repertoire and oral motor skills, language, imitation, intentional communication, play, social, repetitive behaviors, and nonverbal cognition. The available assessment instruments within each of these domains are summarized in the tables, however, as noted in each section, most of the measures have serious limitations for use with minimally verbal children, which has severely impeded progress in both research and clinical practice. No single measure is sufficient, and the difficulty in assessing these children suggests that newer measurement approaches should be developed. However, care

should be exercised in developing new measures by considering assessment burden. Fewer assessments that can provide information across multiple domains may be especially attractive with this population.

Limitations of Current Measures

In terms of research, measurement limitations prevent the use of common descriptors across studies. This is a critical shortcoming because it is often desirable, or even necessary, to combine data sets from different research teams in order to increase the power to detect significant trends and outcomes in this highly heterogeneous population. For example, data sharing through databases such as the National Database for Autism Research (NDAR), or Interactive Autism Project (IAN) allow researchers to combine de-identified data for additional analyses. Such databases function optimally when common assessments can be identified. Similarly, assessments that accurately measure the constructs of interest are essential for clinical practice. Measures across the core areas identified in this paper are necessary to determine appropriate intervention targets for individual children, and also to measure outcomes. That is, interventions often target a specific type of behavior, yet concomitant improvements (spillover effects) to other behavior domains are also expected. For example, interventions that teach AAC to increase communication may also improve social behaviors and decrease repetitive behaviors.

Limitations in existing assessments include the small number of measures that have reported validity and have been reliably administered to minimally verbal children with ASD. Many measures that are appropriate for younger children have not been validated with school-aged children or adolescents. In some cases, it may be valuable to use measures intended for younger children, particularly to describe extant skills. Obviously, any standardization information will not be interpretable when assessments are applied outside the age range for the validation sample. In addition, the age-appropriateness of materials should be carefully considered, and in some cases, modifications may be needed to adapt to the needs and interests of the older child.

Future needs

Because of the many limitations to currently available assessments, new measures are needed that accurately reflect the strengths and weakness of minimally verbal school-aged children with ASD, across the domains covered in this paper. Such newly developed measures will need to be validated with this population. In addition, agreement by researchers on a standard set of measures that would be administered to all children participating in basic or treatment studies with this population would greatly facilitate future data sharing and meta-analytical procedures. In the case of existing well-validated measures, guidelines reflecting the flexibility needed to obtain more accurate results as well as for consistent administration and interpretation are needed.

There is also a pressing need for development of additional behavioral measures reflecting the benchmarks of nonverbal communication. For example, Brady and colleagues recently developed a scale of nonverbal communication that reflects an individual’s use of nonverbal communication including gestures and vocalizations in authentic communicative contexts

(Brady et al., 2011). Additional benchmark measures are needed for both receptive and expressive communication, as well as the other domains that are closely related to language development covered in this paper. Ideally such measures would accurately characterize minimally verbal individuals with ASD for researchers and clinicians, and would be sensitive to changes resulting from interventions and therefore be useful as outcome measures.

The long term goal is to develop a clearer and deeper understanding of who these children are, to be able to provide adequate assessments of their very heterogeneous phenotypes so that they may be included in more research studies on ASD, and to begin to answer the question of why, despite access to early intense interventions, they fail to acquire spoken language skills. The most important direction for future research will be to develop novel interventions that specifically target this population, but without adequate assessment tools and protocols, progress on this will remain severely limited.

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Table 1

Language Measures

Assessment name	Variables assessed	Age range	Assessment context	Citation	Rating
Language Use Inventory	Pragmatic language	18–47 months	Parent report	O'Neill [2002]	◖
Peabody Picture Vocabulary Test—IV	Receptive vocabulary	2; 6–90 years	Standardized	Dunn and Dunn [2004]	●
The MacArthur-Bates Communication Development Inventories (CDI)	Receptive and expressive language	8–37 months[a]	Standardized parent report	Fenson et al. [2006]	◖
Preschool Language Scales-5	Auditory comprehension	Birth-7; 11	Standardized	Zimmerman et al. [2011]	◖
Reynell Developmental Language Scales-III	Verbal comprehension Expressive language	1–6 years	Standardized	Edwards et al. [1999]	◖
Sequenced Inventory of Communicative Development—Revised	Receptive language Sound and speech discrimination Awareness and understanding	4–48 months	Standardized	Hedrick et al. [1984]	◖
Test of Early Language Development—3	Receptive language	2; 0–7; 11 years	Standardized	Hresko et al. [1999]	◖
Language Samples	Expressive language gestures	All ages	Observation Natural contexts and Structured probes	Costanza-Smith [2010] Rojas and Iglesias [2010] Romski et al. [2010] Kaiser and Roberts [2013]	●
Vineland Adaptive Behavior Scales-II	Receptive language Expressive language Written language	0–90 years	Parent report Teacher report	Sparrow, Cicchetti, and Balla [2005]	◖

[a]This measure is not validated on school-aged children, but was included because the raw scores have frequently been used in research and clinical practice with older children.

● = Well suited for use with minimally verbal children

◖ = Use with some caution

○ = Unlikely to yield meaningful results

Table 2

Social Behavior Measures

Assessment name	Variables assessed	Age range	Assessment context	Citation	Rating
Aberrant Behavior Checklist	Social withdrawal	Older preschool to Adult	Parent report Teacher report	Aman, Singh, Stewart, and Field [1985]	●
Autism Diagnostic Interview-Revised	Shared enjoyment Nonverbal communication Reciprocity Peers	NVMA 10+ months	Parent report	Le Couteur, Lord, and Rutter [2003]	●
Autism Diagnostic Observation Schedule	Specific behaviors Qualitative summary scores	NVMA 10+ months	Observation Structured probes	Lord, Rutter, Dilavore, and Risi [1999]	●
Autism Treatment Evaluation Checklist	Sociability	5–12 years	Parents, Teachers or Caregiver report	Rimland and Edelson [2000]	○
Behavior Assessment System for Children, Second Ed.	Withdrawal Social skills/peer interaction Response to teacher Sexual behavior	Preschool, school-aged, and adolescent	Teacher report Parent report	Reynolds and Kamphaus [2002]	◖
Childhood Autism Rating Scale	Relating to others Emotions	Preschool and upward	Parent, Teacher, Clinician report	Schopler, Van Bourgondien, Wellman, and Love [2010]	◖
Developmental Behavior Checklist	Relating Self-absorbed Social anxiety	Children, adolescents and adults	Parent, Teacher, Caregiver report	Einfeld and Tonge [1995]	●
PDD Behavior Inventory	Social approach behaviors	1; 6 to 12; 5 years	Parent and Teacher report	Cohen and Sudhalter [2005]	◖
Psychoeducational Profile TEACCH Transition Assessment Profile	PEP III Affective Expression Social reciprocity TTAP Interpersonal behavior Independent function	Preschool to school-age/adolescence	Parent and Teacher report	Mesibov, Thomas, Chapman, and Schopler [2007]	●
Scales of Independent Behavior-Revised	Social interaction	Infancy to elderly	Parent and Teacher report	Bruininks, Woodcock, Weatherman, and Hill [1996]	●
Social Communication Questionnaire	Social behaviors Communication skills	4 years to adult	Parent report	Rutter, Bailey, and Lord [2003]	◖
Social Responsiveness Scale	Social awareness Social cognition Social communication Social motivation	5 years to adolescent	Parent report Teacher report	Constantino and Gruber [2005]	◖
Vineland Adaptive Behavior Scale	Coping skills Relationships Play and leisure Community	Infant to Adult	Parent or Teacher report	Sparrow et al. [2005]	◖

● = Well suited for use with minimally verbal children.

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NVMA, nonverbal mental age; PDD, pervasive developmental disorder; PEP, Psychoeducational Profile; TEACCH, Treatment and Education of Autistic and related Communication Handicapped Children; TTAP, TEACCH Transition Assessment Profile.

Table 3

Repetitive Behaviors/Restricted Interests, Sensory Behavior, and Atypical Behaviors

Assessment name	Variables assessed	Age range	Assessment context	Citation	Rating
Aberrant Behavior Checklist	Irritability Social withdrawal Stereotypic behavior Hyperactivity Excessive speech	All ages	Parent report Teacher report	Aman et al. [1985]	●
Autism Diagnostic Interview-R	Restricted interests Routines and rituals Stereotyped and repetitive motor mannerisms Preoccupation with parts of object or nonfunctional elements	18 months+	Parent report	Lord et al. [1994]	●
Developmental Behavior Checklist	Disruptive/antisocial Self-absorbed Communication disturbance Anxiety Social relating	4–18 years Adult form available	Parent or Teacher report	Einfeld and Tonge [2002]	●
Direct Observation of Repetitive Behaviors in Autism	Frequency of behaviors Duration of behaviors	All ages	Observation	Boyd et al. [2007]	◖
Repetitive Behavior Questionnaire	Repetitive language Sameness of behavior Repetitive movements	Not known	Parent or Teacher report	Turner [1995]	◖
Repetitive Behavior Scale-Revised	Stereotyped Self-injurious Compulsive Ritualistic Sameness Restricted	3 years to adult	Parent report	Bodfish et al. [1999] Bodfish [2003]	●
Sensory Profile Adolescent/Adult Profile	Sensory processing Sensory modulation Behavioral/emotional response to sensory stimuli	3–10 years 11+ years	Parent report	Dunn [1999] Brown and Dunn [2002]	◖
The Interest Scale	Specific interests Measures of functional impairment	6; 0–17; 11 years	Parent report	Bodfish [2003]	◖

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Table 4

Nonverbal Cognitive Abilities

Assessment name	Variables assessed	Age range	Assessment context	Citation	Rating
Differential Ability Scales-II	Nonverbal reasoning Visual-perceptual Spatial visualization Memory Pattern detection Processing	2; 6–17; 11 years	Standardized	Elliott [2007]	◖
Leiter International Performance Scale-R*	Visualization Reasoning Memory Attention	2–21 years	Standardized	Roid and Miller, [1997] Roid et al.	●
Mullen Scales of Early Learning	Fine motor Nonverbal reasoning	0–5; 11 years	Standardized	Mullen [1995]	◖
Psycho-Educational Profile-3	Fine motor Gross motor Visual-Motor imitation	6 months to 7; 0 years (developmental age)	Standardized Parent report	Schopler, Reichler, Lansing, and Marcus [2005]	◖
Ravens Progressive Matrices	Reasoning Problem solving	5–80 years	Standardized	Raven, Raven, and Court [1998]	◖
Snijders Oomen Nonverbal	Abstract/concrete reasoning Spatial reasoning Visual perception	2; 6–16; 11 years	Standardized	Tellegen and Laros [1993]	◖

●= Well suited for use with minimally verbal children.

◖= Use with some caution.

○= Unlikely to yield meaningful results.

*Note: Leiter-3 now published; 3–75 years

Table 5

Imitation Measures

Assessment name	Variables assessed	Age range	Assessment context	Citation	Rating
Imitation Assessments	Gestural imitation Imitation with objects Vocal/verbal imitation	Young children	Structured probes Observation	Roeyers, Oost, and Bothuyne [1998] Rogers et al. [2003] Stone et al. [1997]	●
Imitation Assessment	Imitation of upper and lower facial movements Non-meaningful hand/finger movements	14–22 years	Structured probes Observation	Freitag et al. [2006]	◖

●= Well-suited for use with minimally verbal children.

◖= Use with some caution.

○= Unlikely to yield meaningful results.

Table 6

Object Play Measures

Child-Initiated Pretend Play Assessment	Object substitutions Imitated actions Pretend play	3–7 years	Observation Norm-referenced	Stagnitti [2007]	◖
Observational Play Assessments	Functional play acts Symbolic play acts Play levels	Young children	Structured probes Observation	Lifter, Edwards, Avery, Anderson, and Sulzer-Azaroff [1988] Fewell and Rich [1987] Ungerer and Sigman [1981]	●
Transdisciplinary Play-Based Assessment	Cognitive development Communication Social-behavior Motor skills	0–6 years	Structured probes Observation	Linder [1993]	○
Warwick Symbolic Play Test	Symbolic play and complexity	18 months to 6 years	Structured probes Observation	Doswell, Lewis, Sylva, and Boucher [1994]	○

●= Well suited for use with minimally verbal children.

◖= Use with some caution.

○= Unlikely to yield meaningful results.

Table 7

Intentional Communication Measures

Communication Complexity Scale	Joint attention and requesting gestures and language	12 months through adults	Structured Probes	Brady et al [2012]	●
Checklist of Communicative Competencies	Indirect assessment—joint attention not an explicit category.	Adolescents and Adults	Teacher report	Iacono, West, Bloomberg, and Johnson [2009]	○
Communication Matrix	Indirect information on communicative gestures and language	0–24 months	Teacher report	Rowland [2008]	●
Hobson and Hobson	Joint attention, eye contact	6–14 years	Observation	Hobson and Hobson [2007]	○
Inventory of Potential Communicative Acts	Behavior regulation, commenting, social interaction	Any age	Parent report Teacher report	Sigafoos et al. [2000]	◖
JAMES (items adapted from ESCS)	Joint attention and requesting gestures	5 years to adolescence	Structured probes Observation	Jahromi et al. [2009] Mundy et al. [2003]	●
Social Orienting Continuum and Response Scale	Joint attention initiating and responding	2–5 years	Observation	Mosconi et al. [2009]	○

ESCS Early Social Communication Scales; JAMES, Joint Attention Measure from the ESCS.