Research Article

Verbal and nonverbal outcomes of toddlers with and without autism spectrum disorder, language delay, and global developmental delay

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Abstract

Background and Aims: Children with autism spectrum disorder (ASD) exhibit a heterogeneous clinical phenotype with wide variability in their language and intellectual profiles that complicates efforts at early detection. There is limited research examining observational measures to characterize differences between young children with and without ASD and co-occurring language delay (LD) and global developmental delay (GDD). The first aim of this study was to compare early social communication measured in the second year of life in children diagnosed at age 3 with ASD, developmental delays (DD), and typical development (TD). The second aim was to compare early social communication in six subgroups of children: ASD, ASD+LD, ASD+GDD, LD, GDD, and TD. Our third aim was to determine the collective and unique contributions of early social communication to predict verbal and nonverbal developmental outcomes at three years of age for children with and without ASD.

Methods: Analyses of covariance controlling for maternal education were employed to examine group differences in social communication in 431 toddlers recruited through screening in primary care. Multiple linear regression analyses were conducted to evaluate associations between the Communication and Symbolic Behavior Scales (CSBS) Behavior Sample standard scores and Mullen Scales of Early Learning T scores for children with and without ASD.

Results: Distinct patterns of early social communication were evident by 20 months. Children with TD differed significantly from children with ASD and DD on all three CSBS Behavior Sample composites. Children with ASD had significantly lower scores than those with DD and TD on the social and symbolic composites. Among the six subgroups, all three composites of the CSBS Behavior Sample differentiated children with TD from all other subgroups. Children with ASD+GDD scored significantly lower than all other subgroups on social and symbolic composites. Patterns of social communication emerged for children with and without ASD, which held among subgroups divided by developmental level. The CSBS Behavior Sample social and symbolic composites contributed unique variance in predicting developmental outcomes in both groups. The speech composite contributed unique variance to expressive language.

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receptive language, and visual reception in children without ASD, and contributed uniquely to expressive language only for children with ASD.

**Conclusions:** The CSBS Behavior Sample, an observational measure for children aged 12–24 months, detected social communication delays and explained a significant amount of variance in verbal and nonverbal outcomes a year later in this large sample of young children grouped by ASD diagnosis and developmental level.

**Implications:** In light of the continued search for early predictors of ASD and developmental delay, our findings underscore the importance of monitoring early social communication skills, including the expression of emotions, eye gaze, gestures, rate of communication, joint attention, understanding words, and object use in play. There is a need for clinical utility of screening and evaluation tools that can detect social communication delays in very young children. This would enable intervention for infants and toddlers who show social communication delays which may be early signs for ASD or other DD, rather than waiting to confirm a formal diagnosis.

**Keywords**
Autism spectrum disorder, global developmental delay, language delay, social communication, toddlers

The earliest signs of autism spectrum disorder (ASD) often appear by the end of the first year of life and gradually unfold in the second year, making the toddler years a critical time to detect the emerging features of ASD (Ozonoff et al., 2010; Wetherby et al., 2004; Wetherby, Watt, Morgan, & Shumway, 2007; Zwaigenbaum et al., 2005). A stable diagnosis of ASD can be made between 18 and 24 months by a team of experienced professionals (Barbaro & Dissanayake, 2016; Chawarska, Klin, Paul, & Volkmar, 2007; Guthrie, Swineford, Nottke, & Wetherby, 2013); however, most children are not diagnosed by community providers until school age (Brett, Warnell, McConachie, & Parr, 2016; Christensen, Baio, et al., 2016). On average, children with ASD who begin receiving intervention in the toddler and preschool years benefit substantially (Dawson et al., 2010; Kasari et al., 2014; Pickles et al., 2016; Vivanti, Dissanayake, & Victorian ASELCC Team, 2016; Wetherby et al., 2014), and research has begun to document the positive effects of intervention that begins even earlier (Guthrie et al., under review). In the absence of available biomarkers, the continued investigation of the earliest behavioral characteristics of ASD remains vitally important for promoting children’s best possible outcomes.

Behavioral characteristics of ASD emerge on differing developmental courses in the first three years of life, impacting efforts to lower the age of detection (Zwaigenbaum et al., 2015). Further, individuals with ASD exhibit a heterogeneous clinical phenotype, with wide variability observed in their language and intellectual profiles (Munson et al., 2008; Tek, Mesite, Fein, & Naigles, 2014). Some individuals remain minimally verbal despite receiving intervention, while others score within the average range or higher on measures of language content and form (Tager-Flusberg & Kasari, 2013). Intellectual ability may range from profoundly impaired to superior. The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association [APA], 2013) captures this heterogeneity through severity levels and clinical specifiers of features not considered core deficits but that may co-occur with ASD, including language disorder and intellectual disability (ID). With these modifications in diagnostic criteria has come an expanded interest in characterizing the developmental profiles of children with ASD who do and do not have accompanying developmental delays (Bennett et al., 2014; Grzadzinski, Huerta, & Lord, 2013; Pierce et al., 2017).

**Autism spectrum disorder with language disorder**

Prevalence estimates for developmental language disorders range from 3 to 8% (Beitchman, Nair, Clegg, & Patel, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015). Early delays in expressive language often resolve (Dale, McMillan, Hayiou-Thomas, & Plomin, 1986; Law, Boyle, Harris, Harkness, & Nye, 2000; Norbury et al., 2016; Tomblin et al., 1997), and 44.2% of preschool children under the Individuals with Disabilities Education Act, Part B are served under the disability condition of speech or language impairment (U.S. Department of Education, 2015).
preschool, weaknesses in literacy and sentence structure may linger (Duff, Reen, Plunkett, & Nation, 2015; Rescorla & Turner, 2015; Rice, Taylor, & Zubrick, 2008). Children with language disorders and concomitant deficits with social communication are particularly prone to having lasting difficulties with sustaining peer relationships (Mok, Pickles, Durkin, & Conti-Ramsden, 2014).

In children with ASD, vocabulary, syntax, and morphology have been cited as important predictors of later adaptive behavior and the severity of ASD symptoms (Bennett et al., 2008). Disorders that impact language content and form are no longer considered core features of ASD (APA, 2013); however, children with ASD are at increased risk of having concomitant language disorders (Boucher, 2012; Hudry et al., 2010; Leyfer, Tager-Flusberg, Dowd, Tomblin, & Folstein, 2008; Ozonoff et al., 2014; Williams, Botting, & Boucher, 2008). Likewise, a larger than would be expected portion of the population with language disorders may also have ASD (Conti-Ramsden, Simkin, & Botting, 2006). The two disorders share similar underlying risk factors, such as onset in the early developmental period, male gender, family history of language disorder or ASD, and delayed motor and gestural development (Dohmen, Bishop, Chiat, & Roy, 2016; Landa, Gross, Stuart, & Baumann, 2012; Ozonoff et al., 2014; Tager-Flusberg, 2016). Individuals with ASD who are diagnosed with an accompanying language disorder have been found to have greater impairments in social functioning than those with ASD alone (Anderson, Oti, Lord, & Welch, 2009; Bennett et al., 2014). Bennett et al. (2014) suggested that individuals with ASD and co-occurring language disorder may experience a “double developmental hit” to both their communicative and social competence (p. 2798). If this is the case, the impact may be even greater for individuals with ASD who have global developmental delay.

**Autism spectrum disorder with global developmental delay**

IDs are characterized by significant impairments in adaptive functioning across social, conceptual, and practical domains (APA, 2013). Intellectual ability is relatively unstable in early childhood; therefore, children under the age of 5 with significant delays in more than one developmental domain are instead diagnosed with global developmental delay (GDD; Shevell et al., 2003). Children with GDD display considerable variation in their communication development and adaptive functioning, at least partly due to the large number of potential underlying causes, but there is some evidence that their developmental delays may be more likely to persist into school age than those of children with early language delay (Shevell, Majnemer, Platt, Webster, & Birnbaum, 2005a, 2005b; Thomaidis et al., 2014). Young children with GDD may lack robust early social communication skills in such areas as gesture usage and the coordination of triadic gaze shifts between objects and people during interactions with caregivers, and may be difficult to distinguish from children with ASD (Veness, Prior, Eadie, Bavin, & Reilly, 2014; Ventola et al., 2007). The prevalence of ID and GDD in the general population is approximately 1–3% (Shevell, 2010), but an estimated 32% of school-aged children with ASD are diagnosed with co-occurring ID (Christensen, Baio, et al., 2016), and approximately 46% of preschoolers with ASD have GDD (Christensen, Bilder, et al., 2016; Flanagan et al., 2015; Shevell et al., 2005b). A combined diagnosis of ASD and ID significantly impacts the need for support in the areas of social competence as well as personal independence and daily living (Green & Carter, 2014; Liss et al., 2001; Perry, Flanagan, Geier, & Freeman, 2009). Children with both ASD and ID may make slower progress in their social development than those with ASD alone or ASD with language disorders (Bennett et al., 2014; Itzchak & Zachor, 2007). Preverbal children with both ASD and ID may be less likely to eventually talk than those who also have ID alone (Tager-Flusberg & Kasari, 2013). Finally, lifetime costs of ASD with ID are markedly higher than for ASD alone (Buescher, Cidave, Knapp, & Mandell, 2014).

**Early social communication skills**

Collectively, previous research underscores the important, interwoven contributions of language acquisition and cognitive development to long-term outcomes in individuals with ASD, language disorders, and ID (Bennett et al., 2008; Brady, Marquis, Fleming, & McLean, 2004; Gillespie-Lynch et al., 2012; Luytster, Cadlec, Carter, & Tager-Flusberg, 2008; Szatmari et al., 2009; Thurm, Lord, Lee, & Newschaffer, 2007; Wetherby, Watt, et al., 2007; Yoder & Warren, 2004). Effective early intervention may lessen co-occurring delays in children with ASD; thus, early identification is critical for mitigating the functional and financial costs associated with having ASD combined with language disorders or ID.

Prelinguistic social communication skills, such as joint attention, gesture usage, language comprehension, and the rate and quality of communicative overtures, are observable and measurable months before words emerge and serve as important prognostic indicators in the early developmental period (Anderson et al., 2007; Watt, Wetherby, & Shumway, 2006; Wetherby,
Allen, Cleary, Kublin, & Goldstein, 2002; Wetherby, Goldstein, Cleary, Allen, & Kublin, 2003; Wodka, Mathy, & Kalb, 2013). Much of what is known about the early social communication profiles of children later diagnosed with ASD comes from research on children who are at high familial risk for ASD (Chawarska et al., 2014; Elsabbagh et al., 2013; Estes et al., 2015; Hudry et al., 2014; Jones, Gliga, Bedford, Charman, & Johnson, 2014; Landa, Holman, & Garrett-Mayer, 2007; Ozonoff et al., 2015), and from investigations in which the ascertainment measure in primary care was the Modified Checklist for Autism in Toddlers (M-CHAT, Robins et al., 2014). Sampling biases are inherent in research with high-risk siblings in which children with ASD who are functioning at a higher developmental level may be overrepresented (Ozonoff et al., 2015). High-risk siblings may display subthreshold signs of ASD that may not be detected through general population screening in the community. On the other hand, children without significant delays in meeting developmental milestones may be missed in studies that utilize the M-CHAT in primary care (Robins et al., 2014). The M-CHAT under-identifies children with ASD who exhibit subtler social, cognitive, and behavioral differences (Baird et al., 2000; Stenberg et al., 2014). Heterogeneous samples and disparate findings from studies examining the developmental profiles of young children with ASD, together with the updated, dimensional model of diagnosis in the DSM-5, create a need to closely examine early social communication development of children with ASD and varying levels of cognitive and language development separately to enhance our ability to interpret and generalize research results (Grzadzinski et al., 2013). Moreover, continued efforts to characterize the early social communication development in children screened and diagnosed through differing methodological approaches are needed to inform our understanding of the larger, general population of children with ASD.

Study aims

The first aim of this study was to compare early social communication measured in the second year of life in children ascertained through screening in primary care, who were later diagnosed with ASD, developmental delays without ASD (DD), and typical development (TD). Based on results of previous research, we hypothesized that social communication patterns would be significantly different across ASD, DD, and TD groups (Wetherby, Watt, et al., 2007). Dependent upon finding significant group differences, the second aim was to compare patterns of social communication across six subgroups categorized by diagnosis and developmental level: ASD without language or global developmental delay, ASD with language delay (ASD+LD), ASD with global developmental delay (ASD+GDD), language delay without ASD (LD), global developmental delay without ASD (GDD) and typical development (TD). Among the six subgroups, we anticipated that children with TD would have significantly higher social communication scores than other groups and that children with ASD+GDD would score significantly lower (Bennett et al., 2014). We also hypothesized that children later diagnosed with GDD would score significantly lower than those with LD.

While children with ASD have a range of developmental abilities as wide as the range of children without ASD, there are unique diagnostic characteristics of ASD that impact developmental trajectories and outcomes. Our third aim was to determine the collective and unique contributions of early social communication to predict verbal and nonverbal developmental outcomes at three years of age in children with and without ASD. We hypothesized that the shared variance explained by the composite measures of social communication using the Communication and Symbolic Behavior Scales (CSBS) Behavior Sample (Wetherby & Prizant, 2002) would be significant and largely relative to the unique contributions of individual composites, reflecting the interactions among these early developmental processes (Bates, 2004; Määttä, Laakso, Tolvanen, Westerholm, & Aro, 2016; Watt et al., 2006). Furthermore, we hypothesized that each composite would explain significant unique variance above and beyond the shared variance to predict developmental outcomes and explored whether the CSBS Behavior Sample differentially predicted outcomes in children with and without ASD (Wetherby, Watt, et al., 2007). This study extends current research by directly comparing the early social communication of a large, heterogeneous sample of young children with and without ASD and accompanying developmental delays separately, and further examines the utility of using systematic, direct observational methods to predict the developmental outcomes of children with and without ASD.

Methods

Participants

Participants included 431 children who were recruited through community screening for communication delay in primary care settings from the ongoing, prospective FIRST WORDS® Project (Wetherby, Brosnan-Maddox, Peace, & Newton, 2008). Children were initially screened with the Infant-Toddler Checklist (ITC; Wetherby & Prizant, 2002), a 24-question,
parent-report broadband screener for communication delays, between 9 and 18 months. To be included in this study, children must have subsequently completed two evaluations: (1) a video-recorded CSBS Behavior Sample in the second year of life ($M = 20.44; SD = 2.03$), and (2) a developmental evaluation that included the Mullen Scales of Early Learning (MSEL; Mullen, 1995) at three years of age ($M = 36.67; SD = 3.47$). As part of this project’s recruitment, males with typical development were oversampled in an attempt to represent both genders in proportions similar to the group diagnosed with ASD (Reinhardt, Wetherby, Schatschneider, & Lord, 2015). For children with a developmental delay on the MSEL and/or for whom ASD was suspected, a diagnostic evaluation was conducted to confirm or rule out ASD, which included the Autism Diagnostic Observation Schedule (Lord, Rutter, DiLavore, & Risi, 1999), Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984; Sparrow, Cicchetti, & Balla, 2005), and a developmental history.

To be included in this sample for analyses, each participant must have received a best estimate diagnosis using all available diagnostic information, including the measures listed above, by an experienced team of diagnosticians including a licensed psychologist, speech-language pathologist, and early childhood specialist, at the developmental evaluation (Chawarska et al., 2007; Guthrie et al., 2013). The outcomes of a subset of participants in the current study have been previously reported (e.g., Shumway & Wetherby, 2009; Wetherby, Watt, et al., 2007; Wetherby, Brosnan-Maddox, et al., 2008). Thirty-three children with ASD included in this study also participated in the Early Social Interaction (ESI) Project treatment study (Wetherby et al., 2014). All parents gave written, informed consent, and data collection was approved by this institution’s Human Subjects Committee.

### Measures

**CSBS Behavior Sample.** The CSBS Behavior Sample is a standardized observational measure of social communication normed on children aged between 12 and 24 months. The CSBS was normed on a national sample and demonstrates good internal consistency, test–retest reliability, and predictive validity with language outcomes at two and three years of age (Wetherby & Prizant, 2002; Wetherby, Allen, et al., 2002; Wetherby, Goldstein, et al., 2003). The CSBS Behavior Sample is designed to elicit spontaneous communication within a supportive interaction with a caregiver and an examiner, and provides three composite scores in social, speech, and symbolic domains. The social composite measures three clusters: emotion and eye gaze, communication, and gestures; the speech composite includes the sounds and words clusters; and the symbolic composite measures language comprehension and object use in play. The composites and clusters are represented as standard scores with a mean of 10 ($SD = 3$), and the total score provides a standard score with a mean of 100 ($SD = 15$).

**Mullen Scales of Early Learning.** At the follow-up evaluation at age 3, developmental level was measured with the MSEL. The MSEL is normed for children between the ages of 1 and 68 months. The Early Learning Composite (ELC) is expressed as a standard score ($M = 100, SD = 15$) based on the sum of the T scores ($M = 50, SD = 10$) of cognitive scales (receptive language, expressive language, visual reception, and fine motor). A verbal ability score may be derived from the mean of the receptive and expressive language T scores, while the nonverbal ability score averages visual reception and fine motor T scores. The MSEL is used extensively in research as an evaluation of language development and cognitive functioning in young children suspected of having ASD, and demonstrates good reliability, internal consistency, and convergent validity with other cognitive measures (Bishop, Guthrie, Coffing, & Lord, 2011).

### Analytic plan and preliminary data handling

Two analytic approaches were taken: a categorical approach that directly compared social communication patterns across groups and a continuous approach that explored how CSBS Behavior Sample composites predicted short-term developmental outcomes for children with and without ASD. First, children were classified into six groups based upon the results of their diagnostic evaluation at age 3: ASD alone ($n = 62$), ASD+LD ($n = 31$), ASD+GDD ($n = 98$), LD ($n = 32$), GDD ($n = 35$), and TD ($n = 173$) (Figure 1).

Children with ASD alone received a best estimate diagnosis of ASD, an MSEL ELC greater than 70, and MSEL receptive and expressive language T scores greater than or equal to 40. Children in the ASD+LD group received a best estimate diagnosis of ASD, MSEL ELC scores greater than 70, and an MSEL receptive or expressive language T score more than one standard deviation below the mean (<40; Armstrong et al., 2017; Rice et al., 2008; Snowling, Duff, Nash, & Hulme, 2016). Prior research indicates that young children with LD often exhibit non-linguistic developmental delays in such domains as gross and fine motor skills (Hill, 2001; Visscher, Houwen, Scherder, Moolenaar, & Hartman, 2007; Wang, Lekhal, Aaro, Holte, & Schjolberg, 2014), and motor
Impairments are common in children with ASD (Högblad Carlsson et al., 2013; Ming, Brimacombe, & Wagner, 2007). Therefore, the ASD+LD and LD groups included children who had nonverbal ability (MSEL visual reception and fine motor T) scores within 2 SDs of the mean (Reilly, Bishop, & Tomblin, 2014; Rice, 2016). Children in the ASD+GDD group had a best-estimate ASD diagnosis with an MSEL ELC of 70 or below (Christensen, Bilder, et al., 2016). The LD group scored < 40 on MSEL receptive or expressive scales, had MSEL ELC scores > 70, a nonverbal ability score within two SDs of the mean, and ASD was ruled out during the diagnostic evaluation. Children in the GDD group received an MSEL ELC of ≤ 70, with ASD ruled out. The TD group received MSEL expressive and receptive T scores ≥ 40 and an MSEL ELC of greater than 75. Children were included in the TD group if caregivers did not express concerns about their child’s development, the child did not show red flags for ASD during evaluation, and if a judgment of typical development was made by an experienced diagnostician. Groups were mutually exclusive for the purposes of this study.

To address our first research aim, the LD and GDD groups were combined to form a group of children with developmental delays (DD). This allowed us first to test whether previously observed social communication patterns held for a larger sample than has been reported (Wetherby, Watt, et al., 2007). We worked backward from diagnostic classification at 36 months and performed one-way analyses of covariance (ANCOVA), controlling for maternal education, with Bonferroni-corrected pairwise comparisons to directly compare the CSBS Behavior Sample scores of ASD, DD, and TD groups. For our second aim, one-way ANCOVAs controlling for maternal education were conducted to compare the six subgroups’ scores on the CSBS Behavior Sample. Regression slopes were homogeneous across groups. Statistically significant results on Levene’s test indicated that homogeneity of variance was violated for the social and symbolic composites (p < .001). Following square root transformation, skewness and kurtosis values improved, and Levene’s test was no longer significant (social: \( F(5, 524) = 2.06, p = .07 \); symbolic: \( F(5, 425) = 2.09, p = .07 \)).

To address our third aim, the sample was divided into two groups, ASD and non-ASD. To match the wide variation in developmental levels represented in the ASD group, the non-ASD group comprised children with TD, language delay, and global developmental delay in which ASD had been ruled out. Correlational and multiple linear regression analyses were employed and coefficients were examined to explore relationships between CSBS Behavior Sample
scores late in the second year and MSEL receptive language, expressive language, visual reception, and fine motor skills at age 3 for children with and without ASD. Multiple linear regression allowed for the examination of the significance of each related set of predictors to developmental outcome at age 3, considering all other variables previously entered, and presented the simultaneous variance explained by the entire collection of early skills. Zero-order correlations among each CSBS Behavior Sample composite and MSEL subscale ranged from .38 to .58 for the ASD group and .39 to .62 for the non-ASD group (all \( p < .01 \)), providing a rationale for regression analysis. CSBS Behavior Sample scores were examined for signs of multicollinearity, and correlations among all predictors were \( < .68 \). Standardized residuals appeared to be normally distributed with constant variance. Children with ASD who participated in ESI (\( n = 33 \)) were removed from the dataset to determine whether their inclusion in the intervention study impacted correlations between the CSBS Behavior Sample and the MSEL. Without these children, correlations were observed to remain significant, with comparable effect sizes ranging from .36 to .54 (all \( p < .01 \)). The three composites were entered in the regression model in developmental order (social, speech, and symbolic; Watt et al., 2006). Statistical analyses were conducted using SPSS v.23.

**Results**

**Sample characteristics**

Demographic information for the sample appears in Table 1. Most participants were Caucasian (72%), followed by 17% African American, 8% Biracial, and 2% Asian; 8% of the participants were of Hispanic ethnicity. Results of chi-square tests indicated that a significantly higher number of children in the TD group were Caucasian compared to the GDD group, which included a higher proportion of African American children. Additionally, a higher number of Hispanic children was represented in the ASD+GDD group than in the TD group. On average, mothers had completed 15.14 years of education (\( SD = 2.50 \)) and fathers had 15.12 years of education (\( SD = 2.86 \)). There was a 3.2:1 male-female gender ratio for the entire sample, compared to 4.8:1 for the children with ASD. Maternal education, an extensively studied indicator of socioeconomic status and one of the strongest risk factors associated with ID in children (Bilder et al., 2013; Chapman, Scott, & Stanton-Chapman, 2008), differed significantly among several groups (ASD+GDD \( \leq \) TD, ASD; GDD \( \leq \) ASD, ASD+LD; TD; all \( p < .05 \)).

Developmental characteristics for the CSBS Behavior Sample for children with ASD, DD, and TD, then for the six subgroups, are presented in Tables 2 and 3, respectively. Groups were comparable

| Table 1. Summary of participant demographics. |
|---------------------------------------------|
| Demographic | ASD (n = 191) | DD (n = 67) |  |
| | ASD (n = 62) | ASD+LD (n = 31) | ASD+GDD (n = 98) | LD (n = 32) | GDD (n = 35) | TD (n = 173) | \( \chi^2 \) | df |
| Sex (%) |  |  |  |  |  |  |  |  |
| Male | 82 | 81 | 84 | 69 | 89 | 68 | 15.50*** | 5 |
| Female | 18 | 19 | 16 | 31 | 11 | 32 |  |  |
| Race (%) |  |  |  |  |  |  |  |  |
| Caucasian | 76 | 71 | 68 | 66 | 46a | 80b | 34.74* | 20 |
| African American | 11 | 16 | 21 | 25 | 43a | 9b |  |  |
| Asian | 3 | 0 | 2 | 3 | 0 | 1 |  |  |
| Biracial | 8 | 13 | 7 | 6 | 9 | 8 |  |  |
| Ethnicity (%) |  |  |  |  |  |  |  |  |
| Hispanic | 13 | 7 | 14a | 9 | 11 | 4b | 11.87* | 5 |
| Parents’ education (years) |  |  |  |  |  |  |  |  |
| Mother (M, SD) | 15.86a | 2.50 | 15.07ab,c | 2.84 | 14.33a | 2.35 | 14.63ab | 2.25 | 13.31bd | 2.03 | 15.82a | 2.29 | 10.85*** |
| Father (M, SD) | 15.63a | 3.05 | 15.03ab | 3.17 | 14.47ac | 2.57 | 15.00ad | 3.02 | 13.00bd | 1.93 | 15.72ae | 2.77 | 6.61*** |

Note. Column proportions and means in the same row with different subscripts differ significantly at \( p < .05 \). ASD: autism spectrum disorder; ASD+LD: autism with language delay; ASD+GDD: autism with global developmental delay; DD: language delay or global developmental delay without ASD; LD: language delay without ASD; GDD: global developmental delay without ASD; TD: typically developing.

\* \( p < .05 \); \** \( p < .01 \); \*** \( p < .001 \).
Forty percent of the sample did not use words in communicative acts during the CSBS Behavior Sample, 25% used one to two words, and the remaining 35% used three or more different words. Only 6% of children used combinations of two or more words. On average, the children demonstrated understanding of one object name, person’s name, or body part \( (M = 1.07; SD = 1.13) \). Using spoken language benchmarks developed by Tager-Flusberg et al. (2009), the

| Table 2. Social communication and developmental evaluation – children with ASD, DD, and TD. | ASD (n = 191) | DD (n = 67) | TD (n = 173) | \( F \ (2, 427) \) |
| --- | --- | --- | --- | --- |
| **CSBS Behavior Sample – Time 1** | | | | |
| Age in months | 20.53 \( _a \) 2.15 | 20.63 \( _a \) 2.01 | 20.26 \( _a \) 1.89 | 1.13 |
| Social composite \( a^* \) | 5.63 \( _a \) 2.60 | 7.54 \( _b \) 2.86 | 11.15 \( _c \) 3.02 | 164.22 \( *** \) |
| Speech composite \( a^* \) | 6.30 \( _a \) 2.46 | 6.66 \( _a \) 2.17 | 9.20 \( _b \) 2.45 | 60.17 \( *** \) |
| Symbolic composite \( a^* \) | 6.45 \( _a \) 2.87 | 7.55 \( _b \) 2.60 | 11.39 \( _c \) 2.85 | 134.76 \( *** \) |
| Total \( b^* \) | 75.73 \( _a \) 11.55 | 80.87 \( _b \) 11.11 | 100.02 \( _c \) 12.66 | 179.93 \( *** \) |
| **Mullen Scales of Early Learning – Time 2** | | | | |
| Age in months | 37.25 \( _a \) 3.78 | 36.29 \( _a, \_b \) 3.91 | 37.69 \( _a \) 13.05 | 2.80 | 4.78 \( ** \) |
| Receptive language \( c^* \) | 35.29 \( _a \) 14.01 | 34.18 \( _a \) 10.70 | 34.33 \( _a \) 13.33 | 56.85 \( _b \) 8.73 | 162.28 \( *** \) |
| Expressive language \( c^* \) | 36.68 \( _a \) 14.13 | 30.78 \( _b \) 9.37 | 30.78 \( _b \) 9.37 | 58.26 \( _c \) 8.77 | 188.80 \( *** \) |
| Visual reception \( c^* \) | 37.37 \( _a \) 16.72 | 37.69 \( _b \) 13.05 | 37.37 \( _a \) 16.72 | 60.84 \( _b \) 11.69 | 120.97 \( *** \) |
| Fine motor \( c^* \) | 33.74 \( _a \) 13.02 | 34.33 \( _b \) 13.33 | 33.74 \( _a \) 13.02 | 56.64 \( _b \) 11.72 | 153.45 \( *** \) |
| Early Learning Composite \( d^* \) | 74.97 \( _a \) 23.30 | 71.36 \( _a \) 15.50 | 71.36 \( _a \) 15.50 | 116.11 \( _b \) 15.84 | 218.53 \( *** \) |

Note. Means in the same row with different subscripts differ significantly at \( p < .05 \). ASD: autism spectrum disorder; DD: language delay or global developmental delay without ASD; TD: typical development; CSBS: Communication Symbolic and Behavior Scales.

\( a^* \) Standard scores based on a \( M \) of 10 and \( SD \) of 3.

\( b^* \) Standard scores based on a \( M \) of 100 and \( SD \) of 15.

\( c^* \) T Scores based on a \( M \) of 50 and \( SD \) of 10.

\( d^* \) Early learning composite based on a \( M \) of 100 and \( SD \) of 15.

** \( p < .01 \); *** \( p < .001 \).

| Table 3. Social communication evaluation at 20 months – six groups. | ASD (n = 191) | DD (n = 67) | LD (n = 32) | GDD (n = 35) | TD (n = 173) | \( F \ (5, 424) \) |
| --- | --- | --- | --- | --- | --- | --- |
| **CSBS Behavior Sample** | | | | | | |
| Age in months | 20.40 \( _a \) 2.12 | 20.36 \( _a \) 2.12 | 20.66 \( _a \) 2.16 | 20.81 \( _a \) 1.78 | 20.46 \( _a \) 2.21 | 1.89 | .72 |
| Social composite \( a^* \) | 7.39 \( _a \) 2.75 | 6.42 \( _{a,b} \) 2.41 | 4.27 \( _c \) 1.63 | 8.50 \( _{a,d} \) 2.93 | 6.66 \( _b \) 2.53 | 11.15 \( _c \) 3.02 | 97.76 \( *** \) |
| Speech composite \( a^* \) | 7.60 \( _a \) 2.45 | 7.00 \( _a \) 2.67 | 5.27 \( _b \) 1.88 | 7.34 \( _a \) 2.44 | 6.03 \( _{a,b} \) 1.69 | 9.20 \( _c \) 2.45 | 33.87 \( *** \) |
| Symbolic composite \( a^* \) | 8.18 \( _a \) 3.31 | 6.87 \( _a \) 2.51 | 5.22 \( _b \) 1.96 | 8.59 \( _{a,c} \) 2.87 | 6.60 \( _{a,d} \) 1.90 | 11.39 \( _c \) 2.85 | 76.52 \( *** \) |
| Total \( b^* \) | 83.65 \( _a \) 12.22 | 78.81 \( _a \) 11.45 | 69.75 \( _b \) 6.90 | 85.44 \( _{a,c} \) 11.77 | 76.69 \( _{a,d} \) 8.69 | 100.02 \( _a \) 12.66 | 95.00 \( *** \) |

Note. Means in the same row with different subscripts differ significantly at \( p < .05 \). CSBS: Communication and Symbolic Behavior Scales Behavior Sample. ASD: Autism spectrum disorder; DD: language delay or global developmental delay without ASD; ASD+LD: autism with language delay; ASD+GDD: autism with global developmental delay; LD: language delay without ASD; GDD: global developmental delay without ASD; TD: typically developing.

\( a^* \) Standard Scores based on a \( M \) of 10 and \( SD \) of 3.

\( b^* \) Total Score based on a \( M \) of 100 and \( SD \) of 15.

** \( p < .01 \); *** \( p < .001 \).
toddler in this sample were functioning in the preverbal and first word phases.

Results of the follow-up diagnostic evaluation with the MSEL at 36 months appear in Tables 2 and 4. Of the 191 children with ASD in this sample, 98 (51%) were identified as having co-occurring GDD. The MSEL ELC scores of the ASD+GDD group (M = 55.69, SD = 6.72) indicated mild to moderate global developmental delay on average. Sixty-four children with ASD had MSEL ELC scores within the average range (ELC>85) and 29 children with ASD scored in the borderline range (ELC = 71-85). On average, children with ASD alone scored significantly below children with TD on receptive and expressive language as measured by the MSEL at age 3, although their language scores were not in the delayed range as defined by this study’s parameters.

**Social communication patterns in the second year**

To address our first and second research aims, one-way ANCOVAs controlling for maternal education were conducted to compare social communication in children with ASD, DD, and TD, then across six subgroups: ASD, ASD+LD, ASD+GDD, LD, GDD, and TD. Results of the first ANCOVA indicated that children with TD scored significantly higher than other groups on all three composites (social: F (2, 428) = 164.22, speech: F (2, 428) = 60.17; and symbolic: F (2, 428) = 134.76; all p < .001) (Table 2). Children with ASD had significantly lower scores than those with DD and TD on the social and symbolic composites. ASD did not differ from DD on the speech composite.

Among the six subgroups categorized by diagnosis and developmental level, the omnibus test revealed significant group differences on all CSBS Behavior Sample composites (social: F (5, 424) = 85.62, speech: F (5, 424) = 33.87 and symbolic F (5, 424) = 71.32; all p < .001). Post hoc comparisons confirmed that children with TD differed from all other groups on each composite with medium to large effect sizes using Cohen’s (1988) conventions (all p < .001; all d ≥ .65). In contrast, children with ASD+GDD scored significantly lower than all other groups on the total score and each composite, with one exception: children with ASD+GDD did not differ from the GDD group on the speech composite. Children with ASD+LD scored significantly lower than children with LD on the social composite with a medium effect size (2.08 ± .66, p < .05; d = .78). The GDD group, on average, obtained a significantly lower symbolic composite and total score than the LD group (1.84 ± .64, p < .05; d = .71 and 8.75 ± 2.71, p < .05; d = .85, respectively). The GDD group had nonsignificant but lower social and speech composite scores than the LD group, with medium effect sizes (1.84 ± .64, d = .67 and 1.32 ± .56, d = .62, respectively) and lower speech and symbolic composite scores than ASD (1.57 ± .49, d = .74 and 1.58 ± .56, d = .59, respectively).

A visual representation of the results for each group is presented in Figure 2. Children with DD and TD evidenced a “dip” in the speech composite, with

### Table 4. Diagnostic evaluation at age 3 – six groups.

| MSEL Composite | ASD (n = 191) | DD (n = 67) |
|----------------|--------------|------------|
|                | M            | SD         | M     | SD    | M     | SD    | F (5, 424) |
| Age (months)   | 37.17        | 3.34       | 36.73 | 3.42  | 37.46 | 3.89  |             |
| Receptive      | 51.84        | 7.55       | 37.58 | 7.46  | 24.10 | 6.21  | 42.59       |
| Expressive     | 52.15        | 7.31       | 41.03 | 7.82  | 25.51 | 7.31  | 35.91       |
| Visual         | 54.24        | 12.72      | 44.39 | 11.13 | 24.47 | 6.47  | 47.16       |
| Fine motor     | 46.18        | 11.85      | 37.19 | 7.88  | 24.79 | 6.39  | 42.44       |
| Early Learning  | 102.45       | 14.49      | 80.97 | 7.39  | 55.69 | 6.72  | 84.63       |

Note: Means in the same row with different subscripts differ significantly at p < .05. CSBS: Communication and Symbolic Behavior Scales Behavior Sample; ASD: autism spectrum disorder; DD: language delay or global developmental delay without ASD; ASD+LD: autism with language delay; ASD+GDD: autism with global developmental delay; TD: typically developing.

*p < .05; **p < .10; ***p < .001.

*p < .05; **p < .01; ***p < .001.

LD, ASD, GDD, LD, GDD, and TD. Results of the first ANCOVA indicated that children with TD scored significantly lower than the LD group (1.84 ± .64, p < .05; d = .71 and 8.75 ± 2.71, p < .05; d = .85, respectively). The GDD group had nonsignificant but lower social and speech composite scores than the LD group, with medium effect sizes (1.84 ± .64, d = .67 and 1.32 ± .56, d = .62, respectively) and lower speech and symbolic composite scores than ASD (1.57 ± .49, d = .74 and 1.58 ± .56, d = .59, respectively).
relatively higher scores on social and symbolic composites. This pattern held in the plots of children with TD, LD, and GDD (without ASD). The relatively lower speech composite scores in the TD group likely reflect the resolved early language delays of "late talkers" who were invited for a communication evaluation if they received a positive screen or parents expressed concerns about their child’s development on the ITC. As hypothesized, children with TD scored highest, followed by LD, then GDD. The social communication profiles of children with ASD, ASD+LD, and ASD+GDD followed a different pattern, with lower social composite scores relative to speech and symbolic. Again, children with ASD only obtained the highest scores, followed by ASD+LD, then ASD+GDD. Scores of children with ASD alone, LD, and ASD+LD were generally intermediate to those with TD and GDD; however, children with ASD alone did not differ significantly from ASD+LD, LD, or GDD on any CSBS Behavior Sample composite or the total score.

**Predictive relations of early social communication to developmental outcomes**

Correlational and multiple linear regression analyses were conducted to explore the predictive relationship between social communication measured by the CSBS Behavior Sample in the second year of life and developmental functioning as measured by the MSEL at age 3 in children with and without ASD (Table 5). For children with ASD, the CSBS Behavior Sample accounted for 38% of the variance in receptive language \(f^2 = .61\) and 39% of the variance in expressive language outcome at age 3 \(f^2 = .39\), with large effect sizes. The social and symbolic composites explained significant unique variance in receptive \(f^2 = .06\) and .06, respectively) and expressive language outcomes \(f^2 = .05\) and .07, respectively) with small effect sizes. The speech composite contributed uniquely to expressive language outcome in children with ASD \(f^2 = .03\) but did not explain significant unique variance in receptive language outcome. With regard to nonverbal outcomes, the CSBS Behavior Sample explained 32% of the variance in visual reception at age 3 with a large effect size \(f^2 = .47\). Social and symbolic composites made unique contributions with small effect sizes \(f^2 = .07\) and .03, respectively). Finally, 24% of the variance in fine motor skills was explained by the CSBS Behavior Sample with a medium effect size \(f^2 = .32\). Again, social and symbolic composites contributed unique variance to the prediction with small effect sizes \(f^2 = .03\) and .04, respectively).

For the non-ASD group, the entire collection of early social communication skills measured by the CSBS Behavior Sample accounted for 49% of the
variance in receptive language outcome at age 3 with a large effect size ($f^2 = .96$) (Cohen, 1988). The social, speech, and symbolic composites explained significant unique variance to predict receptive language outcome with small effect sizes ($f^2 = .08, .06, \text{ and } .16$, respectively). The CSBS Behavior Sample accounted for 44% of the variance in expressive language outcome for the non-ASD group, also with a large effect size ($f^2 = .79$). Again, social, speech, and symbolic composites each explained significant unique variance in expressive language outcome with small effect sizes ($f^2 = .05, .09, \text{ and } .07$, respectively). Turning to nonverbal developmental outcomes, the CSBS Behavior Sample accounted for 37% of the variance in visual reception with a large effect size ($f^2 = .59$). All three composites made unique contributions above and beyond the shared variance with small effect sizes ($f^2 = .05$ for social, .02 for speech and .10 for symbolic). The CSBS Behavior Sample explained 29% of the variance in fine motor skills at age 3 ($f^2 = .41$), with social and symbolic composites making unique contributions with small effect sizes ($f^2 = .04$ and .07, respectively).

## Discussion

This study compared the early social communication of young children who were recruited through screening for communication delays in primary care at the age of 9–18 months and diagnosed at age 3 with ASD, DD, or TD. To further explore patterns of social communication in this heterogeneous sample, performance on the CSBS Behavior Sample was examined across six subgroups categorized by diagnosis and developmental level: ASD, ASD+LD, ASD+GDD, LD, GDD, and TD. Finally, the study examined the collective and unique contributions of early social communication to predict verbal and nonverbal developmental outcomes at three years of age in children with and without ASD.

### Social communication patterns in the second year of life

Children with ASD were significantly different from children with DD and TD on the social and symbolic composites of the CSBS Behavior Sample by a mean age of 20 months, and TD differed from ASD and DD on all three composites, consistent with previous research (Wetherby, Woods, et al., 2004; Wetherby, Watt et al., 2007). Among the six subgroups, the CSBS Behavior Sample differentiated children who were TD from all other groups on all composites. Children with ASD+GDD had significantly lower social and symbolic composite scores than every other subgroup. These results extend previous research findings in older children (Bennett et al., 2014), demonstrating that as early as the second year of life, toddlers with ASD and co-occurring cognitive deficits fell significantly behind other subgroups in reaching social communication milestones. On the social composite, children with LD (without ASD) scored significantly higher than children with ASD+LD, and children with GDD (without ASD) scored higher than those with ASD+GDD, which was expected considering the

### Table 5. Social communication predictors of verbal and nonverbal developmental outcomes at age 3 – children with and without ASD.

| CSBS scores | MSEL receptive language | MSEL expressive language | MSEL visual reception | MSEL fine motor |
|-------------|-------------------------|--------------------------|----------------------|-----------------|
|             | $\beta$ | $r^2$ | $f^2$ | $\beta$ | $r^2$ | $f^2$ | $\beta$ | $r^2$ | $f^2$ | $\beta$ | $r^2$ | $f^2$ |
| ASD (n = 191) | Social composite | .32*** | .04 | .06 | .28*** | .03 | .05 | .35*** | .05 | .07 | .21* | .02 | .03 |
| Speech composite | .12 | .01 | .02 | .19* | .02 | .03 | .11 | .01 | .01 | .14 | .01 | .01 |
| Symbolic composite | .26** | .04 | .06 | .26*** | .04 | .07 | .18* | .02 | .03 | .22* | .03 | .04 |
| $R^2$ | .38*** | .61 | .39*** | .64 | .32*** | .47 | .24*** | .32 |
| Non-ASD (n = 240) | Social composite | .25*** | .04 | .08 | .22*** | .03 | .05 | .24*** | .03 | .05 | .24*** | .03 | .04 |
| Speech composite | .21*** | .03 | .06 | .29*** | .05 | .09 | .15* | .01 | .02 | .09 | .01 | .01 |
| Symbolic composite | .37*** | .08 | .16 | .27*** | .04 | .07 | .33*** | .06 | .10 | .30*** | .05 | .07 |
| $R^2$ | .49*** | .96 | .44*** | .79 | .37*** | .59 | .29*** | .41 |

Note. CSBS: Communication Symbolic and Behavior Scales Behavior Sample; MSEL: Mullen Scales of Early Learning; ASD: autism spectrum disorder. Effect size $f^2 = r^2/(1 - R^2)$ for individual predictors; $F^2 = R^2/(1 - R_2^2)$ overall. Small = .02; medium = .15; large = .35 (Cohen, 1988).

* $p < .05$; ** $p < .01$; *** $p < .001$. 

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core deficit in social communication observed in individuals with ASD.

Examining early social communication in children with and without ASD and accompanying DD also illuminated difficulties that may encumber practitioners’ efforts to detect ASD early. Although children with ASD, DD, and TD differed significantly on almost every composite, distinctive patterns, or subtypes, of social communication were apparent for only some of the six subgroups. Children with GDD (without ASD), for example, were not significantly different from ASD or ASD+LD on the social composite of the CSBS Behavior Sample, reaffirming research findings that infants and toddlers with GDD may lack robust skills in early social communication like triadic gaze shifts (Ruskin et al., 1994; Slonims & McConachie, 2006). Patterns of social communication in children with ASD alone, ASD+LD, LD, and GDD often overlapped and were intermediate to those of children with TD and ASD+GDD. Our ASD+LD and LD groups included children with language delays and mild nonverbal developmental delays. Examining only children who exhibited delays specific to language development at age 3 may have led to different results.

Prevalence estimates of ASD over time have revealed a changing landscape in which a significantly higher proportion of children diagnosed with ASD do not have comorbid ID. In the two most recent estimates, the percentage of school-age children with ASD and co-occurring ID has remained stable (32%; Christensen, Baio, et al., 2016). However, in the preschool sample, 46% of children with ASD had comorbid GDD (Christensen, Bilder, et al., 2016). The percentage of children with ASD+GDD in our ASD sample (51%) is very close to current epidemiological estimates for preschoolers. Because our sample was gathered over more than a decade, we divided our entire ASD group (n = 191) by median date of diagnostic evaluation to determine whether there were changes in the proportions of children with ASD+GDD identified over time. The proportions of children with ASD, ASD+LD, and ASD+GDD remained roughly equivalent in both halves of the sample, whether they were evaluated recently or several years ago (older diagnoses: 33%, 14%, and 53%, respectively; recent diagnoses: 32%, 18%, and 50%). The mean MSEL T scores of children with ASD who were found through our screening and evaluation process that began with the ITC, however, were higher than those of children identified by the M-CHAT in primary care (Robins et al., 2014). In fact, children diagnosed with ASD in this study had similar mean MSEL T scores to those who were missed by the M-CHAT. The developmental level of our sample of children with ASD has been found to be comparable, on average, to samples of children at high familial risk for ASD (Day et al., 2016; Ozonoff et al., 2015). Young children with ASD who miss motor and language milestones may be identified earlier in the community than those who exhibit difficulties with social communication and behavior (Christensen, Bilder, et al., 2016). Taken together, our findings point to the strength of, and need for, early standardized, direct observational measures of social communication development to lower the age of identification of ASD and other developmental delays (Dow, Guthrie, Stronach, & Wetherby, 2017). In this study, scoring patterns on the CSBS Behavior Sample differentiated young children with ASD, with and without LD and GDD, from those who were developing typically.

**Early social communication skills as predictors of developmental outcome**

Findings from a series of multiple linear regression analyses indicated that the collection of social communication skills measured by the CSBS Behavior Sample at a mean age of 20.4 months explained a large proportion of variance in predicting verbal and nonverbal developmental outcomes in children with and without ASD at a mean age of 36.7 months. As hypothesized, the shared variance explained by the social, speech, and symbolic composite scores of the CSBS Behavior Sample was largely relative to the unique contributions of individual composites. These results reaffirm previous research that endorses the predictive validity of a direct, systematic observational measure of social communication in the second year of life to developmental outcomes at age 3 (Watt et al., 2006; Wetherby, Allen, et al., 2002; Wetherby, Goldstein, et al., 2003; Wetherby, Watt, et al., 2007), and extend these findings to a larger sample of children with and without ASD, language delay, and global developmental delay.

This study also examined the predictive value of the CSBS Behavior Sample in children with and without ASD. For the non-ASD group, the speech composite made a unique contribution to predicting receptive and expressive language, and visual reception, but not fine motor outcomes. For children with ASD, the speech composite at 20 months explained unique variance in only expressive language, despite significant zero-order correlations with all MSEL scales. The development of spoken language is predicted by nonverbal cognitive ability in individuals with ASD, and language and nonverbal cognitive functioning are two of the most pivotal predictors of long-term developmental outcomes (Mayo, Chlebowski, Fein, & Eigsti, 2013; Tager-Flusberg et al., 2009). However, the predictive value of speech may depend upon when and how it is assessed, and how stable these skills are when they...
are measured. Very few children in this sample had acquired two-word combinations by a mean age 20 months, and 58% of the children with ASD used no words at all.

In contrast to the speech composite, the social and symbolic composites explained significant unique variance in all verbal and nonverbal outcomes for children with and without ASD. In light of the continued search for early predictors of ASD and developmental delay, and to prioritize infants and toddlers who may need intervention to address social communication delays, our findings underscore the importance of monitoring the expression of emotions, eye gaze, gestures, rate of communication, joint attention, understanding words, and object use in play.

Strengths, limitations, and future directions

This study included several strengths to highlight. First, our results extend previous findings on social communication profiles to a larger sample of children ascertained through screening in primary care using the ITC, adding to existing research on community samples as a comparison to studies of children at high familial risk for ASD. Next, our use of an observational measure that is highly correlated with developmental outcomes a year later adds information to studies that utilize parent report measures of language and cognitive development. Finally, we separated and directly compared the early social communication of young children with and without ASD and accompanying precursors to clinical specifiers according to the DSM-5 dimensional criteria. Investigating patterns of social communication in subgroups of children delineated by diagnosis, language, and cognitive levels may inform efforts to tailor intervention to target specific areas of need (Grzadzinski et al., 2013; Tager-Flusberg, 2006).

Limitations should be considered when interpreting our findings. First, although we reported on a larger sample than has previously been examined, deriving six outcome subgroups resulted in relatively smaller subsample sizes in our ASD+LD, LD, and GDD groups and limited our statistical power to detect potentially meaningful group differences. Next, of the sample screened, this study examined only the outcomes of children who returned for further evaluation. It is beyond the scope of this study to characterize the screening sample. However, a prior study of children recruited through the FIRST WORDS Project (Wetherby, Brosnan-Maddox, et al., 2008), which included children we report on in this article, examined the demographics of children screened who did and did not return for a communication evaluation. Wetherby, Brosnan-Maddox, et al. (2008) screened 5,385 toddlers with the ITC, some multiple times, for a total of 8,563 ITCs. Forty-one percent of the screened sample of children were from racial and/or ethnic minority families, while 29% of the sample who returned were minorities. We anticipate that return rates would be similar in this larger sample, although the financial incentives that were provided in later years may have increased the proportion of families who brought their child in for communication and developmental evaluations. Finally, the diagnostic outcomes of the children in this study were confirmed at three years of age. Global developmental delay is correlated with later ID (Riou, Ghosh, Francoeur, & Shevell, 2008), but early expressive language delays may not predict later language outcomes, and speech at 20 months did not uniquely predict receptive language or nonverbal cognitive ability in our sample of children with ASD. Following this sample to school age would add further information about early predictors of verbal and nonverbal outcomes. Another logical next step will be to examine the utility of CSBS profiles in predicting diagnostic group membership using multinomial logistic regression analysis.

Conclusions and implications

In this study, we found that social communication measured in the second year of life differentiated children with ASD, DD, and TD and predicted significant variance in developmental outcomes a year later for toddlers with and without ASD, LD, and GDD. Pickles, Anderson, and Lord (2014) recently emphasized the importance of intervention targeting early communication delays, arguing that given their instability, the most significant changes in language developmental trajectories may be more easily achieved in the preschool years. Infants rely on shared, meaningful social experiences with caregivers and dynamic interactions with the surrounding environment (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Gredebäck, Fikke, & Melinder, 2010; Sheinkopf et al., 2016). Deficits in early eye gaze, shared positive affect, and nonverbal communication may be detected months before words are expected, and place children at increased risk of attenuation of social input from the environment as dyadic interactions with caregivers are impacted (Mundy & Burnette, 2005; Wetherby, Watt, et al., 2007). There is heterogeneity in how early signs of ASD unfold during early development across children, and clinical detectability of symptoms in the second year of life may vary (Bacon et al., 2017; Zwaigenbaum et al., 2015). Further examination and development of broadband and autism-specific screening tools and scoring approaches for younger and older toddlers may be needed to distinguish atypical developmental trajectories and detect early social communication...
delays in very young children (Sturmer, Howard, Bergmann, Stewart, & Afarian, 2017). There is a need for clinical utility of screening and evaluation tools, like the CSBS Behavior Sample, that can detect early social communication delays in very young children. This would enable examination of the potential benefits of early intervention for infants and toddlers who show social communication delays, which may be early signs for ASD or other DD, rather than waiting to confirm a formal diagnosis.

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