Research Article

Using Spoken Language Benchmarks to Characterize the Expressive Language Skills of Young Children With Autism Spectrum Disorders

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Purpose: Spoken language benchmarks proposed by Tager-Flusberg et al. (2009) were used to characterize communication profiles of toddlers with autism spectrum disorders and to investigate if there were differences in variables hypothesized to influence language development at different benchmark levels.

Method: The communication abilities of a large sample of toddlers with autism spectrum disorders ($N = 105$) were characterized in terms of spoken language benchmarks. The toddlers were grouped according to these benchmarks to investigate whether there were differences in selected variables across benchmark groups at a mean age of 2.5 years.

Results: The majority of children in the sample presented with uneven communication profiles with relative strengths in phonology and significant weaknesses in pragmatics. When children were grouped according to one expressive language domain, across-group differences were observed in response to joint attention and gestures but not cognition or restricted and repetitive behaviors.

Conclusion: The spoken language benchmarks are useful for characterizing early communication profiles and investigating features that influence expressive language growth.

There is remarkable variability in the language phenotype of individuals with autism spectrum disorders (ASD). Numerous research studies report significant impairments in both receptive and expressive language abilities (Ellis Weismer, Lord, & Esler, 2010; Paul, Chawarska, Cicchetti, & Volkmar, 2008) although structural language impairments (i.e., phonology, grammar, vocabulary) are not universal (Kjelgaard & Tager-Flusberg, 2001). It has been established since the 1980s that pre-school and school-age children with ASD have uneven profiles across language domains (e.g., Wetherby & Prutting, 1984). As the age of ASD diagnosis has extended downward to toddlers, researchers have begun to characterize the language skills of toddlers, providing insight into the initial stages of language development (Ellis Weismer

et al., 2010; Luyster, Kadlec, Carter, & Tager-Flusberg, 2008; Wetherby, Watt, Morgan, & Shumway, 2007).

These studies have yielded important information about the language skills of toddlers with ASD. For example, the investigation by Wetherby et al. (2007) revealed that the social communication profiles of toddlers with ASD are characterized by fewer gaze shifts, decreased rates of communication and acts for joint attention, and smaller gesture inventories than typically developing toddlers. Investigation into lexical and grammatical skills indicated similarities across the semantic categories and early grammatical complexity of toddlers with ASD as compared with late-talking toddlers (Ellis Weismer et al., 2011). Differences in the trajectory of expressive language growth have been observed in high- and low-verbal toddlers with ASD; high-verbal toddlers demonstrated trajectories comparable to toddlers with typical development (Tek, Mesite, Fein, & Naigles, 2014). These studies provide information regarding similarities and differences of the social communication profiles and developmental trajectories of toddlers with ASD in comparison with toddlers with typical development and toddlers with language delays. Prior studies have not, however, explicitly examined the relationship between

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different expressive language domains. Therefore, we sought to describe the language abilities of toddlers with ASD across different domains of expressive language development.

We characterized the expressive language profiles of toddlers with ASD using a set of benchmarks developed “for defining the acquisition of spoken language in the expressive modality in young children with ASD” (Tager-Flusberg et al., 2009, p. 644). A strength of using the benchmarks is that it enabled us to take an individual differences approach to characterizing the expressive language abilities of this sample of toddlers. Characterizing individual profiles may help us better understand the association between different domains of expressive language across children with ASD. Thus, the comprehensive characterization across all language domains for a relatively large and well-defined group of toddlers with ASD is the primary contribution of this study.

Expressive Language Benchmarks

The expressive language benchmarks used in this study were developed by a group of experts in early language development and ASD. These experts were assembled by the National Institute on Deafness and Other Communication Disorders for the purpose of creating a set of guidelines and objective criteria for defining spoken language development in children with ASD across the areas of phonology, vocabulary, grammar, and pragmatics in order to evaluate the efficacy of interventions that target spoken language acquisition as part of treatment research studies or in applied settings (Tager-Flusberg et al., 2009). These benchmarks provide a systematic way to describe research participants and outcomes as well as acting as a standard set of clinical guidelines. The spoken language benchmarks are based on typical expressive language development between the ages of 12 and 48 months. Developmental criteria are provided for three stages of language development: first words, word combinations, and sentences. Researchers have used these benchmarks as a reference for language development in children with ASD (Maljaars, Noens, Scholte, & van Berckelaer-Onnes, 2012; Mayo, Chlebowski, Fein, & Eigsti, 2013) and to document treatment outcomes (Paul, Campbell, Gilbert, & Tsiouri, 2013; Tsiouri, Simmons, & Paul, 2012). We extended the use of the benchmarks to describe the expressive language profiles of a large sample of toddlers with ASD.

Variables That Influence Language Development in Toddlers With ASD

Expressive language ability is one of the best predictors of adult outcomes (e.g., academic and adaptive functioning, educational and employment history) for individuals with ASD (Howlin, 2000). As such, it is critical to gain insight into factors associated with optimal language development. Although numerous studies investigating this question have been conducted, the use of different outcome measures

across studies makes comparison problematic. Because the benchmarks were developed to provide clinicians and researchers with a systematic way to classify outcomes, in addition to characterizing the expressive language profiles of the toddlers with ASD, we sought to test the consistency of these profiles with regard to previous research by investigating predictors of language acquisition. To do this, we explored whether there were differences in cognitive, social, and behavioral variables hypothesized to underlie expressive language development in toddlers with ASD across different benchmark groupings. We focused on the following variables: cognition, joint attention, gesture, and restricted and repetitive behaviors (RRBs).

Cognition plays a fundamental role in language acquisition in children with ASD. It differentiates toddlers with “good” language outcomes (within two standard deviations of the mean on the Vineland Adaptive Behavior Scales–Second Edition, Survey Interview Form; Sparrow, Cicchetti, & Balla, 2005) from those with “poor” language outcomes (Paul et al., 2008) and accounts for a large proportion of variance in receptive and expressive language skills (Kjellmer, Hedvall, Fernell, Gillberg, & Norrelgen, 2012). However, the exact relationship between cognition and language outcomes remains unclear. For example, Thurm, Lord, Lee, and Newschaffer (2007) reported that cognition at age 2, but not age 3, was a significant predictor of expressive language at age 5. In contrast, Charman, Baron-Cohen, et al. (2003) found that cognition at age 3 was predictive of expressive language abilities at age 7 whereas cognition at age 2 was not. Given that cognition is related to concurrent and later language abilities in toddlers with ASD across the majority of research studies, we chose to investigate if there were significant differences in cognition in children with different expressive language profiles.

The second variable considered in this investigation was joint attention. Response to joint attention (RJA) and initiating joint attention (IJA) require the ability to coordinate attention between a person and an object or event. RJA involves following a communication partner’s bid for attention whereas IJA involves initiating bids for attention. As such, IJA is hypothesized to reflect social motivation and joint attention (Bloom, 1993; Malesa et al., 2013). RJA and IJA have both been reported to predict language acquisition. Toddlers with ASD who achieved “good” language outcomes (an age-equivalent [AE] score above 30 months on the Vineland Adaptive Behavior Expressive Communication Scale) had better RJA skills than those with “poor” outcomes (Paul et al., 2008). Preschoolers with ASD with better RJA skills demonstrated faster language acquisition than those who were initially less responsive (Siller & Sigman, 2008). Sociocognitive skills, including RJA, at 2.5 to 3.5 years of age were the strongest predictors of social communication problems at 9 to 11 years of age (Chiat & Roy, 2013).

There is also evidence of a link between IJA and language abilities. For example, IJA at 14 months, of age in siblings of children with ASD was a significant predictor of language at age 5 whereas RJA was not (Malesa et al., 2013).

The relationship between IJA and language has informed intervention approaches for young children with ASD. Within these approaches, it is theorized that increasing IJA yields improvements in other domains, including language (e.g., Kasari et al., 2005). Investigating if there were differences in IJA and RJA across benchmark groups allowed us to explore which aspect of joint attention, general joint attention skills as indexed by RJA, or social motivation and joint attention as indexed by IJA (Malesa et al., 2013) is critical for language acquisition.

Gestures are other skills strongly associated with language development in young children with ASD (Charman, Drew, Baird, & Baird, 2003; Luyster et al., 2008; Wetherby et al., 2007). Toddlers' gesture inventories, as measured by parent checklists such as the MacArthur-Bates Communicative Developmental Inventory (MCDI; Fenson et al., 1993), predict concurrent language skills in toddlers with ASD (Luyster et al., 2008) as well as later language abilities (Luyster, Qiu, Lopez, & Lord, 2007). Given the foundational role that gestures are hypothesized to play in language development, we chose to investigate if there are differences in the gesture inventories of toddlers with ASD at different language levels.

The final variable considered in this investigation was RRBs. RRBs are a core feature of ASD within the *Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition* (American Psychiatric Association [APA], 2013). RRBs are a broad category of behaviors that includes motor stereotypies, repetitive use of objects or speech, insistence on sameness, adherence to nonfunctional routines or ritualized verbal or nonverbal behaviors, fixated interests that are unusual in intensity or focus, and atypical reactions to sensory input. Researchers propose that RRBs interfere with communication development by decreasing children's availability for learning and interacting with their environment (Richler, Bishop, Kleinke, & Lord, 2007; Richler, Huerta, Bishop, & Lord, 2010). This hypothesis is supported by findings indicating that higher RRBs are associated with poorer language outcomes (Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; Paul et al., 2008; Ray-Subramanian & Ellis Weismer, 2012). For example, repetitive behaviors in toddlers with ASD between 15 and 25 months of age predicted expressive language scores between 3 and 5 years of age (Paul et al., 2008). Additional evidence includes the finding that increases in receptive and expressive language abilities from age 2 to 3 years significantly predicted decreases in RRBs even after controlling for gains in nonverbal cognition (Ray-Subramanian & Ellis Weismer, 2012).

Purpose

The purpose of this investigation was twofold. First, we describe the range of communication profiles observed in a sample of toddlers with ASD at a mean age of 2.5 years as defined by the expressive language benchmarks proposed by Tager-Flusberg et al. (2009). Next, we investigated if there were differences in cognitive, social, and behavioral

features across children grouped according to their expressive language benchmarks. The specific research questions addressed were as follows: (a) What types of communication profiles are observed in toddlers with ASD at a mean age of approximately two and a half years using the expressive language benchmarks, and (b) are there differences in cognitive, social, and behavioral variables across benchmark groupings?

Method

Participants

Participants were part of a larger longitudinal study investigating early language development in young children with ASD. For detailed descriptions regarding the inclusion and exclusion criteria and the number of children assessed as part of the longitudinal study, refer to Davidson and Ellis Weismer (2014) and Venker, Ray-Subramanian, Bolt, and Ellis Weismer (2014). One hundred twenty-nine children were enrolled in the study. Twenty-four participants were excluded because we were unable to create benchmark profiles for these children due to missing scores. We report on data from the 105 children (mean chronological age = 31.23 months, $SD = 3.95$ months, range = 23–39 months) with scores across all measures. All of the children were included in the first research question, which focused on characterizing the expressive language profiles of the toddlers in the sample. The second research question investigated if there were differences in cognitive, social, and behavioral features when children were grouped according to their expressive language benchmarks. Only three children met criteria for the Sentences group in the domain of vocabulary/grammar. These children were excluded from the analyses conducted to answer Research Question 2 due to the small sample size ($n = 3$) of this group. Thus, Research Question 2 consisted of 102 children. The participants with ASD have formed the basis for a number of previously published reports by Ellis Weismer and colleagues (e.g., Bean Ellawadi & Ellis Weismer, 2014; Ellis Weismer et al., 2011; Ray-Subramanian & Ellis Weismer, 2012). Table 1 contains the participant characteristics and demographic information, including gender, ethnicity, age, maternal education (years), and Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) scores.

Recruitment

Monolingual English-speaking children ages 24–36 months who had previously been diagnosed or were suspected to be on the autism spectrum were recruited from various community sources. These community sources included a statewide early intervention program for infants and toddlers with developmental delays, pediatricians, and a university-based developmental disabilities clinic. This study was approved by the Institutional Review Board at the University of Wisconsin–Madison.

Table 1. Participant characteristics and demographic information when children were grouped according to their vocabulary/grammar benchmark levels.

Variable	Total sample <i>N</i> = 105	Prelinguistic <i>n</i> = 19	First words <i>n</i> = 61	Word combinations <i>n</i> = 22	Sentences <i>n</i> = 3
Gender					
Male	92	17	54	18	3
Female	13	2	7	4	0
Ethnicity					
White	90	17	52	19	2
African American	2	0	0	1	1
Hispanic	3	0	2	1	0
Native American	2	0	2	0	0
Other	8	2	5	1	0
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
Age	31.23 (3.95)	29.21 (3.95)	30.95 (3.74)	32.59 (3.81)	36 (1.00)
Mat. Ed.	13.23 (11.21)	14.37 (2.06)	14.59 (2.34)	8.18 (2.39)	16 (2.00)
ADOS	7.54 (1.86)	7.16 (1.74)	7.70 (1.99)	7.59 (1.68)	6 (0)

Note. Mat. Ed = maternal education, ADOS = Autism Diagnostic Observation Schedule Calibrated Severity Score (Gotham et al., 2009).

Procedure

As part of the longitudinal study, children participated in annual comprehensive diagnostic evaluations over the course of 3 years; however, only data from the first year is included in the present investigation. Autism diagnoses were made at Time 1 by a psychologist with extensive experience in diagnosing autism in young children in collaboration with an experienced speech-language pathologist. Only those toddlers who received an ASD diagnosis by the study team were enrolled in this investigation. Consistent with previous research studies, criteria from the *Diagnostic and Statistical Manual of Mental Disorders–Fourth Edition* (APA, 1994) as well as all available information obtained during the comprehensive diagnostic evaluation (see description of measures below) were used to make best estimate clinical diagnoses (e.g., Chawarska, Klin, Paul, & Volkmar, 2007; Lord et al., 2006). Researchers have shown that these diagnoses are reliable (Klin, Lang, Cicchetti, & Volkmar, 2000) and generally stable over time even for children who receive their diagnosis prior to the age of 3 years (Moore & Goodson, 2003).

Diagnostic Evaluation

Autism-Specific Diagnostic Measures

The Autism Diagnostic Interview–Revised (ADI-R; Rutter, LeCouteur, & Lord, 2003) is a caregiver interview with questions designed to probe for autism-specific behaviors across social interaction, communication, and RRBs in the child's daily life. The caregivers' responses are scored and used to create an algorithm that is used for diagnosis. The ADI-R is a reliable and valid measure of autism with high sensitivity and specificity (Lord, Rutter, & LeCouteur, 1994). The ADOS or Autism Diagnostic Observation Schedule–Toddler Module (ADOS-T; Luyster et al. 2009) were administered. The ADOS and ADOS-T are semistructured observations designed to elicit behaviors identified

as important to the diagnosis of ASD, including communication, social interaction, and RRBs. The ADOS is a well-accepted and widely used autism diagnostic measure (Chawarska et al., 2007) with high reliability for classifying autism versus non-autism spectrum (Lord et al., 2000). The ADI-R and ADOS were administered by research-reliable examiners. Calibrated autism severity scores were computed for the ADOS on the basis of guidelines developed by Gotham, Pickles, and Lord (2009).

Cognitive and Adaptive Measures

Cognition was assessed using the Bayley Scales of Infant and Toddler Development–Third Edition (Bayley, 2006). This scale measures cognitive skills, including sensorimotor development, exploration and manipulation, object relatedness, concept formation, memory, habituation, visual acuity, visual preference, and object permanence as well as other aspects of cognitive processing. The child demonstrates cognitive skills by assembling objects, completing puzzles, matching colors, engaging in representational and pretend play, and discriminating patterns. The Bayley-III standard scores have a mean of 100 and *SD* of 15. The Bayley-III has good reliability, ranging from .86 to .93 across subtests, and high specificity (ranging from 0.77 to 1.00). The Vineland Adaptive Behavior Scales–Second Edition, Survey Interview Form, was used to assess cognitive abilities and adaptive behavior and provide information about communication, daily living skills, socialization, and motor skills. This survey interview is designed to aid in the diagnosis of developmental disabilities such as ASD.

Language Measures

Three different aspects of communication were assessed: phonology, vocabulary/grammar, and pragmatics. Information from the measures described below was used to classify toddlers as falling into the Prelinguistic, First

Words, or Word Combinations group according to the criteria established by Tager-Flusberg et al. (2009). See Table 2 for a summary of the criteria used for the present study, and refer to Tager-Flusberg et al. (2009) for a more detailed description of the criteria comprising the different expressive language benchmark stages.

Phonology was assessed using a speech analysis summary completed by a licensed speech-language pathologist during the speech-language portion of the assessment at Time 1. The total number of different consonants produced by the child was tallied online and used as an index of each child's phonological inventory. Minimum criteria (i.e., the number of consonants produced out of the 24 possible consonants in the English language) were used to group children. On the basis of the benchmarks criteria, if children produced fewer than four consonants they were placed in the Prelinguistic group; if they produced between four and nine consonants, they were placed in the First Words Group; and if they produced 10–15 consonants, they were placed in the Word Combinations group. A minimum criteria was not specified for the Sentences group; therefore, we used the range of typical development, 16–24 consonants, specified in the benchmarks paper to inform our grouping for this stage. AE scores from the Preschool Language Scale–Fourth Edition (PLS-4; Zimmerman, Steiner, & Pond, 2002) were used to group children according to their expressive language benchmark groups. The PLS-4 is a standardized language assessment designed to assess expressive and receptive language skills in children from birth through 6 years, 11 months of age. The auditory comprehension and expressive communication subscales measure semantic and syntactic skills. The semantic skills assessed include basic vocabulary as well as quantities and qualitative, spatial, and temporal concepts. The linguistic skills assessed include morphology and various levels of syntactic complexity. The PLS-4 has high test–retest reliability with reliability coefficients for the subscale scores (range = .82–.95) and for total language scores (range = .90–.97). AEs from the PLS-4 have been identified as reliable and valid measures of early syntactic and semantic abilities in young children with ASD (Volden et al., 2011). As per the recommendations of Tager-Flusberg et al. (2009), AEs were used as a measure of expressive language (vocabulary and grammar). Children with AEs less than 15 months were placed in the Prelinguistic group, children with AEs between 15 and 23 months were

placed in the First Words group, children with AEs between 24 and 35 months were placed in the Word Combinations group, and children with AEs higher than 35 months were placed in the Sentences group.

The Early Social Communication Scale (ESCS; Mundy et al., 2003), which is a structured observation designed to measure nonverbal social skills that typically emerge in children between 8 and 30 months of age, was used to assess IJA, RJA, and pragmatics. The assessment consists of tasks that are designed to elicit a variety of social communication skills. Children's behaviors are coded according to their complexity, function (joint attention, behavioral request, or social interaction), and if the communication behavior was in response to the examiner's bid or initiated by the child. RJA and IJA were assessed using the ESCS because it is specifically designed to evaluate joint attention and provides a scaled score for RJA and IJA rather than rankings, which are used in other assessments, such as the ADOS. RJA was assessed within the book presentation (i.e., did the child follow the examiner's point to interesting pictures in the book) and the gaze-following task (i.e., did the child follow the examiner's distal point and gaze to a picture on the wall) as well as when the child pointed to interesting objects or events after the examiner had pointed. The following IJA behaviors were coded throughout the assessment: establishing eye contact with the examiner while manipulating or touching an inactive mechanical toy, alternating looks between an active object and the examiner, pointing to an active object or anything out of reach, showing toys or objects to the examiner, and addressing the caregiver in the room. This is in line with previous work that has used the ESCS as a measure of joint attention in children with ASD (e.g., Luyster et al., 2008; Siller, Hutman, & Sigman, 2013). Training for ESCS coders was completed using materials and training videotapes provided by the lead author of this measure (Mundy et al., 2003) as well as four training videos of toddlers with ASD; coders met at least .80 inter-rater agreement on all ESCS codes (commenting, requesting, turn taking) as well as RJA.

The number of different communication functions produced by the child during the ESCS was used as an index of pragmatics. The ESCS was chosen as an index of pragmatics because it has been identified as a valid and reliable measure of social communication skills (e.g., Mundy,

Table 2. Grouping criteria.

Communication domain	First words	Word combinations	Sentences
Phonology	4–9 consonants	10–15 consonants	>15 consonants
Vocabulary/grammar	AE 15–23 months	AE 24–35 months	AE >35 months
Pragmatics	Comments + 1 other	Comments, requesting, and turn taking	1 narrative

Note. Children who did not meet criteria for the First Words group were placed in the Prelinguistic group. For the Sentences group, the lowest number for the range in typical development was used for the consonant inventory because minimum criteria was not specified in the area of consonant inventory for this group. In the area of pragmatics, the highest benchmark level that children could achieve was word combinations because narratives were not scored in the Early Social Communication Scale. AE = age equivalent.

Sigman, & Kasari, 1994). The specific communication functions scored during the ESCS included commenting, requesting, and turn taking. Within the ESCS, turn taking is defined as a sequence of turns with the examiner in which the child rolls or throws the ball or car to the examiner. A limitation of this assessment is that narratives were not scored. Therefore, the highest level that a child could attain is the Word Combinations grouping. Children who produced fewer than two social communication acts were placed in the Prelinguistic group; children who produced commenting and another social communication act, such as requesting or turn taking were placed in the First Words group; and children who produced commenting, requesting, and turn taking were placed into the Word Combinations group.

Gestures were assessed using the MCDI: Words and Gestures (Fenson et al., 1993). The CDI is a parent checklist that contains 63 gestures organized into two main sections. The Early Gestures (first communicative gestures and games and routines) section probes children's use of gesture for intentional communication and social interactions, and the Later Gestures section (actions with objects, pretending to be a parent, and imitating other adult actions) probes emerging symbolic understanding. The CDI has been used in previous work investigating the relationship between gesture and language development in toddlers with ASD (Luyster, Lopez, & Lord, 2007; Luyster, Qiu, et al., 2007; Mitchell et al., 2006) and has been identified as a reliable and valid measure (Fenson et al., 2007). Research investigating gesture assessment in children with ASD has demonstrated that scoring of gestures is not consistent across instruments. For example, researchers found that there was not a significant correlation between giving gestures as assessed by the ESCS, CDI, and ADOS (Bean Ellawadi & Ellis Weismer, 2014). Thus, we chose to use an instrument that provided a measure of children's overall gesture inventory rather than rate gesture through observational methods in order to enable comparison with previous research studies.

A composite RRB score that has been used in previous research (Ray-Subramanian & Ellis Weismer, 2012) was created using the ADOS. These composite scores were created to enable researchers to explicitly explore the relationship between RRBs and different domains of language. There are other recently developed conventions for creating RRB scores (e.g., Hus, Gotham, & Lord, 2014); however, we chose to use the same conventions that had been previously established in order to compare and extend our prior results. For children who received the ADOS-T ($n = 47$), scores were summed across the following items: unusual sensory interest in play material/person, hand and finger or the higher value from either hand and finger movements/posturing or other complex mannerisms. For children who received ADOS Module 1 ($n = 46$) or Module 2 ($n = 12$), scores were summed across unusual sensory interest in play material/person, hand and finger and other complex mannerisms, and unusually repetitive interests or stereotyped behaviors. The possible range of scores on this variable was 0 to 7.

Analytic Plan

Children were grouped using the criteria of the expressive language benchmarks as defined by Tager-Flusberg et al. (2009) across the following domains: phonology, vocabulary/grammar, and pragmatics. For the first research question, a qualitative analysis was implemented. We describe the communication profiles of the sample and discuss trends that were observed across the sample. In the second research question, we investigated if there were differences in identified cognitive, social, and behavioral features across expressive language groups at a mean age of 2.5 years.

For the second research question, AE scores from the expressive language communication scale of the PLS-4 were used to group children according to the spoken language benchmarks. A multivariate analysis of covariance (MANCOVA) was calculated to determine if there were across-group differences in cognitive, social, and behavioral features. Due to the small sample size in the Sentences group ($n = 3$) for vocabulary/grammar benchmark groupings, only the Prelinguistic, First Words, and Word Combinations groups were included in the analyses for Research Question 2. The independent variable was group and the dependent variables were cognition, RJA, gesture, and RRBs. Age was used as a covariate due to the significant difference in age across groups. Post hoc comparisons of significant differences across the three groups were analyzed using a Bonferroni test.

Results

In the area of phonology, 15 children met criteria for the Prelinguistic group, 39 met criteria for the First Words group, 32 met criteria for the Word Combinations group, and 19 met criteria for the Sentences group. With regard to vocabulary/grammar, 19 children met criteria for the Prelinguistic Group, 61 met criteria for the First Words group, 22 met criteria for the Word Combinations group, and three met criteria for the Sentences group. For pragmatics, 92 children met criteria for the Prelinguistic group, six met criteria for the First Words group, and seven met criteria for the Word Combinations group (see Figure 1).

Individual profiles across domains were constructed by grouping children according to the relationship observed across the language domains to determine if trends emerged. Ten children demonstrated even communication profiles; they achieved the same benchmark level across phonology, vocabulary/grammar, and pragmatics. The remaining 90% of the sample demonstrated uneven communication profiles. A summary of the various expressive language profiles is provided in Table 3.

For the second research question, we compared performance of the children in the different expressive language groups to determine if there were differences in variables hypothesized to underlie language development. The majority of the sample presented with uneven profiles. Therefore, our first analyses investigated differences across groups when children were grouped according to their vocabulary/

Figure 1. Number of children who met criteria for each language domain.

grammar benchmark levels followed by an investigation into if there were differences across groups when children were grouped according to their phonology benchmark levels. We could not compare across pragmatic levels because the majority of the sample fell into the Prelinguistic group. In the area of vocabulary/grammar, there were a total of 19 children in the Prelinguistic group, 61 children in the First Words group, and 22 children in the Word Combinations group (see Table 4).

The results of the MANCOVA for the vocabulary/grammar grouping were as follows: There was a significant difference in RJA, $F(2, 98) = 10.42, p < .001, \eta^2_p = .18$. The

Table 3. Expressive language communication profiles.

Expressive language profiles	Number of children
Phonology = vocabulary/grammar = pragmatics	$N = 10$
Phonology > vocabulary/grammar > pragmatics	$N = 38$
Phonology > vocabulary/grammar = pragmatics	$N = 10$
Phonology = vocabulary/grammar > pragmatics	$N = 35$
Vocabulary/grammar > phonology = pragmatics	$N = 3$
Vocabulary/grammar > phonology > pragmatics	$N = 1$
Pragmatics > phonology = vocabulary/grammar	$N = 6$
Pragmatics > vocabulary/grammar > phonology	$N = 2$

Word Combinations group had higher RJA scores than the Prelinguistic and the First Words groups ($ps < .01$). The First Words group had higher RJA scores than the Prelinguistic group ($p = .02$). There was a significant difference in the total number of early, $F(2, 98) = 10.57, p < .001, \eta^2_p = .18$, and late gestures, $F(2, 98) = 6.18, p < .001, \eta^2_p = .18$. The Word Combinations group produced more early gestures than the First Words and Prelinguistic groups ($ps < .001$). The First Words group produced significantly more gestures than the Prelinguistic group ($p = .04$). With regard to late gestures, the Word Combinations group produced more late gestures than the First Words ($p = .006$) and Prelinguistic groups ($p = .001$); however, there was not a statistically significant difference between the First Words group and the Prelinguistic group ($p = .15$). There was not a significant difference in cognition, $F(2, 98) = 1.13, p = .33$; IJA, $F(2, 98) = 2.90, p = .06$; or RRB scores, $F(2, 98) = 1.04, p = .36$, across the groups.

A second MANCOVA with age as a covariate was conducted to determine if similar across-group differences were observed when children were grouped according to their phonology benchmark levels. There was a significant difference in RJA, $F(3, 97) = 4.05, p < .001, \eta^2_p = .11$. The Sentences group had higher RJA scores than the Prelinguistic ($p = .001$) and First Words groups ($p = .02$). The Word Combinations group had higher RJA scores than the Prelinguistic group ($p = .02$). There was not a difference between the Word Combinations and First Words groups or the First Words group and the Prelinguistic group. There was also a significant difference in early, $F(3, 97) = 3.42, p = .02, \eta^2_p = .10$, and late gestures, $F(3, 97) = 4.58, p = .005, \eta^2_p = .12$. The Sentences and Word Combinations groups produced more early and late gestures than the First Words group ($ps < .05$). The Sentences and Word Combinations groups produced significantly more early gestures than the Prelinguistic group ($p < .001$), and the Sentences group produced more late gestures than the Prelinguistic group ($p = .02$). There was not a significant difference in cognition, $F(3, 97) = .86, p = .46$; IJA, $F(3, 97) = 1.93, p = .13$; or RRBs, $F(3, 97) = 1.63, p = .19$.

Discussion

For the first research question, we characterized expressive language in a large sample of toddlers on the autism spectrum using expressive language benchmarks defined by Tager-Flusberg et al. (2009) to describe their communication profiles. We first consider the profiles observed. Phonology emerged as an area of relative strength, and vocabulary/grammar and pragmatics were areas of impairment. For a large proportion of children, phonology was found to be the area of greatest strength. Pragmatics reflected the area of greatest impairment. These findings are consistent with a review of the language acquisition literature in ASD (Eigsti, de Marchena, Schuh, & Kelley, 2011), which notes that phonology tends to be relatively intact for most individuals whereas pragmatic difficulties are nearly universal even in children who no longer meet

Table 4. Means and standard deviations across different expressive benchmark groupings.

Variable	Prelinguistic	First words	Word combinations	Sentences
Vocabulary/grammar	(<i>n</i> = 19)	(<i>n</i> = 61)	(<i>n</i> = 22)	(<i>n/a</i>)
RJA	0.21 (0.18)	0.44 (0.32)	0.67 (0.27)	
IJA	2.26 (2.38)	5.18 (6.87)	8.91 (11.95)	
Early gestures	7.79 (2.49)	10.03 (3.57)	13.32 (3.01)	
Late gestures	14.79 (6.47)	18.66 (8.25)	24.77 (6.34)	
Cognition SS	76.84 (9.89)	84.51 (9.73)	94.77 (13.84)	
Raw score	63.79 (6.14)	63.31 (8.07)	61.36 (5.92)	
RRBs	5.79 (1.47)	5.64 (1.70)	5.18 (2.04)	
Phonology	(<i>n</i> = 15)	(<i>n</i> = 39)	(<i>n</i> = 32)	(<i>n</i> = 16)
RJA	0.25 (0.22)	0.39 (0.31)	0.51 (0.32)	0.64 (0.30)
IJA	3.47 (5.60)	3.74 (3.77)	6.41 (8.34)	9.50 (13.66)
Early gestures	8.47 (2.83)	9.10 (3.51)	11.84 (3.53)	12.00 (3.61)
Late gestures	16.60 (6.13)	15.79 (7.84)	22.44 (7.26)	23.81 (8.29)
Cognition SS	80.67 (11.32)	82.56 (10.12)	86.72 (11.40)	93.43 (15.02)
Raw score	64.13 (7.06)	63.44 (8.32)	61.72 (7.01)	63.31 (5.59)
RRBs	5.73 (1.62)	5.89 (1.76)	5.38 (1.70)	5.00 (1.83)

Note. Scores are reported as means and standard deviations. RJA = response to joint attention; IJA = initiating joint attention; Early gestures = total number of early gestures produced; Late gestures = total number of late gestures produced; SS = standard scores on the Bayley-III; RRBs = restricted and repetitive behaviors.

criteria for being on the autism spectrum (Kelley, Paul, Fein, & Naigles, 2006). In terms of pragmatics, 88% of the children fell into the Prelinguistic group, which reflects a developmental level of less than 12 months of age. With regard to vocabulary/grammar, only three children met criteria for the Sentences group. The pervasive deficits in pragmatic skills are consistent with the social impairments that characterize ASD (e.g., APA, 1994, 2013; Wetherby et al., 2007), and the delayed expressive vocabulary/grammar development is consistent with the pervasive expressive language impairments that characterize toddlers with ASD (Ellis Weismer et al., 2010; Paul et al., 2008). However, it is also possible that the distribution observed across this sample may be a reflection of the benchmark definitions and/or the measurement tools used.

With regard to pragmatics, a variety of communication functions may be related to overall volume of communication such that children with a higher volume of communication produce a greater variety of communicative functions. Measurement tools such as the ESCS (used in the current study) and the Communication and Symbolic Behavior Scales (Wetherby & Prizant, 2002) assess communicative functions during direct observation of natural play as well as communication temptations. Although measurement tools that are designed to elicit behaviors such as turn taking and commenting increase the likelihood of observing these behaviors, this does not guarantee that the behavior will be observed during the assessment. Measurement tools that rely on parent report, such as the Language Use Inventory (O'Neill, 2009), may have yielded a different pragmatic profile. We hypothesize that our choice of measurement may have also affected the pattern that we observed in the domain of vocabulary/grammar. Only three of the children in this sample met the criteria for the Sentences group in the domain of vocabulary/grammar. Parent report measures, such as the MCDI, may have yielded different vocabulary/

grammar groupings than the direct measurement used in this study. Previous work investigating gesture production found that gesture production differed across measurement tools and tasks for this sample of toddlers with ASD (Bean Ellawadi & Ellis Weismer, 2014); however, in other studies, researchers report high agreement among language assessment measures (e.g., Luyster et al., 2008). Thus, researchers should explore the impact that measurement tools (e.g., direct measurement, parent report, language sampling) have on benchmark groupings.

In addition to investigating the sample as a whole, we created individual language profiles by grouping children according to the relationship observed across expressive language domains. Ten children presented with even profiles, achieving the same benchmark level for phonology, grammar/vocabulary, and pragmatics. The remaining 95 children presented with uneven profiles that varied in presentation. Forty-six percent of the children achieved higher phonology benchmark levels than their vocabulary/grammar and pragmatic levels. Thirty-three percent of the children achieved equivalent benchmark levels in phonology and vocabulary/grammar and a lower benchmark level in pragmatics. A small subset of children presented with unexpected profiles.

Eight children presented with pragmatic benchmark levels that exceeded their vocabulary/grammar and phonology levels. This profile is unique given that social communication is a defining feature of this disorder (APA, 1994, 2013) and pragmatic impairments in toddlers with ASD are well documented (e.g., Chawarska, Klin, Paul, Macari, & Volkmar, 2009; Wetherby et al., 2007). To our knowledge, previous research has not individually profiled pragmatic skills relative to language skills, so it is plausible that the profile demonstrated by this small subset of toddlers is not unique. It may also be the case that, for this subset of toddlers, marked pragmatic impairments may not appear

until later in development. As noted by Chawarska et al. (2009, p. 1242), the “challenges of a complex peer and academic environment” in kindergarten may tax the social communication skills of children with ASD who do present with better pragmatic skills. As an alternative, young children who display this atypically positive pragmatic profile may be the subgroup of children with ASD who are more likely to have “optimal outcomes” (Fein et al., 2013). Future work should determine how the outcomes of these children overlap and differ from their peers with more typical ASD spoken language profiles.

Four children presented with vocabulary/grammar benchmark levels that exceeded their phonological and pragmatic levels, and half of the children in this subset achieved a prelinguistic benchmark level for phonology, which indicates they produced fewer than four consonants during the assessment. It is possible that the significant impairments in phonological and expressive language observed in this subset of children may be due to oral-motor difficulties. The hypothesis that apraxia of speech underlies the phonological delays observed in children with ASD has not been supported (Shriberg, Paul, Black, & van Santen, 2011). There is, however, evidence of fine and gross motor skills delays in young children with ASD (Bhat, Galloway, & Landa, 2012; Lloyd, MacDonald, & Lord, 2013). In recent work investigating the relationship between speech motor function and language skills in toddlers with ASD, researchers reported a significant correlation between place of articulation measures and concurrent language and motor abilities. Indeed a subset of toddlers with ASD with significantly poorer language skills demonstrated differences in measures that reflect place of articulation leading as compared with the toddlers with ASD with better language skills (Sullivan, Sharda, Greenson, Dawson, & Singh, 2013). As with children with typical development, it is possible that these children may have articulation disorders that are affecting their speech and language development. Overall, these findings suggest that a relationship between restricted phonological inventories and subsequently poorer vocabulary/grammar skills may be a manifestation of these fine motor delays.

In addition to describing the social communication profiles of the sample of children, we used the expressive language groups to examine if there were differences in cognitive, social, and behavioral variables across different benchmark groupings. To our knowledge, this is the first investigation to test the consistency of known cognitive, social, and behavioral variables differ across benchmark profiles. Our results differed on the basis of how the toddlers were grouped. When the toddlers were grouped according to one aspect of their expressive language (i.e., phonology, vocabulary/grammar benchmark levels) differences in RJA, early gestures and late gestures were observed across the groups. We consider these results with regard to our hypotheses as well as the implications of the differing results observed across profile groupings.

Consistent with our hypotheses, there was a significant difference in children’s RJA scores across groups. However,

this difference only emerged when children were grouped according to one aspect of their expressive language, phonology or vocabulary/grammar. Some researchers suggest that early language learning takes place during unstructured social interactions (e.g., Hoff, 2003) during which children must learn to selectively allocate their attention (Posner & Petersen, 1990; for a contrasting view, see Yurovsky, Smith, & Yu, 2013). Thus, children who respond to their communication partner’s bids for joint attention are more likely to allocate their attention to relevant information that supports language learning. Contrary to our hypothesis, there was not a significant difference in IJA across any of the groupings. This was unexpected given the language gains reported in interventions targeting IJA. For example, a group of children with ASD who received a joint attention intervention at age 3.5 years as part of a randomized clinical trial were followed up 5 years later. At follow-up, 80% of the children had achieved functional use of spoken language. In addition, the group that received joint attention intervention gained 12.5 expressive language standard score points above the control group (Kasari, Gulsrud, Freeman, Paparella, & Helleman, 2012). These findings suggest that general joint attention skills rather than joint attention and social motivation are critical for early language learning.

Differences in early gestures were found when children were grouped according to one aspect of their expressive language. This is consistent with Luyster et al.’s (2008) finding that early gestures predicted concurrent expressive vocabulary skills in toddlers with ASD. Gestures enable children to communicate intentionally before they have the language to do so. This intentional communication, such as pointing to objects, may in turn elicit language from parents. Thus, children’s gesture production also serves to facilitate language input from parents, which may account for the relationship observed between early gestures and language ability. Although early gestures differentiated the groups when children were grouped according to their vocabulary/grammar benchmark levels, only late gestures differentiated children across both groupings. In previous work, late gestures at age 2 predicted expressive language at age 9 (Luyster, Qiu, et al., 2007). The early gestures on the MCDI reflect social communicative gestures, whereas the late gestures reflect symbolic gestures. The finding that late gestures was the only variable that consistently differed across benchmark groupings may be a reflection of the skills found within this domain. In addition to reflecting symbolic understanding, Miniscalco, Rudling, Råstam, Gillberg, and Åsberg Johnels (2014) found that the imitation subscale of the MCDI drove pragmatic development in a sample of young children with ASD. Therefore, it may be that imitation rather than symbolic gesture development plays a foundational role in language acquisition.

Contrary to our hypotheses, we did not find differences in cognition or RRBs. It is possible that our failure to find significant differences in cognition across language groups may be a reflection of our sample. Unlike previous research studies, we used raw scores and controlled for age

in our analyses due to the significant difference in ages across groups with the more advanced language group being older. With respect to RRBs, although RRBs are stable over time (Kim & Lord, 2011), research has shown that different RRBs tend to become stronger and increase with age, leading to different relationships over the course of development. A study by Bishop, Richler, and Lord (2006) found that only unusual sensory interests were related to IQ in children less than 3 years of age, whereas in children between 3 and 6 years of age, a variety of RRBs were related to IQ. When Richler and colleagues (2010) partitioned RRBs into two different types, insistence on sameness and repetitive sensorimotor behaviors, they found a relationship between early social communication skills and insistence on sameness but not between early social communication skills and repetitive sensorimotor behaviors. In this particular study, we focused on repetitive sensorimotor behaviors. Future work should continue to explore this relationship by investigating if differences emerge across RRB types.

Grouping children with ASD according to the spoken language benchmarks revealed a range of expressive language profiles with the majority of children exhibiting an uneven communication profile across the different language domains (phonology, vocabulary/grammar, and pragmatics). As such, the benchmarks appear to serve as a useful tool for clinically characterizing a child's communication profile as well as a means to chart outcomes across different aspects of communication. Grouping children according to their communication profiles may also serve as a helpful approach for investigating if children with specific profiles respond better to certain identified interventions than others. As noted by the National Research Council (2001) a one-size-fits-all approach to intervention is not likely to be appropriate for children with ASD. Creating profiles for individual children may yield important insights into which treatments are most effective for specific developmental profiles.

Grouping the children according to these benchmarks enabled us to investigate the processes underlying different levels of language development in toddlers with ASD. Contrary to our expectations, our findings differed on the basis of how children were grouped. Overall, the benchmarks provided clear criteria on how to group the children and proved useful as a means for describing the communication profiles for the sample as a whole as well as individual children across language domains. However, our findings suggest that different variables may emerge that are important for language acquisition on the basis of how children are grouped, and it is possible that the measurement tools used may affect the benchmark levels that children achieve. Thus, the measurement tools and groupings used by researchers should be considered when comparing results observed across research studies.

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