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Measures of Early Social Communication and Vocabulary Production to Predict Language Outcomes at Two and Three Years in Late-Talking Toddlers

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Abstract

Background: Late talkers are a heterogeneous group of toddlers and reliable predictors of persistent language delay have been elusive. The purpose of this study was to determine the extent to which early social communication and vocabulary production predicted variance in language outcomes at 2 and 3 years of age.

Methods: Participants were 408 typically developing and late-talking toddlers who completed the Communication and Symbolic Behavior Scales Caregiver Questionnaire and Behavior Sample (CSBS CQ and CSBS BS) at a mean of 20 months, the Language Development Survey (LDS) at a mean of 24 months, and the Mullen Scales of Early Learning (MSEL) at a mean of 25 months. A subgroup of 198 children completed a second MSEL at 3 years of age. Associations among the LDS, CSBS CQ, CSBS BS, and MSEL were examined using correlational and hierarchical linear regression analyses. Logistic regression was used to examine each measure's contribution to predicting language delay at 2 and 3 years.

Results: Moderate to large correlations were observed among all variables. The LDS, CSBS CQ, and CSBS BS added unique contributions to the prediction of 2- and 3-year expressive and receptive language outcomes. Measures of speech and vocabulary production were the strongest predictors of language outcomes at age 2. At age 3, social and symbolic communication played a

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more significant role in accounting for variance in expressive and receptive language outcome. A similar pattern emerged for the categorical prediction of language delay.

Conclusions: Measures of social communication between 18–21 months added important information to predicting language outcomes at 2 and 3 years, above and beyond parent-reported expressive vocabulary production measured at 24 months, with small effect sizes overall. Implications for identifying younger children who are at risk for continued language delay and recommendations for referral to early intervention programs are discussed.

Keywords

late talkers; social communication; language outcomes; early identification; parent report; observational measures

When children are late to talk, it is a frequent point of parent and medical provider concern (Ellis & Thal, 2008). Indeed, the most common first sign of the presence of a neurodevelopmental disorder, including language disorder (LD), intellectual disability, learning disability, and autism spectrum disorder (ASD) may be a delay in meeting early communication milestones (Rescorla, 2011). Up to 7% of children have LD at school age, and recent research suggests that when children begin school with low or below average language skills, it is difficult to change their developmental trajectories (McKean et al., 2017; Miniscalco et al., 2018; Norbury et al., 2017). LD has been shown to impact success in social, emotional, behavioral, and literacy skills into middle childhood, adolescence, and adulthood (Beitchman, Brownlie, & Bao, 2014; Conti-Ramsden & Botting, 2008; Yew & O'Kearney, 2013).

Identifying young children at risk for persistent language delay can enable access to early intervention and education that maximizes child outcomes (Buschmann et al., 2015; Roberts & Kaiser, 2015; St. Clair, Pickles, Durkin, & Conti-Ramsden, 2011). However, the challenge of identifying young children with LD is among the most critical issues faced in the efforts to implement the Individuals with Disabilities Education Act (IDEA). Despite the federal mandate for early intervention through IDEA, Part C, it is estimated that only 20% of children who need special education services at school age receive early intervention (IDEA; 2016). Mounting concern about the achievement of early developmental milestones has driven policy initiatives including universally funded early childhood education for 3–5-year-olds, in the face of increasingly stringent school-age academic standards. "Catching up" earlier is now emphasized more than ever, and researchers continue to search for the earliest predictors of lasting delays in language (Armstrong et al., 2017; Duff, Reen, Plunkett, & Nation, 2015; Hammer et al., 2017).

Late Talkers

An estimated 10–20% of 2-year-olds are late talkers (LTs), children whose parents report an expressive vocabulary of fewer than 50 words and/or an absence of word combinations on measures including the Language Development Survey (LDS; Rescorla, 1989; Desmarais, Sylvestre, Meyer, Bairati, & Rouleau, 2008; Rescorla, 2011; Rice, Taylor, & Zubrick, 2008; Zubrick, Taylor, Rice, & Slegers, 2007). Although some studies have excluded LTs with

receptive language delays, the definition of late talking has become multidimensional and now includes children with expressive only, or a combination of expressive and receptive language delays (Hawa & Spanoudis, 2014). Delayed expressive language onset is not in itself a clinical diagnosis. Still, many children who are LTs present with challenges in following verbal instructions, phonological differences, and reduced symbolic gestures, play, and object representation (O'Neill & Chiat, 2015; Rescorla & Goossens, 1992; Thal, Marchman, & Tomblin, 2013; Thal & Tobias, 1992).

Approximately half of LTs catch up with peers who are typically developing (TD) by age 3 (Paul, Looney, & Dahm, 1991; Rescorla, Roberts, & Dahlsgaard, 1997); however, up to 25% have language deficits that persist to school age (Dale, Price, Bishop, & Plomin, 2003; Dale, McMillan, Hayiou-Thomas, & Plomin, 2014; Rice et al., 2008). Even LTs who eventually develop language skills that are within the average range may have residual, subclinical weaknesses in areas such as literacy and sentence structure complexity and tend to perform below their peers who were not LTs (Duff et al., 2015; Grossheinrich et al., 2019; Hammer et al., 2017; Pickles et al., 2009; Rice, et al., 2008; Rescorla, 2009; Rescorla & Turner, 2015). In a follow up study of 128, 7-year-old children identified as LTs at 24 months and 109 epidemiologically equivalent control children, for example, children with a positive history of late talking were almost twice as likely to be identified as below normative levels on general language ability than were children in the control group (20% versus 11%; Rice, et al., 2008). Earlier studies have found that a history of late talking is associated with weaker performance on measures of phonological awareness, oral reading, and reading comprehension at school age compared to peers who were not late talkers (Paul et al., 1997; Preston et al., 2010; Rescorla, 2002, 2005, 2009; Scarborough & Dobrich, 1990). Most recently, Grossheinrich and colleagues (2019) found that late talkers (n = 39) demonstrated significantly lower scores on literacy and language assessments when followed to third grade relative to typically developing controls. Longitudinal study of LTs is both theoretically and clinically relevant. Gaining clarity on significant predictors of language outcome in LTs improves our theoretical understanding of developmental pathways to a variety of language outcomes. Clinically, this information can be used to improve the accuracy of distinguishing between LTs who will catch up and those who will ultimately be identified with language or other neurodevelopmental disorders. It is possible that research on early-emerging predictors of language delay may also help identify and tailor interventions for LTs.

Predictors of Persistent Language Delay in Late Talkers

Differentiating children with LD from "late bloomers" who catch up without intervention is important, but challenging, in toddlers (Dale et al., 2003; Duff et al., 2015; Reilly et al., 2010; Sylvestre, Desmarais, Meyer, Bairati, & Leblond, 2017). The wide variability in typical language development alone creates one challenge: the number of words spoken by a 24-month-old male can range from 79–511 and be considered within normal limits (Fenson et al., 2007). Most perplexing, a host of potential demographic and developmental variables has been examined over decades of longitudinal and epidemiological investigations, but has returned mixed results and explained limited variance in the literature with regard to predicting outcomes in LTs (Rescorla, 2011). Maternal education, parental stress, sex, birth order, receptive language, and expressive vocabulary, for example, all appear to account for

a small amount of variability in outcomes for LTs. Research results suggest that testing older late talkers leads to better prediction of continued delay or disorder as language skills stabilize (Dale, et al., 2003; Duff et al., 2015; Hawa & Spanoudis, 2014; Henrichs, et al., 2011; Paul, Murray, Clancy, & Andrews, 1997; Rescorla, 2011). Given late talking as a risk factor for later diagnoses, however, researchers continue to search for the earliest predictors so that "catching up" can occur in time for the academic demands of elementary school (Singleton, 2018).

Expressive Vocabulary

Not surprisingly, words alone have significant predictive power regarding language outcomes (Henrichs et al., 2011; Reilly et al., 2010; Sylvestre et al., 2017; Watt, Wetherby, & Shumway, 2006). Along with other family and child variables, late talking status at 24 months, measured by the MacArthur-Bates Communicative Development Inventory (Fenson et al., 2007), contributed significantly to the prediction of receptive and expressive language outcome at 4 years in a community sample of 1,910 children (Reilly et al., 2010). In another large study of 3,759 children, lexical knowledge at 18 months explained almost 12% of the variance in 30-month-olds (Henrichs, et al., 2011). Parent report measures of children's vocabulary production have been used as a convenient and easily accessible index of typical language development (Fenson et al., 1994; Rescorla & Alley, 2001). The LDS, for example, has demonstrated strong correlations with standardized language assessments as well as sensitivity and specificity of 80% or better in the detection of expressive language delay when administered at 24 months of age (Rescorla & Alley, 2001). The contribution of early vocabulary to later reading ability has also been investigated. Recently, Suggate, Schaughency, McAnally, and Reese (2018) reported that parent-reported expressive vocabulary at 19 months of age had a significant, medium correlation with reading comprehension at age 12.

Although the emergence of words significantly predicts expressive and receptive language outcomes in young children, the exclusive use of vocabulary production measures has explained relatively little variance and has limited utility for children younger than 2 years. Young children with or at risk for language delay are often evaluated for the first time well after their second birthdays and even as late as their preschool years. Waiting until children are delayed in acquiring words may result in long-term language and learning weaknesses that could be mitigated by early intervention. Further, waiting for the time when delays in expressive vocabulary emerge may be too late for young children to access early intervention services. Indications of delay may be apparent during the development of children's prelinguistic communication skills and prior to the age at which first words are expected (De Giacomo & Fombonne, 1998; Wetherby et al., 2003; 2007). Thus, the differentiation among children who merely are late to develop language from those who will have persistent impairment should, if possible, be made prior to 24 months of age, the age at which many children who are not using at least 50 words and are not combining words are typically labeled as LTs (Rice, et al., 2008). There remains a great need to identify predictors beyond expressive vocabulary that explain additional variance, more accurately predict language outcome, and contribute to distinguishing delays that are likely to be persistent. Examining measures that tap into earlier developing prelinguistic communication skills is a

potential solution to improve early identification of children at risk for persistent language delay.

Early Social Communication and Prediction of Language Outcome

Social communication development in very young children provides critical information relevant to the identification, assessment, and treatment of early communication delays and disorders. The key transition from prelinguistic to linguistic communication, and a thorough understanding of its associated developmental milestones and how these early achievements in social communication predict later language outcome is at center of this realm of study (e.g., Määttä et al., 2016). In typical development, prelinguistic social communication skills emerge between 7 and 9 months of age, first words appear between 12 and 15 months of age, and children have an expressive vocabulary of potentially hundreds of words and are combining words together by 24 months of age (Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Crais, Douglas, & Campbell, 2004; Dale, Price, Bishop, & Plomin, 2003; Wetherby & Prizant, 1992; 1996; 2002). Extant research has indicated that early communication predicts later language abilities, and a collection of social, speech, and symbolic predictors that typically emerge prior to words have been identified that are key indicators of later expressive and receptive language development for children with typical development as well as those with communication delay.

Social.

Social communication skills that develop before children learn to talk, including gestures, eye gaze, shared enjoyment, rate of communicating, and understanding of words, are significant predictors of expressive and receptive language and nonverbal cognitive ability (Calandrella & Wilcox, 2000; Delehanty, Stronach, Guthrie, Slate, & Wetherby, 2018; Watt et al., 2006). The earliest communicative gestures appear between 7 to 9 months of age and are one of first consistent indicators of intentionality (Crais et al., 2004). Numerous studies have reported on the relationship of gesture development and its association with language outcome (Callandrella & Wilcox, 2000; Crais et al., 2004; Watson, Crais, & Baranek, 2013; Delehanty et al., 2018; Thal & Tobias, 1992; Thal, Tobias, & Morrison, 1991). Thal and Tobias (1992) highlighted a relationship between children’s rate of gestural communication and later language outcomes. Smith (1998) found that the presence of showing and requesting gestures at 10 months of age significantly predicted language outcome at 24 and 36 months. In a retrospective study of children classified as “truly delayed” and those who were late bloomers, late bloomers were observed to use significantly higher rates of gestural communication than children with persistent delay (Thal & Tobias, 1992). Callandrella and Wilcox (2000) measured gestural indicating behaviors during mother-child interactions at two observation points six months apart. Rate of gestural indicating behaviors at observation two was predictive of expressive language outcomes. Symbolic gesture production at 18–24 months differentiated LTs with persistent problems from those who caught up (Thal, Tobias, & Morrison, 1991). Recently, Delehanty and colleagues (2018) found that scores on the social composite of the Communication and Symbolic Behavior Scales - Behavior Sample (CSBS BS; Wetherby & Prizant, 2002), which measures gesture use and shared enjoyment, administered at a mean age of 20 months, differentiated children who were diagnosed with

language delay at age 3 and explained significant variance in expressive and receptive language skills for the entire sample of children with and without language and global developmental delays.

Another critical social communication skill, joint attention, is the ability to coordinate attention between objects and people for social purposes. Joint attention can be described in terms of responding (e.g., following another's point) and initiating (pointing or showing to draw attention to an object; Tomasello, 1988). Morales and colleagues (2000) specifically examined the relationship of responding to joint attention to receptive and expressive vocabulary outcome measured at 24 and 30 months of age. A combined measure of responding to join attention from 6 to 18 months of age significantly predicted expressive and receptive vocabulary outcome at 30 months of age beyond the contribution made by the 24-month parent report measure of language skills. In a longitudinal evaluation of 145 randomly-selected children from a UK health district, Smith (1998), again, found that initiating joint attention at 10 months of age significantly predicted auditory comprehension and expressive language outcome at 24 and 36 months. Young children who more frequently communicate by coordinating their attention with a communicative partner regarding an object, action, or event tend to have better language outcomes than children who do display fewer acts of joint attention (Mundy & Gomes, 1998; Morales et al., 2000). In an examination of the relationship between joint attention and behavior regulation at 15 months of age and language outcomes after 18 months of age in typically developing children (N=22), Mundy and Gomes (1998) reported that initiation of both behavior regulation and joint attention were significantly correlated with the follow-up expressive and receptive language skills.

Speech.

The variety of children's phonetic repertoires (Klein, 1985; Stoel-Gammon, 1989; Vihman, 1986) and the rate of vocalizations that contain consonants (McCathren et al., 1999; Menyuk et al., 1986; Wetherby et al., 1988; Whitehurst et al., 1991) are related to later language and speech. The number of consonant-vowel syllables produced at 12 months of age in typically-developing children significantly predicts the age at which first words are produced (Stoel-Gammon, 1991). Wetherby, Watt, Morgan, & Shumway (2007) reported a large, significant correlation between the inventory of consonants produced in a sample of 50 toddlers with ASD and both verbal and nonverbal DQ at three years of age. McCathren, Yoder, and Warren (1999) used portions of the CSBS (Wetherby & Prizant, 2003) to examine the predictive validity of consonants in the babble of children with developmental delays at 17–34 month of age. They found that rate of vocalization, rate of vocalizations with consonants, and rate of vocalizations used interactively were positively correlated with expressive vocabulary one year later. As mentioned, expressive vocabulary has shown to have strong predictive value for language outcomes; however, expressive vocabulary alone may not an adequate measure of language development to predict outcome in children who are younger than 24 months of age. Fisher (2017), for example, reported that expressive vocabulary and phrase speech in toddlerhood had small, albeit statistically significant, relationships with expressive language outcomes.

Symbolic.

A growing body of evidence supports receptive language skills as an early predictor of language outcome. Watt and colleagues (2006), for example, found that comprehension in the second year of life significantly predicted receptive and expressive language outcomes at 3 years of age, and a recent meta-analysis reported that receptive language at age explained approximately 12% of variance in expressive language outcomes at preschool (Fisher, 2017). Other longitudinal studies have shown that strengths in receptive language at 2 years predicts accelerated vocabulary growth across the 2nd year (Fernald, Perfors, & Marchman, 2006) as well as better language and cognitive outcomes at 8 years of age (Marchman & Fernald, 2008). Fernald and colleagues (2012) have provided evidence that individual differences in the efficiency of real-time verbal processing in infancy predicts vocabulary growth from 18 to 30 months in both LTs and in TD children. Receptive language delays, nonverbal cognitive ability, and decreased use of symbolic gestures are three important predictors of language and learning outcome in LTs (Bishop et al., 2012; Bishop, Snowling, Thompson, Greenhalgh, and CATALISE Consortium, 2016; Ellis Weismer, 2007; Heinrichs et al., 2011; Thal et al., 2013; Watt, Wetherby, & Shumway, 2007; Wetherby et al., 2002). Language comprehension in the toddler and preschool years has been found to differentiate LTs with persistent problems from those who caught up to typical developmental levels (O'Neill, Murphy, & Chiat, 2019; Thal, Tobias, & Morrison, 1991; Zambrana, Pons, Eadie, & Eystrom, 2014).

Taken together, the research indicating that early social communication skills are significant indicators of later language development could provide a practical route through which to improve early identification. Children who present only with delays in expressive vocabulary are more likely to catch up to typical developmental levels, whereas children who are delayed in other areas are more likely to have persistent learning and language concerns (Dale, Price, Bishop, & Plomin, 2003; Ellis Weismer, 2007; Luinge, Post, Wit, & Goorhuis-Brouwer, 2006; Westerlund, Bergland, & Eriksson, 2006). Evaluation of prelinguistic predictors including nonverbal communication, gestures, communicative rate, use of sounds, and comprehension may provide prognostic clues prior to the emergence of first words and phrases. These findings provide a strong rationale for examination of the predictive validity of early social and symbolic communication skills that emerge prior to words relative to vocabulary alone. Delays in social communication may be apparent months before first words are expected, and these skills may be efficiently measured by community-based professionals using existing clinical tools (Carta, Greenwood, Luze, Cline, & Kuntz, 2004; Greenwood, Buzhardt, Walker, McCune, & Howard, 2013; Walker, Carta, Greenwood, & Buzhardt, 2008; Wetherby, Goldstein, Cleary, Allen, & Kublin, 2003). Given that accurate prediction of persistent communication delay in toddlers continues to be elusive, it is important to challenge existing paradigms and standard practice in pediatric and early intervention settings, to go beyond expressive vocabulary. Examining measures that tap into early-developing social communication skills is a potential solution to improve early identification of children at risk for LD.

Purpose of the Present Study

The purpose of this study was to determine the extent to which early social communication, measured with the CSBS Caregiver Questionnaire (CQ) and Behavior Sample (BS), and vocabulary production, measured with the LDS, predicted variance in language outcomes for a heterogeneous group of toddlers including both children who were LTs and TD. Specific research questions were:

1. What are the individual, collective, and unique contributions of CSBS CQ and CSBS BS composite scores to the prediction of vocabulary production measured by the LDS at 2 years of age?
2. What are the individual, collective, and unique contributions of the LDS, CSBS CQ, CSBS BS to the prediction of expressive and receptive language outcome at 2 and 3 years of age?
3. What are the individual, collective, and unique contributions of the LDS, CSBS CQ, and CSBS BS to predicting the presence of language delay at 2 and 3 years?

Methods

Participants

Children were selected from the archival database of the FIRST WORDS Project®, an ongoing, prospective longitudinal investigation that conducts screening in primary care settings on a general population sample to identify children with communication delays and ASD (Wetherby, Brosnan-Maddox, Peace, & Newton, 2008). For a full account of recruitment procedures, please see Wetherby et al., 2008. In brief, children were screened in primary care with the Infant-Toddler Checklist (ITC; Wetherby et al., 2008), a broadband screening checklist for communication delays, between 9 and 24 months of age. Those who scored in the bottom 10^{th} percentile of the Infant-Toddler Checklist or whose caregiver(s) responded affirmatively to the question of whether they had any concerns about their child's development were invited for a communication evaluation, alongside randomly-selected children who screened negative for communication delays on the ITC. Children included in the current study had completed the CSBS CQ and CSBS BS between 18 and 21 months of age and a follow-up language and developmental evaluation at or near their second birthday that included the LDS and Mullen Scales of Early Learning (MSEL; Mullen, 1995). The LDS was mailed to families around each child's second birthday. Project staff mailed a second LDS if the first was not returned. Children who received a diagnosis of ASD in the course of their participation in the FIRST WORDS Project were excluded from this study during participant selection, in an effort to narrow the sample to include children for whom late talking was not secondary to a diagnosed neurodevelopmental disorder (Fischer, 2017; Rescorla, 2011). Finally, all children were invited for a follow-up developmental evaluation around their third birthday that included the MSEL. Those who met the above criteria and had a follow-up language and developmental evaluation at or near their third birthday formed a subgroup for further analyses for this study (n = 198; 122 TD and 76 LTs).

Measures

Communication and Symbolic Behavior Scales (CSBS).

The CSBS was designed to measure 20 scales of behavior that fall within the seven language predictors previously discussed (i.e., emotion and eye gaze, rate and function of communication, use of gestures, use of sounds, use of words, understanding of words, use of objects; Wetherby et al., 2002; 2003). Developed for children from 6–24 months of age, the CSBS consists of three components: The ITC, the CQ, a more detailed caregiver questionnaire; and the BS, an observational measure. The ITC is a freely available, 24-item parent-report checklist that is used routinely in developmental screening to determine whether further evaluation is indicated. The ITC can be completed by caregivers in five minutes and scored by pediatric healthcare professionals in two minutes or less. The CSBS CQ is a more in-depth, 41-item parent-report tool administered when ITC results indicate a need for further assessment. The CSBS BS is a standardized, direct observation measure administered while a child interacts with a clinician in the presence of a caregiver. The child is presented with communicative opportunities including toys, book sharing, play materials, and comprehension probes. The CSBS BS takes approximately 20 minutes to administer. The CQ and BS yield total scores and three composite scores: 1) social, 2) speech, and 3) symbolic.

Social.—This composite comprises three clusters: Emotion and Eye Gaze, Communication, and Gestures. Emotion and Eye Gaze consists of three scales that measure gaze shifts, shared positive affect, and gaze/point following. Communication includes the rate of communication as well as scales of three communicative functions: behavior regulation, social interaction, and joint attention. Gestures include an inventory of both conventional and distal gestures.

Speech.—This composite is comprised of two clusters including Sounds and Words. Sounds include a scale that measures the variety of different consonants produced and communicative acts that include a consonant + vowel combination. Words include four scales including: use of words in communicative acts, inventory of words, word combinations, and inventory of word combinations.

Symbolic.—This composite is comprised of two clusters including Understanding and Object Use. Understanding includes a scale of language comprehension including object names, person names, and body parts. Object Use is a cluster containing the scales of inventory of action schemes, action schemes toward other, action schemes in a sequence, and constructive play.

In the development of this measure, the relationship among the 20 scales of the Behavior Sample was analyzed using a principal components analysis to determine whether the scales were more interpretable by grouping them as composites. A Varimax rotation identified three components interpreted as 3 composites: 1) Speech Composite; 2) Social Composite; and 3) Symbolic Composite. Previous research has shown the Speech Composite to be the strongest predictor of expressive language whereas the Symbolic and Social Composites are the strongest predictors of receptive language outcome (Wetherby et al., 2002). Strong

validity has been demonstrated by high correlations between the CSBS and follow-up standardized language assessments (Wetherby et al., 2002; 2003; Watt et al., 2006). Wetherby and colleagues (2002) examined the validity and reliability of the three measures (i.e., Infant-Toddler Checklist, Caregiver Questionnaire, Behavior Sample) of the CSBS. In children 12 to 24 months of age, large correlations (.70***–.87***) were found between the parent report measures of the Infant-Toddler Checklist (ITC) and the Caregiver Questionnaire (CQ). Moderate to large correlations were found between measure of the parent report measures and the face-to-face evaluation of the Behavior Sample (BS; .40***–.75***). All three measures demonstrated strong test-retest reliability over a 4-month period. The raw scores increased as expected during this time due to developmental progression; however, the standard scores remained relatively constant (i.e., no significant differences between the test and retest standard scores). Wetherby and colleagues (2003) compared the diagnostic classification of the ITC and the Behavior Sample (BS) for children 12 to 24 months of age to the diagnostic classification of the follow-up testing at 2 and 3 years of age using the MSEL and the Preschool Language Scale-3 (PLS-3; Zimmerman, Steiner, Pond, 1992). The CSBS demonstrated strong levels of sensitivity (80%) and specificity (79% to 86%) at 2 years of age with a positive predictive value range from 63% to 75%. At 3 years of age, the sensitivity (83% to 91%) and specificity (70% to 76%) levels continued to be strong with a positive predictive value range from 44% to 52%. A higher proportion of children who were identified at risk on the CSBS measures had language delays at 3 years of age than at 2 years of age on the follow-up language measures thus indicating the CSBS had good predictive validity (Wetherby et al., 2003). In addition, multiple regression analyses determined the ITC explained 32% to 35% of the variance in the language outcomes at 2 years of age. The BS explained an additional 18% to 20% of unique variance beyond that of the ITC. At 3 years of age, the ITC explained 20% to 25% of the variance in language outcomes and the BS explained 26% to 27% of unique variance beyond that of the ITC. Therefore, the CSBS is an effective method for screening and evaluating the prelinguistic communication skills of young children (Wetherby et al., 2003). Internal consistency estimates range from .86 to .89 for the individual clusters and composite scores respectively, and .90 for the total score (Wetherby & Prizant, 2002).

The Language Development Survey (LDS).

The LDS is parent report measure using a vocabulary checklist of 310 familiar words in 14 semantic categories. The measure can be completed without professional staff in about 10 minutes and is easy to score. At a mean of 24.81 months of age (*SD* = 1.41) caregivers completed the LDS for each child in the study. The LDS delay criteria consisting of a cut-off of fewer than 50 words *or* no word combinations at 24 months was used to identify an LT group (N=201). This cut-off has been used in previous studies and has yielded rates of language delay from 10 to 20% (Klee et al., 1998, Rescorla, 1989; Rescorla & Alley, 2001; Rescorla et al., 1993). The LDS has demonstrated strong test-retest reliability and internal consistency (Cronbach's alpha = .99; Rescorla, 1989; Rescorla & Alley, 2001). Validity has been demonstrated by high correlations between the LDS vocabulary score and various standardized language assessments (Klee et al., 1998; Rescorla, 1989; Rescorla & Alley, 2001). In addition, the LDS has demonstrated sensitivity of 80% or better and specificity of

85% or better in the detection of language delay (Klee et al., 1998, Rescorla, 1989; Rescorla & Alley, 2001; Rescorla et al., 1993).

Mullen Scales of Early Learning (MSEL).

The MSEL is a standardized, direct measure of cognitive development that has been shown to demonstrate good psychometric properties for the children in the age range of this study, with high inter-scorer reliability (.95-.98), and internal consistency estimates ranging from .76 to .86 for the receptive language scale and .88 to .91 for the expressive language scale. The receptive language scale consists of 33 items targeting understanding of verbal directions, auditory-spatial and auditory quantitative concepts, memory for 1, 2, and 3 step commands, and long-term general information memory. The expressive language scale consists of 28 items assessing spontaneous utterances, specific vocal/verbal responses to vocabulary, practical reasoning, and high-level concept formation. The MSEL has been shown to demonstrate good psychometric properties for the children in the age range of this study. With regard to reliability, the MSEL shows good internal consistency estimates ranging from .76 to .86 for the receptive language scale for the age groups in this study, and .88 to .91 for the expressive language subtest, and high interscorer reliability of .95 for the receptive scale and .98 for the expressive scale.

Inter-rater Reliability

Inter-rater reliability on the CSBS was assessed as the BS requires that raters make judgments about the occurrence/non-occurrence of behaviors during ongoing interaction. Generalizability (g) coefficients (e.g. intraclass correlations) were used to calculate inter-rater reliability by comparing the scores for pairs of four independent raters using randomly selected videotapes of the behavior sample for at least 20% of the samples scored by each rater. The g coefficient is a measure of the source and magnitude of variance accounted for by the subjects and the raters. This has been used as a measure of reliability in similar research (e.g., McCathren et al., 2000; McWilliam & Ware, 1994; Wetherby et al. 2002). Compared to an expert rater, four independent raters demonstrated *g* coefficients ranging from .94 to .97 for the Speech Composite, .95 to .99 for the Symbolic Composite, and .90 to .97 for the Social Composite.

Statistical Analyses

To address our first research question, hierarchical linear regression analysis was employed to explore contributions of the CSBS CQ and CSBS BS to predicting LDS vocabulary production at age 2. For our second research question, hierarchical linear regression models were used to examine contributions of the LDS, CSBS CQ, and CSBS BS to explaining variance in expressive and receptive language performance on the MSEL at 2, then 3 years of age. Children who did and did not return for evaluation at age three were separated (n = 198 and n = 210, respectively) to compare their demographics and outcomes of communication and language evaluations (Supplementary Tables 1 and 2). Mothers of children who returned for an evaluation at age three were significantly but only slightly older than those who did not. The two groups were statistically equivalent across all developmental outcomes.

For our third research question, children who scored over 1 *SD* below the mean (< 40) on MSEL receptive or expressive language T scores at ages 2 and 3 were categorized as having a language delay (Armstrong et al., 2017; Rice et al., 2008; Snowling, Duff, Nash, & Hulme, 2016). To compare all measures on the same scale, LDS raw scores were z-scored and converted to scaled scores ($M = 10$, $SD = 3$). Single-variable logistic regression analyses were used to determine contributions of each CSBS CQ and BS composite and LDS vocabulary production to a categorical prediction of the presence of language delay at 2, then 3 years. Finally, each measure was examined to determine collective and unique contributions to the prediction of language delay at 2 and 3 years. Analyses were conducted using SPSSv23.

Results

Participant Demographic and Developmental Characteristics

Of the 408 children included in this study, 249 were TD and 159 were LTs based on parent report from the LDS of an expressive vocabulary of fewer than 50 words and/or an absence of word combinations. Participant demographics are shown in Table 1. Children who were TD and LTs were not significantly different with respect to maternal education, but paternal education levels of the LT group were significantly lower than those of the TD group, with a small effect size ($t(389) = 2.39$, $p < .05$, $d = 0.18$). Mothers of children in the TD group were significantly older than those of LTs, but the difference was small ($t(401) = 2.40$, $p < .05$, $d = 0.18$). Significant differences in race and ethnicity were not detected between TD and LT groups. At the first time point, children in the LT group were significantly older (but less than one month) than the TD group on average with small effect sizes (CSBS CQ: $t(406) = 2.38$, $p < .05$, $d = 0.24$; CSBS BS: $t(406) = 2.06$, $p < .05$, $d = 0.21$) (Table 2). At the time of administration of the LDS and MSEL, LT and TD groups were not significantly different with respect to age (LDS: $M_{age} = 24.46$ months, $SD = 0.82$, $t(406) = 0.80$, $d = 0.09$; MSEL: $M_{age} = 25.01$ months, $SD = 0.97$, $t(406) = 0.22$, $d = 0.02$). Finally, for the subgroup who returned for an MSEL around age three, LTs and TD did not differ with respect to age ($M_{age} = 37.29$ months, $SD = 1.95$, $t(196) = 0.22$, $d = 0.02$).

Table 2 also presents results of communication and language measures as well as group differences for the entire sample. LTs were observed to score significantly lower than TD on all composites of the CSBS CQ and BS, with a large effect size on the speech composite, a medium effect on the symbolic composite, and a small effect on the social composite. As expected, there were substantial, significant differences between LDS vocabulary production scores of children who were TD and LTs. Each group exhibited a broad range of performance on the LDS as indicated by large standard deviations. At 2 years, LTs performed significantly lower than TD in expressive language and receptive language as measured by the MSEL with large and medium effect sizes, respectively. At 3 years, large, significant differences in both receptive and expressive language were found on the MSEL between children who were TD and LTs.

CSBS and Prediction of LDS Vocabulary Production

Significant correlations among CSBS CQ, CSBS BS, and LDS scores were observed and suggested a large amount of shared variance, which supported exploring their unique contributions in a regression model (Table 3). A small but significant correlation was observed between the age of administration of the CSBS and the LDS vocabulary production score (r = .17). Maternal education (in years) was also considered, as the CSBS CQ and the LDS are parent report measures. Therefore, in the first model, child age at the time the CSBS BS was administered and maternal education were entered. Together, these variables explained approximately 3% of the variance in the LDS vocabulary production score. Next, all three composites of the CSBS CQ were entered, explaining 61% of the variance in vocabulary production at 2 years of age with a large effect size. Finally, the addition of the three CSBS BS composites contributed significantly to the prediction of expressive vocabulary with a small effect size. In the final model, the CSBS CQ speech composite (with a medium effect size that approached large) and the CSBS BS speech composite (with a small effect size) each explained significant unique variance in vocabulary production at age 2.

LDS, CSBS, and Prediction of Expressive and Receptive Language at Age 2

The LDS, CSBS CQ, and CSBS BS were then examined in relation to expressive and receptive language measured by the MSEL at 2 years of age (Table 4). Child age at the time the CSBS BS was administered and maternal education (in years) were entered at step one, as small but significant correlations were observed between these variables and MSEL expressive and receptive language outcomes (range r = .12 - .19). At this step, 5% of the variance in expressive, and 4% of the variance in receptive language was explained. Next, the addition of the LDS vocabulary production score accounted for 58% and 20% of the variance in expressive and receptive language outcomes at age 2, respectively, with large and medium effect sizes. In the third step, CSBS CQ composites explained an additional 1% of the variance in expressive and 9% in receptive language outcomes, respectively, with small effect sizes. Finally, the three CSBS BS composites were entered, accounting for an additional 5% of the variance in the prediction of expressive language and 16% for receptive language. CSBS BS social and speech composites and the LDS contributed uniquely to the prediction of expressive language at 2 years of age, controlling for other variables in the model. For the prediction to receptive language outcome, the CSBS CQ symbolic composite, the CSBS BS social and symbolic composites, and the LDS added to the prediction with small effect sizes.

CSBS, LDS, and Prediction of Expressive and Receptive Language at Age 3

Predictions to language outcome as measured by the MSEL at 3 years of age appear in Table 5. Again, the LDS, CSBS CQ, and CSBS BS each made statistically significant contributions to predicting receptive and expressive language. First, the age at which the CSBS BS was administered and maternal education explained a significant amount of variance (8% in expressive language, and 12% in receptive language) at age 3, with small effect sizes. The LDS accounted for an additional 24% of the variance in the prediction of expressive language and 19% of receptive language, with large and medium effect sizes. In

the third step, the three CSBS CQ composites was observed to contribute an added 7% and 11% of the variance in expressive and receptive language with medium and large effect sizes, respectively. In the final model, accounting for all variables in the model the CSBS BS accounted for an additional 5% and 9% of the variance, respectively, for a final R^2 value of .44 for expressive and .49 for receptive language. Accounting for all variables in the model, the LDS, the CSBS CQ symbolic, CSBS BS symbolic composites contributed significant unique variance to the prediction of expressive language, while the LDS, CQ symbolic, BS social, and BS symbolic contributed significant uniqu variance to receptive language at 3 years of age, all with small effect sizes.

Associations with Language Delay at 2 or 3 Years of Age

Single-variable logistic regressions were used to examine the three composites of the CSBS CQ, the three CSBS BS composites, and scaled LDS vocabulary production score in relation to predicting the presence of language delay at 2 or 3 years of age. In this study, language delay was defined as a score of greater than 1 *SD* below the mean (< 40) on MSEL receptive or expressive language T scores (Armstrong et al., 2017; Rice et al., 2008; Snowling, Duff, Nash, & Hulme, 2016). All CSBS CQ composites, all CSBS BS composites, and the LDS had significant associations with language delay at both ages, with ORs ranging from 1.21–2.00 (Supplementary Table 3; all $p < .001$). Next, the three measures were examined to determine collective and unique variance in predicting language delay. At age 2, 34% of the sample exhibited a receptive or expressive language delay on the MSEL. Of these children, 76% were also classified as LTs using the LDS. Each of the three measures was a significant predictor of language delay at age 2 (CSBS CQ: χ^2 (3) = 116.10, Nagelkerke $R^2 = .34$, $p < .001$; CSBS BS: χ^2 (3) = 143.92, Nagelkerke $R^2 = .41$, $p < .001$; LDS: χ^2 (1) = 154.08, Nagelkerke $R^2 = .44$, $p < .001$). The CSBS CQ speech composite made a significant, unique contribution, controlling for all other CQ composites, at age 2 (OR = 1.73, 95% CI [1.50, 1.99], $p < .001$). Among CSBS BS composites, the speech and symbolic composites made significant, additive contributions to the prediction (speech: OR = 1.76, 95% CI [1.53, 2.03], $p < .001$; symbolic: OR = 1.23, 95% CI [1.02, 1.24], $p < .05$). Finally, the LDS vocabulary production score alone was a significant predictor of language delay at age 2 (OR = 2.00, 95% CI [1.71, 2.33], $p < .001$).

At age 3, 20% of children who returned for an evaluation at this time point had a language delay, 62% of whom had been classified as LTs at age 2. Ninety-eight percent of children who had a language delay at 3 were also delayed at 2. Again, all three measures were significantly associated with the presence of language delay (CSBS CQ: χ^2 (3) = 37.61, Nagelkerke $R^2 = .28$, $p < .001$; CSBS BS: χ^2 (3) = 42.12, Nagelkerke $R^2 = .31$, $p < .001$; LDS: χ^2 (1) = 19.85, Nagelkerke $R^2 = .15$, $p < .001$). The CSBS CQ symbolic composite made a significant, unique contribution when controlling for all other CQ composites (OR = 1.55, 95% CI [1.18, 2.04], $p < .01$). Among the three composites of the CSBS BS, the social and symbolic composites contributed unique variance to the prediction (social: OR = 1.18, 95% CI [1.01, 1.38], $p < .05$; symbolic: OR = 1.22, 95% CI [1.04, 1.44], $p < .05$. Finally, the LDS was significantly associated with the presence of language delay at age 3 (OR = 1.38, 95% CI [1.17, 1.63], $p < .001$).

Discussion

The purpose of this study was to examine the extent to which social communication measured late in the second year of life (CSBS CQ; CSBS BS) and vocabulary production measured at 24 months (LDS), were associated with expressive and receptive language outcomes at 2 and 3 years of age for a heterogeneous group of toddlers who were TD and LTs. Each of the three measures was significantly associated with both continuous and categorical language outcomes at 2 and 3 years of age. The CQ and the BS contributed significantly to the prediction of language outcome beyond that of the LDS at both ages. At 2 years of age, CQ and BS speech composites were observed to be the strongest predictors of expressive language beyond that predicted by the LDS. The CQ and BS symbolic composites were the strongest predictors of expressive language beyond the LDS at ages 2 and 3. For the prediction of receptive language at 2 and 3. Finally, results of single-variable logistic regressions suggested that all three measures contribute to the categorical prediction of language delay at the ages of two and three.

The results of this study provide additional evidence of the predictive validity of the composite measures of the CSBS and the LDS, adding to a number of previous studies (Määttä et al., 2016; Rescorla & Alley, 2001; Rescorla & Schwartz, 1999; Sim et al., 2019; Watt et al., 2006; Wetherby et al., 2002, 2003). It has been well established from decades of research that early social communication skills are foundational to language development (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Carpenter & Tomasello, 2000; Watt et al., 2006). Measures that assess social, speech, and symbolic communication skills, like the CSBS, may be administered earlier than vocabulary checklists such as the LDS, even before words are expected to emerge. Prior research indicates that children who are delayed only in the use of sounds and words are more likely to catch up to typical developmental levels, while children who show delays in language comprehension, social interaction, and play are at higher risk for later language and learning difficulties (Rescorla, 2011). Overall, results of this study indicate that examining measures that tap into early-emerging social communication skills, including expression of emotion and eye gaze, rate of communicating, gestures, understanding of words, and object use in play, may allow for earlier identification of children who may be at risk for persistent language delay.

The changes in predictive patterns of the CSBS composites from 2 to 3 years point to patterns of language development that may provide the opportunity for more nuanced prediction of language outcome. These findings suggest that parent report of sounds and words is a robust indicator of expressive language development at age 2 but that understanding may contribute more to the prediction of expressive language status at age 3. This finding is consistent with the results of a recent meta-analysis suggesting that what a toddler understands may be a better predictor of expressive language outcome than vocabulary size (Fisher, 2017). Given that there is wide variability in the development of speech, and a large percentage of “late bloomers” with few words in the second year of life catch up without needing intervention, it is not surprising that measures of speech declined in importance in the prediction language from age two to three. In our analyses predicting membership in groups of children with and without language delay, the LDS and the speech composites of the CSBS CQ and BS at 18–21 months were observed to be significantly

associated with an outcome of language delay at age 2; however, symbolic, then social composites were found to have the strongest relationships with language delay at age 3. Together, these findings again underscore the importance of going beyond vocabulary production when using parent-report measures.

Clinically, these data indicate that utilization of measures of social communication like the CSBS may result in identification of children who are likely to have persistent language problems, which may enable families with young children to access to intervention sooner. Although vocabulary checklists like the LDS remain powerful tools for screening language development in young children at risk for delays, if we are to respond to the call that earlier intervention results in greater positive outcomes for children, we must utilize tools that identify a potential problem even before children are considered to be delayed in expressive vocabulary. It is evident that results of assessment measures that tap into prelinguistic communication skills during the second year of life can reveal group differences in LTs and children who are TD even earlier than what is allowed by the measurement of expressive vocabulary alone.

Screening for language delay via parent report has been identified as a cost effective and feasible technique (Klee, 1998). Both parent report tools utilized in this study, the CQ and the LDS, are inexpensive, easily administered, and provide important information with respect to identifying children at risk for persistent language delays. Although both measures indicate evidence of predictive validity, this study confirms previous research indicating the need to go beyond parent report in early identification efforts (Klee, Pearce, & Carson, 2000). In our regression analyses, the CSBS BS, a clinician-administered tool, added significantly to the prediction of expressive and receptive language at both 2 and 3 years of age, thus strengthening the ability to identify children who should be provided intervention early versus those who should be simply monitored for progress. There may be a need to test a two-tiered approach to developmental screening that begins prior to 18 months with parent report and proceeds with observational measures of social communication for those deemed at higher risk for language delay (e.g., Dale, et al., 2003).

A strength of this study is that it provides pertinent clinical information by examining a sample of children with TD, but also children identified as LTs who may be similar to a population screened, then referred, for communication evaluations in the community. Many studies of late talkers have examined relatively homogeneous, primarily Caucasian, or higher SES groups (Cable & Domsch, 2011). By including children with TD and children identified as LTs in this sample, we include a range of receptive and expressive language performance, allowing for greater generalization to the clinical population. Because a communication delay often is the first sign that something is amiss with a child’s development, identification of important risk factors may also lead to earlier diagnosis of related concerns such as ASD or potential learning or intellectual disabilities to which late talking itself is secondary. Screening and evaluating late talkers earlier and using measurements that take a wider variety of risk factors into account can help to identify those who are most in need of early intervention (Hawa & Spanoudis, 2014; Paul & Roth, 2011). Further, although language delays resolve in some LTs, others may need some level of intervention as they tend to perform below those who were not LTs at school age. It is possible that they may benefit

from preventive, structured language enrichment, which could be initiated before expressive vocabulary delay is evident (Justice, Jiang, & Strasser, 2018; Zauche, Thul, Mahoney, & Stapel-Wax, 2016; Wallace et al., 2015).

Limitations and Future Directions

Limitations of this study worthy of note are as follows. First, our sample size at age 3 is relatively small, limiting statistical power and our ability to generalize findings to the larger population. Relatedly, of the sample originally screened, this study examined only the outcomes of children who returned for further evaluation. A previous 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 et al. (2008) screened 5,385 toddlers over time with the ITC, and 41% of the screened sample of children were from racial and/or ethnic minority families, while only 29% of the sample who returned for a communication evaluation were minorities. We anticipate that return rates would be similar in this sample; however, characterizing our screening sample is beyond the scope of this study. Next, as we conducted our statistical analyses, large correlations were noted between the speech composite of the CSBS CQ and the LDS, which may indicate a lack of independence of these variables. While this interferes with our ability to determine the precise effect of each predictor, it was important to examine each composite of every measure in the model to illustrate the clinical utility of earlier timing of administration of parent report measures. Finally, in concordance with previous research in this area, our predictive relationships, though statistically significant, were small in size. Examining other variables including familial risk, alongside scores on measures of social communication development, may contribute to a stronger prediction of persistent versus transient language delay (Zambrana et al., 2014).

Future research evaluating the relationships among social communication and language in children under 18 months of age is the logical next step to elucidate predictive patterns from early in the second year of life. These patterns should be examined, both at the composite and individual level, with a younger group of children who later evidence language delay. For the present study, the CSBS CQ was administered at an average age of 20 months. Although we make the case in this article about the importance of identifying children under 24 months of age, we have only evaluated predictive relations from a few months earlier. Evaluating these relationships in children under 18 months of age may be important for early identification efforts but also to elucidate how predictive patterns may change for children early in the second year of life, particularly those with communication delays. Finally, following this sample to school age would add information about differentiating children whose language delays at preschool did and did not resolve.

Conclusions

The challenge of identifying young children with communication delay is among the most critical issues faced in efforts to implement IDEA. By illustrating the predictive power of social communication skills that develop prior to the expected emergence of words, the

results of this study add strength to the notion of challenging existing paradigms of thought and standard practice in pediatric and early intervention settings. Specifically, it speaks to the rationale for pushing for the use of screening tools that can be used at earlier ages and that go beyond vocabulary alone. This work further illustrates the futility of the 'wait and see' approach and even more, urges the critical consideration of delays in social communication prior to the time at which application of the term 'late talker' is relevant.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

LTs	Late talkers
CSBS	Communication and Symbolic Behavior Scales
LDS	Language Development Survey
MSEL	Mullen Scales of Early Learning
TD	Typically developing
BS	Behavior Sample
CQ	Caregiver Questionnaire

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Highlights:

- Reliable predictors of continued language delay in late talkers have been elusive
- Children with delays in language comprehension, symbolic ability, and gesture use are at an increased risk of persistent language and learning disorders and autism spectrum disorder
- Parent-reported expressive vocabulary is often used to screen young children's communication development
- Evaluation of early social communication may provide an evidence-based approach to improving early detection *before* children are classified as late talkers
- Evaluating social communication delays between 18–21 months, or earlier, may guide clinicians in recommending preventive early intervention to children who are at risk for persistent language delay

Table 1

Participant Demographics

	Total (*N* = 408)		TD (*n* = 249)		LT (*n* = 159)		*t*	*df*	Cohen's *d*[a]
Parents' education in years completed									
Mother (*M, SD*)	15.68	2.38	15.66	2.24	15.73	2.48	0.13	389	0.03
Father (*M, SD*)	15.66	2.69	15.99	2.68	15.51	2.69	2.39*	389	0.18
Parents' age at child's birth in years									
Mother (*M, SD*)	31.49	5.60	31.99	5.49	30.91	5.58	2.40*	401	0.18
Father (*M, SD*)	33.73	6.37	34.09	6.23	33.31	6.40	1.54	390	0.12
							x^2	*df*	Cramer's V
Males (%)	63		60		68		2.72	1	.08
Race (%)							1.18	4	.10
White	78		79		75				
Black	12		12		12				
Asian	4		3		5				
Other	6		6		8				
Ethnicity (%)							2.93	1	.09
Hispanic	4		3		6				

Note. TD=Typically developing. LT=Late talker.

[a]Effect size Cohen's $d \geq .20$ is small, .50 is medium, and .80 is large. Effect size Cramer's $V \geq .10$ is small, .30 is medium, and, .50 is large (Cohen, 1988).

*$p<.05$;

**$p<.01$;

***$p<.001$

Table 2

Participant Developmental Characteristics at 2 and 3 Years

	Total (N = 408)		TD (n = 249)		LT (n = 159)				
	M	***SD***	***M***	***SD***	***M***	***SD***	***t***	***df***	**Cohen's *d*[c]**
CSBS Caregiver Questionnaire[a]									
Age (months)	19.80	1.59	19.66	1.53	20.04	1.66	2.38*	406	0.24
Social	9.94	2.95	10.33	2.90	9.33	2.94	3.35**	406	0.32
Speech	8.85	2.77	10.08	2.64	6.93	1.66	14.80***	406	1.43
Symbolic	9.03	2.39	9.56	2.28	8.21	2.34	5.79***	406	0.58
CSBS Behavior Sample[a]									
Age (months)	20.25	1.54	20.13	1.46	20.45	1.64	2.06*	406	0.21
Social	10.46	3.20	10.86	3.17	9.82	3.17	3.23**	406	0.33
Speech	8.60	2.46	9.56	2.20	7.11	2.08	11.20***	406	1.14
Symbolic	10.22	3.01	10.78	2.89	9.35	3.01	4.75***	406	0.49
Language Development Survey									
Age (months)	24.46	0.82	24.49	0.83	24.42	0.79	0.80	406	0.09
VP	102.20	78.73	145.81	68.55	33.90	29.96	22.60***	406	2.12
Scaled VP	9.99	2.97	11.64	2.59	7.42	1.13	22.60***	406	2.12
Mullen Scales of Early Learning[b]									
Age (months)	25.01	0.97	25.02	1.01	25.00	0.89	0.22	406	0.02

	Total (*N* = 408)		TD (*n* = 249)		LT (*n* = 159)				
	M	***SD***	***M***	***SD***	***M***	***SD***	***t***	***df***	**Cohen's *d*[c]**
Expressive T	46.02	13.02	52.11	11.34	36.47	9.20	15.27***	406	1.51
Receptive T	52.62	11.90	55.53	10.73	48.06	12.22	6.31***	406	0.65
	Total (*N* = 198)		**TD (*n* = 122)**		**LT (*n* = 76)**				
	M	**SD**	**M**	**SD**	**M**	**SD**	**t**	**df**	***d***
Mullen Scales of Early Learning[b]									
Age (months)	37.29	1.95	37.28	2.08	37.25	1.64	0.22	196	0.02
Expressive T	51.54	13.09	55.33	11.78	45.34	12.49	5.66***	196	0.82
Receptive T	51.42	11.95	54.74	11.18	45.75	11.11	5.67***	196	0.81

Note. CSBS=Communication and Symbolic Behavior Scales. VP=Vocabulary production.

[a] Standard Scores based on M=10, SD=3.

[b] T Scores based on M=50, SD=10.

[c] Effect size based on Cohen's $d \geq .20$ is small, .50 is medium, and .80 is large (Cohen, 1988).

* $p<.05$;

** $p<.01$;

*** $p<.001$.

Table 3

Social Communication Predictors of Vocabulary Production at 2 Years of Age

			LDS Vocabulary Production (n = 408)				
		r	R^2	ΔR^2	β	sr^2	Effect size (f^2)[a]
Model 1: CSBS BS Age & Maternal Education			.03*				.03
	CSBS Age	−.17*			−0.17*	.03	.03
	Maternal Education	.07			0.06	---	---
Model 2: CSBS BS Age, Maternal Education, & CSBS CQ			.61***	.58			1.49
	CSBS Age	−.17*			−0.03	---	
	Maternal Education	.07			−0.03	---	
	CQ-Social	.30***			−0.08	---	---
	CQ-Speech	.78***			0.77***	.38	.97
	CQ-Symbolic	.46***			0.07	---	---
Model 3: CSBS BS Age, Maternal Education, CSBS CQ, & CSBS BS			.65***	.04			0.11
	CSBS Age	−.17*			−0.03	---	
	Maternal Education	.07			−0.03	---	
	CQ-Social	.30***			−0.06	---	.00
	CQ-Speech	.78***			0.56***	0.10	.34
	CQ-Symbolic	.46***			0.09	---	.00
	BS-Social	.25***			−0.07	---	.00

			LDS Vocabulary Production (n = 408)				
		r	R^2	ΔR^2	β	sr^2	Effect size (f^2)[a]
	BS-Speech	.67***			0.29***	0.04	.09
	BS-Symbolic	.35***			0.04	---	.00

Note. LDS = Language Development Survey. CSBS = Communication and Symbolic Behavior Scales. CQ = CSBS Caregiver Questionnaire. BS = CSBS Behavior Sample. Standard Scores: M = 10; SD = 3.

[a]Effect size $f^2 = sr^2/(1 - R^2)$ for individual predictors; $f^2 = \Delta R^2/1 - R^2$ for R^2 change; $f^2 = R^2/(1-R^2)$ overall; small f^2 = .02, medium f^2 = .15, and large f^2 = .35 (Cohen, 1988).

*$p < .05$;

**$p < .01$;

***$p < .001$

Table 4

Predictors of Expressive and Receptive Language at 2 Years of Age

	Mullen Scales of Early Learning (n = 408) Expressive						Receptive					
	Expressive T						Receptive T					
	r	R^2	ΔR^2	β	Sr^2	Effect size (f^2)[a]	r	R^2	ΔR^2	β	Sr^2	Effect size (f^2)[a]
Model 1: CSBS BS Age & Maternal Education	.05 ***				.05			.04 ***				.04
CSBS Age	−.17 ***			−0.17 *	.03	.03	−.08			−0.07	---	---
Maternal Education	.13 **			0.13 *	.02	.02	.19 ***			0.18 ***	.03	.03
Model 2: CSBS BS Age, Maternal Education, & LDS	.58 ***	.54		1.23				.20 ***	.16			.20
CSBS Age	.17 ***			−0.04	---	---	−.08			.002	---	---
Maternal Education	.13 **			0.08 *	---	---	.19 ***			0.16 ***	.03	.04
LDS	.76 ***			0.74 ***	.53	1.26	.42 ***			0.41 ***	.16	.20
Model 3: CSBS Age, Maternal Education, LDS, & CSBS CQ	.59 ***	.01			.02			.29 ***	.09			.13
CSBS Age	.17 ***			−0.04	---	---	−.08			.001	---	---
Maternal Education	.13 **			0.08 *	---	---	.19 ***			0.10 *	.01	.01
LDS	.76 ***			0.62	.15	.37	.42 ***			0.29 ***	.03	.04
CQ-Social	.29 ***			−0.07	---	---	.35 ***				---	---

	Mullen Scales of Early Learning (n = 408) Expressive												
	Expressive T						Receptive T					
	r	R^2	ΔR^2	β	Sr^2	Effect size (f^2)[a]	r	R^2	ΔR^2	β	Sr^2	Effect size (f^2)[a]
CQ-Speech	.66***			0.17**	.01	.02	.40***				---	---
CQ-Symbolic	.38***			−0.06	---	---	.48***				---	---
Model 4: CSBS Age, Maternal Education, LDS, CSBS CQ, & CSBS BS		.64***	.05			.14		.45**	.16			.29
CSBS Age	.17***			−0.05	---	---	−.08			−0.02	---	---
Maternal Education	.13**			0.07*	---	---	.19***			0.08*	---	---
LDS	.76***			0.54***	.01	.29	.42***			0.21**	.01	.02
CQ-Social	.33***			0.04	---	---	.35***			0.02	---	---
CQ-Speech	.66***			0.07	---	---	.40***			−0.10	---	---
CQ-Symbolic	.39***			−0.07	---	---	.48***			0.18**	.01	.02
BS-Social	.38***			0.13**	.01	.03	.50***			.26***	.04	.07
BS-Speech	.67***			0.18***	.01	.03	.43***			0.07	---	---
BS-Symbolic	.38***			0.04	---	---	.56***			0.27***	.04	.07

Note. LDS=Language Development Survey. CSBS=Communication and Symbolic Behavior Scales. CQ=CSBS Caregiver Questionnaire. BS=CSBS Behavior Sample. CSBS Standard Scores: M = 10; SD = 3.

[a]Effect size $f^2 = sr^2/(1 - R^2)$ for individual predictors; $f^2 = \Delta R^2/1 - R^2$ for R^2 change; $f^2 = R^2/(1-R^2)$ overall; small f^2 = .02, medium f^2 = .15, and large f^2 = .35 (Cohen, 1988).

*$p < .05$;

**$p < .01$;

***$p < .001$

Table 5

Predictors of Expressive and Receptive Language at 3 Years of Age

	Mullen Scales of Early Learning (n = 198)												
	Expressive T						Receptive T						
	r	R^2	ΔR^2	β	Sr^2	Effect size (f^2)[a]	r	R^2	ΔR^2	β	Sr^2	Effect size (f^2)[a]
Model 1: CSBS BS Age & Maternal Education		.08***				.09		.12***				.14
CSBS Age	−.16*			−0.15*	.02	.02	.20**			−.20**	.04	.05
Maternal Education	.24**			0.24**	.06	.07	.28***			.28***	.08	.09
Model 2: CSBS BS Age, Maternal Education, & LDS		.32***	.24			.35		.31***	.19***			.28
CSBS Age	−.16*			−.03	---	---	.20**			−.09	.01	.01
Maternal Education	.24**			.22***	.05	.07	.28***			.26***	.07	.10
LDS	.52***			.50***	.24	.35				.45***	.19	.28
Model 3: CSBS Age, Maternal Education, LDS, & CSBS CQ		.38***	.07			.11		.42***	.11***			.21
CSBS Age	−.16*			−.03	---	---	.20**			−.09	.01	.02
Maternal Education	.24**			.17***	.03	.05	.28***			.19***	.04	.07
LDS	.52***			.47***	.08	.13				.35***	.05	.09
CQ-Social	.34***			.02	---	---	.39***			−.02	---	---
CQ-Speech	.45***			−.18	.01	---	.46***			−.17	.01	.02

		Mullen Scales of Early Learning (*n* = 198)												
		Expressive T							Receptive T					
		r	R^2	ΔR^2	β	Sr^2	Effect size (f^2)[a]		*r*	R^2	ΔR^2	β	Sr^2	Effect size (f^2)[a]
	CQ-Symbolic	.51***			.33**	.04	.06		.58***			.43***	.07	.12
Model 4: CSBS Age, Maternal Education, LDS, CSBS CQ, & CSBS BS				.05			.08			.49***	.09***			.18
	CSBS Age	−.16*			−.03	---	---		.20***			−.08	.01	.02
	Maternal Education	.24**			.15**	.02	.03		.28***			.17**	.03	.06
	LDS	.52***			.38***	.04	.06					.23*	.02	.04
	CQ-Social	.34***			−.01	---	---		.38***			−.03	---	---
	CQ-Speech	.45***			−.19	---	---		.42***			−.17	.01	.02
	CQ-Symbolic	.51***			.22*	.01	.02		.58***			.28**	.03	.06
	BS-Social	.43***			.14	.01	.02		.52***			.19**	.02	.04
	BS-Speech	.46***			.08	---	---		.49***			.11	---	---
	BS-Symbolic	.48***			.17*	.02	.03		.56***			.21**	.03	.06

Note. LDS=Language Development Survey. CSBS=Communication and Symbolic Behavior Scales. CQ=CSBS Caregiver Questionnaire. BS=CSBS Behavior Sample. CSBS Standard Scores: $M = 10$; $SD = 3$.

[a] Effect size $f^2 = sr^2/(1 - R^2)$ for individual predictors; $f^2 = \Delta R^2/1 - R^2$ for R^2 change; $f^2 = R^2/(1-R^2)$ overall; small $f^2 = .02$, medium $f^2 = .15$, and large $f^2 = .35$ (Cohen, 1988).

* $p < .05$;

** $p < .01$;

*** $p < .001$.