Prelinguistic Predictors of Language Outcome at 3 Years of Age

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Purpose: The purpose of this study was to examine the predictive validity of a collection of prelinguistic skills measured longitudinally in the 2nd year of life to language outcome in the 3rd year in children with typical language development.
Method: A collection of prelinguistic skills was assessed in 160 children early (M = 14.31 months; SD = 1.36) and late (M = 19.76 months; SD = 1.16) in their 2nd year by using the Communication and Symbolic Behavior Scales Developmental Profile Behavior Sample (A. Wetherby & B. Prizant, 2002). The relation between the prelinguistic skills and the receptive and expressive language near the 3rd birthday was examined.
Results: Significant correlations were observed between many prelinguistic skills and language outcome. Regression analyses indicated that comprehension both early and late contributed unique variance to receptive and expressive language outcome. In addition, early in the 2nd year, inventory of conventional gestures contributed uniquely to receptive language outcome, and acts for joint attention contributed uniquely to expressive outcome. Late in the 2nd year, inventory of consonants contributed uniquely to expressive outcome.
Conclusions: The findings demonstrate continuity between prelinguistic and linguistic skills and how individual differences in a number of prelinguistic skills contribute collectively and uniquely to language outcome in typically developing children.

KEY WORDS: prelinguistic communication, language development, early predictors

The study of prelinguistic predictors of language outcome is essential to our understanding of the course of language development. Identifying a collection of predictors that has strong relations with language outcome contributes to conceptualizing models of language development by elucidating the relative importance of the underpinnings of language. In addition, identifying these predictors is essential for improving early identification of children who may be at risk for poor language outcomes (Wetherby, Goldstein, Cleary, Allen, & Kublin, 2003). There is still uncertainty about the age at which accurate predictions of language outcome can be made. However, given the growing consensus that earlier intervention with at-risk children leads to better language outcomes (Guralnick, 2001), continued research to increase understanding of early predictors is needed.

This study focused on prelinguistic skills demonstrated by children in the second year of life. The prelinguistic communication stage refers to the "period of development before a child has a linguistic system for acquiring language" (Wetherby, Warren, & Reichle, 1998, p. 4), thus spanning intentional preverbal communication and the transition to first words. Children move into linguistic communication when they develop a generative semantic system evident in the production of creative word

combinations; vocabulary growth accelerates rapidly (Bates, O'Connell, & Shore, 1987; Wetherby, Reichle & Pierce, 1998). In this article, the term *prelinguistic skills* is used to refer to intentional preverbal communication skills and the beginning use of single words.

The prelinguistic period during the second year of life is an important stage of development for considering early predictors of language outcome. An infant's first birthday and ensuing months of the second year have been referred to as a "social–cognitive revolution" (Carpenter & Tomasello, 2000, p. 40) during which many social and cognitive skills emerge and develop. These skills include the emergence of the ability to follow another's line of regard (responding to joint attention) and to initiate communication for a variety of functions such as behavior regulation, joint attention, and social interaction (Bruner, 1981; Wetherby, Cain, Yonclas, & Walker, 1988). According to the social pragmatic theory of language acquisition, language emerges in the second year because it requires a special application of the emerging social–cognitive skills to understand the communicative intentions of adults (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Carpenter & Tomasello, 2000). Mundy and Gomes (1997) stated that early "nonverbal skills and their underlying social–cognitive structures reflect a unique component of the prelinguistic psychological foundation requisite to language development" (p. 109).

The study of the predictive significance of individual differences in language acquisition research has a rich historical tradition exemplified in the work of Bates and colleagues in the 1970s (e.g., Bates et al., 1979). This has been termed a *skills approach* and is considered particularly suited to investigating links between social and communication skills and language acquisition (Mundy & Gomes, 1997). Individual differences in a number of prelinguistic skills in the second year have been found to predict later language skills. A brief review of findings from studies of prelinguistic skills of typically developing children in the second year of life follows.

Social Communication Skills

Joint attention. One of the social communication skills most studied in terms of its predictive relation with language outcome is joint attention, defined as the ability to coordinate attention between people and objects for social purposes (Tomasello, 1988). This is typified in behaviors such as following the direction of an adult's gaze or point (responding to joint attention) and pointing or showing an object for the purpose of drawing another's attention to an object or event (initiating joint attention). Aggregated differences in responding-to-joint-attention skills across the 6- to 18-month period have been found to predict receptive and expressive vocabulary at 30 months in typical infants (Morales et al., 2000); individual correlations at 6, 10, and 15 months were moderate in size. Morales et al. demonstrated that individual differences in responding to joint attention in typical children older than 18 months of age no longer predicted language, indicating a clear developmental change in predictive strength over the second year of life. Initiating bids for joint attention and for behavior regulation between 14 and 17 months have been found to predict expressive language outcome 4 months later (r = .51 and r = .49, respectively) in typical children (Mundy & Gomes, 1998).

Gestures. Most studies examining the relation between gestures and language have examined these concurrently (see Thal & Tobias, 1994, for a review). Large concurrent correlations have been observed between parental reports on the MacArthur Communicative Development Inventory of gestures and language comprehension (r = .54), but not between gestures and language production (r = .28) between 8 and 16 months of age (Fenson et al., 1994). This pattern of relations is in part a natural reflection of the order in which these skills emerge; however, Fenson and colleagues suggest that gestures may serve as a bridge from understanding language to actively producing language in the second year. This is supported by findings showing that efforts to increase the use of gestures in hearing toddlers have led to increases in both receptive and expressive language skills in the second year of life (Goodwyn, Acredolo, & Brown, 2000).

Vocalizations and words. Stoel-Gammon (1991) found that the number of CV syllables at 12 months predicted the age at which first words were produced in typical infants. Furthermore, diversity of syllable and sound types from 6 to 14 months predicted performance on speech and language tests at 5 years of age (Stoel-Gammon, 1998), suggesting continuity in expressive skills from prelinguistic vocalizations to later expressive language. Fenson et al. (1994) also demonstrated strong continuity in productive vocabulary as measured by parent report from a mean age of 13.45 (SD = 1.71) to 20.15 (SD = 1.86) months of age and 20.26 (SD = 2.40) to 26.88 (SD = 0.62) months of age. These studies provide important information on the contributions of early sounds and words to later expressive language. However, research is needed to investigate the unique contributions of sounds and words in the second year to language outcome in the same sample of children.

Comprehension. Most studies indicating a relation between early comprehension skills in the second year and later language skills have used parent report. Strong evidence of continuity in vocabulary comprehension as measured by parent report on the MacArthur Communicative Development Inventory was shown for 62 children from a mean age of 9.91 months (SD = 0.72) to a mean age of 16.34 months (SD = 0.81; Fenson et al., 1994). Parent-report measures of comprehension at

13 months have also been shown to predict both receptive vocabulary on the Peabody Picture Vocabulary Test—Revised (Dunn & Dunn, 1981) and grammatical complexity (mean length of utterance) at 28 months of age in typical infants (Bates, Bretherton, & Snyder, 1988). Few studies have found a relation between early comprehension assessed on observational measures and later language outcome. Direct observation of comprehension in experimental or laboratory testing has been criticized as unreliable in children under 2 years because of difficulty in ensuring the child's compliance to the task (Bates, 1993; Tomasello & Mervis, 1994).

Play. Play as an early predictor of language outcome has been of interest because it provides a context for language learning and is presumed to reflect a child's cognitive abilities (Bates et al., 1987; McCune, 1995). In their control group of 94 typical children, Lyytinen, Poikkeus, Laakso, Eklund, and Lyytinen (2001) found that symbolic play as measured by inventory of play actions at 14 months was significantly correlated with receptive language at 30 months (r = .39), as well as receptive vocabulary (r = .30) and comprehension of instructions (r = .28) at 42 months. However, symbolic play did not uniquely predict language outcomes in regression models that controlled for early comprehension on the MacArthur Communicative Development Inventory at 14 months and risk status (i.e., at risk for dyslexia vs. control group).

Communication and Symbolic Behavior Scales Developmental Profile

In light of the accumulating research on prelinguistic predictors of language outcome and the need to consolidate this information in clinical assessment tools for earlier identification of children at risk for language delays or disorders, Wetherby and Prizant developed the Communication and Symbolic Behavior Scales (CSBS; Wetherby & Prizant, 1993), followed by the CSBS Developmental Profile (CSBS DP; Wetherby & Prizant, 2002). As a shortened version of the original CSBS, the CSBS DP was designed to be an efficient evaluation procedure for early identification of communication disorders. The CSBS DP consists of (a) two parent-report measures called the Infant–Toddler Checklist and the Caregiver Questionnaire and (b) a direct observation measure called the Behavior Sample. The sampling and scoring procedures of the CSBS and the CSBS DP were based on the socialpragmatic model of language acquisition and on previous work by the authors (Wetherby et al., 1988; Wetherby & Rodriguez, 1992).

The CSBS DP Behavior Sample is a semistructured, interactive assessment designed to encourage a child to communicate by presenting a series of communication temptations and other sampling opportunities, including the presentation of a number of interesting toys, sharing books, language comprehension probes, and a play sample. The scoring procedures for the Behavior Sample consist of 20 individual items from which three composites were derived empirically based on factor analyses of the standardization sample: the Social, Speech, and Symbolic composites. The three composite scores of the CSBS DP Behavior Sample have been found to have good concurrent and predictive validity with mixed samples of children with typical development and children at risk for developmental delays (Wetherby, Allen, Cleary, Kublin, & Goldstein, 2002; Wetherby et al., 2003; Wetherby & Prizant, 2002). The composite scores also predicted significant proportions of receptive and expressive language outcomes at 2 years of age (Wetherby et al., 2002), and the total scores explained unique proportions of receptive and expressive language outcomes beyond the Infant–Toddler Checklist at 2 and 3 years of age (Wetherby et al., 2003). These findings suggest the benefits of direct behavior sampling, as well as the benefits of parent report and including a collection of prelinguistic variables to improve early identification of speech and language disorders in children under 2 years of age.

To date, studies of the CSBS DP have not yet examined the predictive validity of the individual items or constructs represented within the composite scores. Although the individual items have been shown to "hang together" theoretically and empirically within the three composite scores, individual items may have different abilities to predict later language skills, and predictive validity may change for individual items over time in the second year. In addition, no researchers have examined the predictive validity of the CSBS DP Behavior Sample items in a sample of children with typical development. This is important to document in order to understand how clinical populations may differ in their performance on these items. Therefore, the purpose of this study was to extend current research regarding prelinguistic predictors of language acquisition by investigating the predictive validity of individual items of the CSBS DP Behavior Sample as they reflect specific constructs, as well as the amount of variance in language outcome they account for both individually and collectively. This study included only children with typical language outcomes in order to compare the results to previous studies of processes underlying normal language acquisition and to provide additional normative data to which performance of clinical groups can be compared.

Method

Participants

Children with typical development were recruited from the ongoing, longitudinal FIRST WORDS Project. The FIRST WORDS® Project has screened approximately

1,000 children annually between 6 and 24 months of age for the past 5 years using the CSBS DP Infant–Toddler Checklist. The target population for screening is children who have not yet been identified as having a developmental delay, and therefore does not include children with obvious or significant developmental problems. Follow-up evaluations using the CSBS DP Behavior Sample have been conducted on at least 100 children per year between 12 and 24 months of age and then annually after 2 years of age to study the relations between prelinguistic communication skills measured under 24 months of age and later language skills. The participants for this study were drawn from the FIRST WORDS Project database according to the following criteria: (a) they had completed two Behavior Samples, one early in the second year between 12 and 16 months of age and the other late in the second year between 18 and 22 months of age, and (b) they had a follow-up language and developmental assessment in the third year with a majority near their third birthday and had scored 75 or above on the Learning Composite of the Mullen Scales of Early Learning (MSEL; Mullen, 1995). There were 160 children who met these selection criteria and were included in the study.

Participant characteristics and demographics are presented in Table 1. Outcome scores on the MSEL are given in *T* scores (*M* of 50 and *SD* of 10). The receptive and expressive language *T*-score means and standard deviations indicate language functioning in the average range. The socioeconomic indicators of mothers' and fathers' age and education were representative of the population in the area of Tallahassee, Florida. The racial composition of the children in this sample was slightly overrepresentative of Caucasian children compared with regional proportions.

Table 1. Participant characteristics and demographics of the sample (*N* = 160).

Characteristic	*M*	*SD*
Age at CSBS DP Behavior Sample		
Early sample	14.31	1.36
Late sample	19.67	1.16
Mullen Scales of Early Learning		
Chronological age (in months)	33.38	6.17
Receptive Language *T*	55.31	9.61
Expressive Language *T*	55.54	11.90
Nonverbal *T*	58.89	11.26
Socioeconomic indicators (in years)		
Mother's age	31.90	5.25
Mother's education	15.73	2.20
Father's age	34.94	5.99
Father's education	16.01	2.55
Gender (% male)	57.0	
Race/ethnicity (%)		
Caucasian	80.0	
African American	7.5	
Hispanic	5.6	
Asian	3.8	
Other	3.1	
Birth order (% first born)	45.0	

Note. CSBS DP = Communication and Symbolic Behavior Scales Developmental Profile.

Measures of Prelinguistic Skills

All prelinguistic skills were measured from the Behavior Sample of the CSBS DP. For this study, individual items reflecting specific prelinguistic constructs from each of the three composites that have been found to be associated with language outcome were selected for analysis. The following items were studied.

Social Composite Skills

Gaze point follow. This is a measure of the ability to follow the regard of another person's gaze and point at a distance. It is also referred to as responding to joint attention. Two probes were presented during which the adult said "look" and looked at and pointed to a picture on the wall, one to the side of the child and one behind the child. The raw score is the number of times that the child looked where the clinician was pointing, and it ranges from 0 to 2. As there are only two opportunities for the child to follow a gaze and point in the standardized administration of the Behavior Sample, this subscale may have limited power to demonstrate a range of variability in this sample. However, it has been shown to be sensitive to change (Wetherby & Prizant, 2002) and was included to reflect the skill of responding to joint attention.

Acts for joint attention. Joint attention is a measure of a child's use of a vocal or gestural communicative signal to direct another person's attention to an object or event to get the other person to look at or notice something of interest. The raw score is the number of activities in which the child communicated for joint attention out of six activities, and it ranges from 0 to 6.

Acts for behavior regulation. Behavior regulation is a measure of a child's use of a vocal or gestural communicative signal to regulate the behavior of another person to request or protest an object or action. The raw score is the number of activities during which the child communicated for behavior regulation out of six activities, and it ranges from 0 to 6.

Acts for social interaction. This is a measure of a child's use of a vocal or gestural communicative signal to draw another person's attention to him- or herself to get the other person to look at, notice, or comfort him or her. The raw score is the number of activities during which

the child communicated for social interaction out of six activities, and it ranges from 0 to 6.

Inventory of gestures. This is a measure of gestural communicative means to express intentions and consists of the number of different conventional gestures used by a child during the sample out of eight possible (e.g., give, show, point, reach, wave), and the raw score ranges from 0 to 8.

Speech Composite Skills

Inventory of consonants. This is a measure of vocal communicative means to express intentions and consists of the number of different consonants produced during the sample out of 10 possible, and the raw score ranges from 0 to 10.

Inventory of words. This is a measure of verbal communicative means to express intentions and consists of the number of different words (i.e., forms that are used referentially and that approximate conventional words, spoken or signed) used during the sample out of 16 possible, and the raw score ranges from 0 to 16.

Inventory of word combinations. This measure consists of the number of different word combinations used during the sample out of eight possible, and the raw score ranges from 0 to 8.

Symbolic Composite Skills

Comprehension. Comprehension is a measure of symbolic capacity to understand single words without gestural cues. Probes were presented during which the adult said "give me" or "show me" up to three different object names, two different person names, and three different body parts. The child identified each by touching, showing, or making a clear change in direction of gaze. The score used in this study is a sum of the number of object names out of three possible, person names out of two possible, plus body parts out of three possible, and it ranges from 0 to 8.

Symbolic play. This score consists of the number of play actions that a child used towards another person or object (e.g., Big Bird) during play up to a maximum of six possible, and it ranges from 0 to 6.

Internal Consistency Reliability

Internal consistency estimates for the composite scores of the Behavior Sample, made up of all the individual items, range from .86 to .89 (Wetherby & Prizant, 2002). As individual items were selected to reflect specific constructs in this study, it was not possible to calculate internal consistency estimates, but there was one exception. Internal consistency was calculated for comprehension, which consists of three subparts: comprehension of body parts, object names, and familiar person names. Consistency was found to be .70 both early and late in the second year. Because three items may not yield a valid measure of internal consistency, the interitem correlations were also calculated. The interitem correlations ranged from .33 to .54 early in the second year and from .39 to .59 late in the second year. Both of these estimates suggest satisfactory internal reliability of the comprehension measure.

Interrater Reliability

Interrater reliability on the CSBS DP was assessed as the Behavior Sample requires that raters make judgments about the occurrence or nonoccurrence of behaviors during ongoing interaction. Generalizability (g) or intraclass correlation coefficients were used to calculate interrater 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 participants and the raters and has been used in similar research (e.g., McCathren, Yoder, & Warren, 2000; McWilliam & Ware, 1994; Wetherby et al., 2002). A g coefficient approaches 1 as the variance accounted for by the participants is large in comparison with the variance accounted for by raters (Bakeman & Gottman, 1997), and coefficients of .6 or greater are considered acceptable for demonstrating interrater reliability (Mitchell, 1979). The g coefficients in Table 2 indicate that the CSBS DP raters exhibited high interrater reliability for the measures used in this study.

Measure of Language Outcome

Language outcome was assessed at a mean age of 33.38 months (SD = 6.17) using the receptive and

Table 2. Generalizability (g) coefficients for the predictor variables measured on the CSBS DP.

Behavior sample item	Rater 2 (n = 56)	Rater 3 (n = 53)	Rater 4 (n = 25)
Gaze point follow	.90	.94	.82
Acts for joint attention	.91	.89	.89
Acts for behavior regulation	.89	.91	.78
Acts for social interaction	.93	.86	.88
Inventory of gestures	.94	.90	.93
Inventory of consonants	.91	.94	.95
Inventory of words	.96	.95	.94
Inventory of word combinations	.93	.89	.91
Comprehension	.98	.97	.99
Symbolic play	.96	.97	.98

expressive language *T* scores of the MSEL. The Receptive Language Scale consists of 33 items targeting understanding of verbal directions; auditory spatial and auditory quantitative concepts; memory for one, two, and three 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 regards to reliability, the MSEL shows good internal consistency estimates ranging from .76 to .86 for the Receptive Language Scale for the age groups relevant to this study and .88 to .91 for the Expressive Language Scale. There was high interscorer reliability of .95 for the Receptive Scale and .98 for the Expressive Scale.

Results

All correlational and regression analyses controlled for age at the time of the CSBS DP Behavior Samples to control for the sensitivity of the CSBS DP in detecting change in raw scores over short periods of time (Wetherby & Prizant, 2002). The mean scores for the early and late prelinguistic measures and paired *t* statistics measuring the difference between the early and late scores are reported in Table 3. The children's mean scores early in the second year indicate that they were communicating intentionally for a variety of functions mainly with gestures and some vocalizations with consonants, but very few words. The majority of the children (64.4%) used no words in the behavior sample, while 25.0% used one to two single words and 10.6% used three or more different single words. Only 2 children used one or two combinations of two words. On average, the children understood about two words in the decontextualized comprehension probes ($M = 1.86$; $SD = 2.17$). These means characterize the children early in the second year as functioning in the prelinguistic communication stage spanning intentional preverbal communication, with some children transitioning to first words.

The paired *t* tests indicate that scores on all measures increased significantly from early to late in the second year, with large effects noted for the inventories of gestures, consonants, and words, as well as comprehension and symbolic play. Most of the children (90.6%) used one or more single words in the late Behavior Sample. Of the 90.6% who used words, 23.8% used one to two single words and 66.8% used three or more single words. The mean number of word combinations remained below one, and 78.8% of the children did not produce any word combinations during the Behavior Sample. The children comprehended an average of five words in the decontextualized comprehension probes. These means at the late assessment characterize the children as functioning in the late prelinguistic stage with consistent use of single words, which is characteristic of the transition to linguistic communication. The distributions of inventory of word combinations early and late in the second year were positively skewed because of a floor effect; therefore, this variable was not included in any subsequent analyses.

The concurrent correlations among the predictors both early and late in the second year are presented in Table 4. These correlations indicate that many of the prelinguistic skills were correlated with one another concurrently, suggesting a large amount of shared variance. Early in the second year, inventory of gestures was significantly correlated with all other measures. Acts for

Table 3. Mean scores, paired *t* statistic, and partial correlations for early and late prelinguistic skills ($N = 160$).

	Early (14.31 months)		Late (19.67 months)		Mean differences		
Behavior sample item	*M*	*SD*	*M*	*SD*	*t*(159)	*p*	*d*
Gaze point follow	1.32	0.79	1.79	0.48	7.41***	.000	0.59
Acts for joint attention	3.11	1.89	4.24	1.55	7.33***	.000	0.58
Acts for behavior regulation	5.06	1.31	5.59	0.61	4.95***	.000	0.40
Acts for social interaction	1.57	1.47	2.56	1.88	5.48***	.000	0.43
Inventory of gestures	3.84	1.52	5.18	1.38	11.61***	.000	0.92
Inventory of consonants	2.18	1.85	4.79	2.37	16.18***	.000	1.28
Inventory of words	0.84	1.60	6.47	5.58	13.81***	.000	1.09
Inventory of word combinations	0.01	0.11	0.77	1.88	5.08***	.000	0.40
Comprehension	1.86	2.17	5.31	2.47	17.46***	.000	1.38
Symbolic play	1.56	1.47	3.34	1.48	12.62***	.000	1.00

Note. Effect size $d = \Delta M / SD_{pooled}$; small $d = .20$, medium $d = .50$, and large $d = .80$ (Cohen, 1988).

***$p < .001$.

Table 4. Concurrent correlations among early and late predictors in the second year ($N = 160$).

Behavior sample item	1	2	3	4	5	6	7	8	9
1. Gaze point follow		.10	.10	−.11	.17	.11	.18	.25	.21
2. Acts for joint attention	.33***		.16	.00	.38***	.52***	.52***	.30***	.14
3. Acts for behavior regulation	.32***	.33***		.03	.29***	.11	.12	.05	.12
4. Acts for social interaction	.12	.01	.07		.25	.17	.17	.17	.11
5. Inventory of gestures	.46***	.41***	.46***	.33***		.47***	.43***	.26	.19
6. Inventory of consonants	.25	.47***	.32***	.20	.40***		.75***	.27	.16
7. Inventory of words	.23	.29***	.14	.12	.38***	.61***		.42***	.28***
8. Comprehension	.29***	.33***	.13	.20	.30***	.34***	.35***		.28***
9. Symbolic play	.34***	.45***	.26	.03	.29***	.25	.19	.44***	

Note. Concurrent correlations among early predictors are under the diagonal. Concurrent correlations among late predictors are above the diagonal. All correlations control for age.

***$p < .001$ (Bonferroni-corrected p value).

joint attention were significantly correlated with all other measures except acts for social interaction, which was significantly correlated with few other measures. There were fewer significant concurrent correlations late in the second year. Acts for joint attention were significantly correlated after Bonferroni correction with inventory of gestures, consonants, and words and comprehension. Inventory of gestures, consonants, and words all significantly correlated with each other. Late comprehension also correlated significantly with late symbolic play and inventory of words.

Predictive correlations between the early and late prelinguistic skills are presented in Table 5. The partial correlations between the corresponding early and late item scores are highlighted in bold on the diagonal. Moderate and large correlations, which were significant following the Bonferroni correction, were observed between corresponding scores for early and late acts for joint attention, inventory of gestures, consonants, and words and comprehension. These correlations indicated significant continuity in individual differences in these skills over the second year. Small correlations were observed between the early and late scores of acts for behavior regulation and social interaction, suggesting little continuity in individual differences in these scores. Regarding the predictive correlations across different prelinguistic skills, gaze point follow, acts for joint attention and behavior regulation, inventory of gestures, and inventory of consonants early in the second year were all significantly correlated with inventory of consonants, words, and comprehension late in the second year. In addition, early comprehension also correlated with late inventory of words, while early symbolic play correlated with late comprehension. There were few significant predictive

Table 5. Predictive correlations between early and late predictors in the second year ($N = 160$).

	Late predictors								
Behavior sample item	1	2	3	4	5	6	7	8	9
Early predictors									
1. Gaze point follow	**.25**	.21	.17	.07	.23	.27	.35***	.36***	.32***
2. Acts for joint attention	.21	**.39*** **	.08	.00	.20	.31***	.42***	.48***	.13
3. Acts for behavior regulation	.22	.13	**.14**	.07	.27	.18	.30***	.30***	.23
4. Acts for social interaction	.05	.17	.06	**.09**	.20	.30***	.18	.17	.13
5. Inventory of gestures	.24	.33***	.17	.10	**.49*** **	.44***	.53***	.41***	.32***
6. Inventory of consonants	.12	.39***	.10	.13	.26	**.59*** **	.59***	.32***	.14
7. Inventory of words	.02	.22	.04	.13	.21	.42***	**.50*** **	.25	.21
8. Comprehension	.15	.17	−.01	.22	.18	.21	.35***	**.47*** **	.19
9. Symbolic play	.14	.13	.05	.00	.06	.15	.20	.31***	**.27**

Note. Predictive correlations between corresponding skills early and late in the second year are highlighted in bold on the diagonal. Correlations between different skills early and late in the second year are off the diagonal. All correlations control for age.

***$p < .001$ (Bonferroni-corrected p value).

Table 6. Correlations among early and late predictors and language outcome ($N = 160$).

	Early predictors and language outcome				Late predictors and language outcome			
	Receptive		Expressive		Receptive		Expressive	
Behavior sample item	*pr*	*p*	*pr*	*p*	*pr*	*p*	*pr*	*p*
Gaze point follow	.14	.076	.16	.046	.19	.018	.14	.088
Acts for joint attention	.31***	.000	.37***	.000	.19	.014	.35***	.000
Acts for behavior regulation	.24	.002	.24	.003	.14	.082	.09	.245
Acts for social interaction	.10	.200	.13	.108	.15	.064	.15	.062
Inventory of gestures	.33***	.000	.28***	.000	.25	.002	.23	.004
Inventory of consonants	.18	.021	.33***	.000	.25	.002	.43***	.000
Inventory of words	.19	.250	.25	.001	.31***	.000	.44***	.000
Comprehension	.41***	.000	.38***	.000	.54***	.000	.60***	.000
Symbolic play	.33***	.000	.19	.016	.09	.251	.12	.139

Note. All correlations control for age.

***$p < .001$ (Bonferroni-corrected p value).

correlations to late measures of gaze point follow, acts for behavior regulation and social interaction, and inventory of conventional gestures.

Partial correlations controlling for the effects of age at each Behavior Sample were calculated to determine the relations among the early and late prelinguistic skills and receptive and expressive language outcome. These partial correlations are provided in Table 6. Following the Bonferroni correction, only a subset of prelinguistic skills both early and late in the second year correlated significantly with language outcome. Early in the second year, acts for joint attention, inventory of gestures, and comprehension correlated significantly with both receptive and expressive outcome. In addition, symbolic play correlated with receptive outcome, and inventory of consonants correlated with expressive outcome. All significant correlations between early prelinguistic skills and outcome were moderate in size. Late in the second year, inventory of words and comprehension correlated significantly with both receptive and expressive outcome, while acts for joint attention and inventory of consonants were correlated with expressive outcome only. The correlations between late comprehension and language outcome were large in size.

Finally, a series of hierarchical regression analyses were conducted to calculate the collective and unique contributions of the subset of prelinguistic skills that had significant bivariate correlations with language outcome following Bonferroni correction, as indicated in Table 6. Thus, for receptive language outcome, this subset of prelinguistic skills consisted of acts for joint attention, inventory of gestures, comprehension, and symbolic play early in the second year, and inventory of words and comprehension late in the second year. For expressive language outcome, the subset of prelinguistic skills in the regression models consisted of acts for joint attention, inventory of gestures, inventory of consonants, and comprehension early in the second year, and acts for joint attention, inventory of consonants, inventory of words, and comprehension late in the second year. The contribution of these early and late subsets of prelinguistic skills to receptive and expressive language outcome was first examined separately. Those skills found to contribute uniquely to language outcome early and late in the second year were then examined in combination in the final set of regressions. The subsets of prelinguistic skills were entered into the regression models in the order of their developmental appearance: social followed by speech followed by symbolic composite prelinguistic skills. In each regression, the changes in R^2 as a result of adding each prelinguistic skill or set of prelinguistic skills were calculated at each step. The total R^2 and the unique contributions of the prelinguistic skills in the final models containing all skills were then considered. The effect size f^2 was calculated using the following formulae: $f^2 = \Delta R^2 / 1 - R^2$ for the change in total variance accounted for by the addition of a set of prelinguistic skills; $f^2 = sr^2 / 1 - R^2$ for the individual skills within the set, where sr^2 refers to the squared part (semipartial) correlations; and $f^2 = R^2 / 1 - R^2$ for the total set of prelinguistic skills. Cohen's (1988) benchmark figures for interpreting these effect sizes are as follows: small = .02, medium = .15, and large = .35.

The results of the regression predicting receptive language outcome from the subset of prelinguistic skills measured early in the second year are presented in Table 7. In the first model, the social prelinguistic skills as a set accounted for 15% of receptive language outcome, which is a medium effect size. Within this social set, both acts for joint attention and inventory of gestures

Table 7. Hierarchical regression results for early predictors of receptive language outcome ($N = 160$).

Sample items	R^2	ΔR^2	β	sr^2	f^2
Model 1: Social	.15***				.19
Acts for joint attention			.21*	.03*	.04
Inventory of gestures			.25**	.03**	.05
Model 2: Social + Symbolic	.24***	.09***			.12
Acts for joint attention			.10	.01	.01
Inventory of gestures			.18*	.02*	.03
Comprehension			.30**	.06**	.08
Symbolic play			.12	.01	.01

Note. Age was controlled for in all models. Effect size $f^2 = \Delta R^2/1 - R^2$ for R^2 change; $f^2 = sr^2/1 - R^2$ for individual predictors; small $f^2 = .02$, medium $f^2 = .15$, and large $f^2 = .35$ (Cohen, 1988).

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

contributed significant unique variance to outcome, each with small effect sizes. The subset of symbolic prelinguistic skills was then added in the second model. This set resulted in a significant change in total variance ($\Delta R^2 = .09$). In the final model, inventory of gestures and comprehension contributed unique variance to receptive language, each with small effects. The difference between the sum of the unique variances (10%) and the total variance explained by the full model (24%) indicates a substantial proportion of shared variance among the predictors in the model.

Table 8 presents the results of the regression predicting expressive language outcome from the subset of early prelinguistic skills. Similar to receptive language outcome, the social composite skills accounted for 16% of the variance in expressive language outcome. However, acts for joint attention was the only social composite skill contributing significant unique variance (7%) to expressive language outcome, a small effect. Adding the speech composite skill of inventory of consonants resulted in a significant change in R^2, and both acts for joint attention and inventory of consonants contributed unique variance to expressive outcome in this model. Comprehension was added in the final model, also resulting in a significant change in R^2 of .05. In this final model, acts for joint attention and comprehension early in the second year contributed unique variance to expressive outcome.

Table 8. Hierarchical regression results for early predictors of expressive language outcome ($N = 160$).

Sample items	R^2	ΔR^2	β	sr^2	f^2
Model 1: Social	.16***				.19
Acts for joint attention			.31***	.07***	.08
Inventory of gestures			.16	.01	.01
Model 2: Social + Speech	.18***	.02*			.02
Acts for joint attention			.25**	.04	.05
Inventory of gestures			.12	.01	.01
Inventory of consonants			.18*	.02	.02
Model 3: Social + Speech + Symbolic	.23***	.05**			.06
Acts for joint attention			.21*	.03*	.04
Inventory of gestures			.08	.00	.00
Inventory of consonants			.13	.01	.01
Comprehension			.26**	.05**	.06

Note. Age was controlled for in all models. Effect size $f^2 = \Delta R^2/1 - R^2$ for R^2 change; $f^2 = sr^2/1 - R^2$ for individual predictors; small $f^2 = .02$, medium $f^2 = .15$, and large $f^2 = .35$ (Cohen, 1988).

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

Table 9 presents the results of the regression predicting receptive language from the subset of late prelinguistic skills with significant correlations with language outcome, which were inventory of words and comprehension. Therefore, there were only two models in this

Table 9. Hierarchical regression results for late predictors of receptive language outcome ($N = 160$).

Sample items	R^2	ΔR^2	β	sr^2	f^2
Model 1: Speech	.10***				.11
Inventory of words			.33***	.09***	.10
Model 2: Speech + Symbolic	.31***	.21***			.30
Inventory of words			.11	.01	.01
Comprehension			.51***	.21***	.30

Note. Age was controlled for in all models. Effect size $f^2 = \Delta R^2/1 - R^2$ for R^2 change; $f^2 = sr^2/1 - R^2$ for individual predictors; small $f^2 = .02$, medium $f^2 = .15$, and large $f^2 = .35$ (Cohen, 1988).

***$p < .001$.

Table 10. Hierarchical regression results for late predictors of expressive language outcome (N = 160).

Sample items	R^2	ΔR^2	β	sr^2	f^2
Model 1: Social	.12***				.14
Acts for joint attention			.35***	.12***	.14
Model 2: Social + Speech	.23***	.11***			.14
Acts for joint attention			.13	.01	.01
Inventory of consonants			.20	.01	.01
Inventory of words			.26*	.02*	.03
Model 3: Social + Speech + Symbolic	.44***	.21***			.38
Acts for joint attention			.06	.00	.00
Inventory of consonants			.28**	.03**	.05
Inventory of words			.01	.00	.00
Comprehension			.52***	.21***	.38

Note. Age was controlled for in all models. Effect size $f^2 = \Delta R^2/1 - R^2$ for R^2 change; $f^2 = sr^2/1 - R^2$ for individual predictors; small f^2 = .02, medium f^2 = .15, and large f^2 = .35 (Cohen, 1988).

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

regression. In the final model, only comprehension contributed unique variance to receptive language, and this contribution (ΔR^2 = .21; f^2 = .30) approached the benchmark of a large effect (.35). The effect size of the total variance accounted for (R^2 = .31) was also large (f^2 = .45).

Table 10 presents the results of the regression calculating the contributions of the subset of prelinguistic skills late in the second year to expressive language outcome. Acts for joint attention in the first model contributed significant unique variance to outcome, with an effect size falling just short of the medium benchmark of .15. Adding the two speech composite skills in Model 2 resulted in a significant change in R^2, with inventory of words contributing uniquely to outcome with a small effect size. Adding the symbolic composite skill of comprehension in the final model also resulted in a significant change in R^2 with a large effect (f^2 = .38). In the final model, comprehension and, surprisingly, inventory of consonants rather than inventory of words contributed unique variance to expressive language outcome. The unique contribution of comprehension was large (f^2 = .38), and the total explained variance of Model 3 was very large (f^2 = .79). Again, the difference between the sum of the squared semipartials (sr^2) of .24 and the total variance accounted for by the final model of .44 indicates substantial shared variance among the predictors.

Finally, two regression analyses were run in which the unique predictors identified both early and late in the second year in the previous four regressions (see Tables 7–10) were entered in a single step: one for receptive and one for expressive language outcome. For receptive language outcome, this included inventory of conventional gestures and comprehension early in the second year and comprehension late in the second year. Together, these prelinguistic skills accounted for 35% of the variance in receptive language outcome. Comprehension both early and late contributed significant unique variance to receptive language with βs = .19 and .43, ps < .015 and .000, and f^2s = .04 and .19, respectively. For expressive language outcome, the unique predictors included in the model were acts for joint attention and comprehension early in the second year and inventory of consonants and comprehension late in the second year. These prelinguistic skills accounted for 45% of the variance in expressive language outcome. Only the late prelinguistic skills of inventory of consonants and comprehension contributed unique variance, however, with βs = .30 and .47, ps < .000 for both, and f^2s = .12 and .25, respectively.

Discussion

The purpose of this study was to examine the predictive validity of a collection of social, speech, and symbolic prelinguistic skills as measured on the CSBS DP Behavior Sample to later language competence in typical language learners. The results of this study confirm continuity of most skills from early to late within the prelinguistic period and from the prelinguistic to linguistic stages of language development. They suggest that the skills included in this study share a substantial amount of variance, but that some skills make significant unique contributions to language outcome. The main findings are discussed next in regard to the role of social, speech, and symbolic composite skills in predicting language outcome in typical children, which is followed by implications for the social pragmatic theory of language acquisition.

The Role of Social Composite Skills

The social composite skills measured in this study included gaze point follow; acts for joint attention, behavior regulation, and social interaction; and inventory of gestures. There were clear differences among these skills in their relation with language outcome. Early in the second year, both acts for joint attention and inventory of conventional gestures showed significant relations with receptive language outcome, although only the contribution of inventory of gestures remained significant once comprehension was added to the model. This finding is consistent with the close concurrent relation between parent-reported inventory of gestures and comprehension already identified (Fenson et al., 1994), and extends previous research by indicating that inventory

of conventional gestures as assessed by direct observation makes a unique significant contribution to later receptive language. Acts for joint attention contributed uniquely to later expressive language, after controlling for all other early prelinguistic skills with significant correlations with expressive outcome. The unique role of acts for joint attention in expressive language outcome is consistent with previous research (e.g., Mundy & Gomes, 1998). The contributions of early inventory of gestures to receptive outcome and early acts for joint attention to expressive outcome were no longer significant when predictors late in the second year were included in the final two regression analyses. Taken together with the significant correlations between early inventory of gestures and later comprehension, and early acts for joint attention and later inventory of consonants and comprehension indicated in Table 5, these findings suggest that both early inventory of gestures and acts for joint attention may influence later language outcomes through their impact on comprehension and inventory of consonants late in the second year.

Small relations between gaze point follow and language outcomes were observed, which may be due to the limited variance on this item in this sample of typical children. The small-to-moderate correlations between acts for behavior regulation and language outcome are probably related to a ceiling effect, particularly late in the second year. The correlations between acts for social regulation and language outcome were consistently small. The children scored low on this item on the whole, ruling out a ceiling effect, but perhaps suggesting that there were too few opportunities for them to demonstrate this skill in the Behavior Sample for individual differences to have predictive significance, which is a limitation of this item.

The Role of Speech Composite Skills

Both inventory of consonants and words early and late in the second year showed moderate-to-large significant correlations with expressive outcome. However, the regressions indicated that neither contributed unique variance to later expressive language until late in the second year when controlling for all other skills with significant correlations with expressive language. This does not appear to be the result of a floor effect of the CSBD DP scoring, except perhaps for inventory of words early in the second year.

An unexpected result was observed in the regression predicting expressive language from the late prelinguistic skills. In the second model, inventory of words contributed uniquely to outcome controlling for inventory of consonants. However, in the final model, inventory of words contributed no unique variance to outcome, while the contribution of inventory of consonants was significant. This result is consistent with Bates et al.'s (1988) three-strand model of language acquisition. In their study of the three-strand model, they detected an expressive language pathway, labeled the *second strand,* that was characterized by rote or imitative expressive language. Bates et al. found evidence for this rote output strand at 13 months with continuity to 20 months, but no further evidence of its existence at 28 months. What is particularly relevant to this study is that it was their laboratory observations of productive vocabulary, as opposed to their parental-report measures, that reflected this rote strand at 20 months of age. Bates et al. concluded that at 20 months,

> parent report seems to tap into what the child *knows,* variance which is in turn associated with an analytic approach to language from the earliest stages; observed vocabulary taps into what the child typically *does,* variance that plugs into the rote production strand of development. (p. 263)

Therefore, it is possible that the inventory of words item in the CSBS DP Behavior Sample also captured this rote expressive language, which would explain why it did not contribute any unique variance to the creative use of expressive language outcome as measured on the MSEL. Alternatively, although there were stable individual differences on the inventory of words item from early to late in the second year, this item may have been too limited as a measure of expressive vocabulary to be representative of the individual differences in expressive vocabulary present in these typically developing toddlers at 20 months of age.

The Role of Comprehension

The findings of this study suggest that comprehension throughout the second year of life plays an important role in both receptive and expressive language acquisition. This confirms previous accounts of continuity of individual differences in comprehension over time (Fenson et al., 1994), and indicates that this continuity begins very early in the language acquisition process. The relation between early comprehension and later expressive language skills extends previous findings of studies that have used parent-report measures (Bates et al., 1988; Fenson et al., 1994) and is consistent with the first strand of Bates and colleagues' three-strand model of language acquisition. This first strand is defined as the analytical mechanism responsible for comprehension and the flexible production of language (Bates et al., 1988). In their detailed analysis of this strand using both parent-report and laboratory measures of lexical and grammatical growth from 10 to 28 months of age, these researchers found that children high in early comprehension showed more advanced receptive and expressive grammatical skills at 28 months of age. Bates et al. concluded that "children who are high in comprehension,

using their repertoire of nouns in a flexible way, have reached insight into the idea that things have names" (p. 262). The MSEL used in this study also measures creative, analyzed expressive use of language that children already understand. The strong relation between comprehension measured both early and late in the second year in the Behavior Sample and expressive outcome on the MSEL suggests that it is possible to detect this first strand using the direct comprehension probes of the CSBS DP Behavior Sample.

The robust relation observed between comprehension in the second year and later language outcomes in this study is particularly noteworthy considering the widely acknowledged difficulties inherent in the direct assessment of comprehension early in life (Bates, 1993; Tomasello & Mervis, 1994). There are many reasons a child may not perform in experimental assessments of comprehension, including lack of compliance, which often result in low internal reliability of such measures (Bates, 1993). Despite these well-documented difficulties in measuring comprehension directly in the second year, the internal consistency of the Behavior Sample comprehension probes appeared to be satisfactory in this study, as indicated by the alpha values of .70 and the interitem correlations early and late in the second year. In addition, large correlations were observed in the standardization sample between the symbolic composite of the Behavior Sample, of which comprehension forms a part, and the symbolic composites of the parent-report tools of the CSBS DP, the Infant–Toddler Checklist ($r = .57$), and the Caregiver Questionnaire ($r = .58$), which provide further evidence of the validity of the Behavior Sample probes (Wetherby & Prizant, 2002).

The nature of the administration procedures of the comprehension probes may help explain their reliability and validity. The probes occurred in a supportive context created by the naturalistic sampling procedures that included the parent. Also, the comprehension probes were presented toward the end of the Behavior Sample, following a number of less demanding activities designed to promote spontaneous communication prior to expecting the child to comply with specific requests. Therefore, the child may have been more comfortable with the examiner and the assessment setting by the time the comprehension probes were administered. Finally, the probes tapped three content areas—familiar objects, body parts, and person names—which have been shown to emerge in the second year of life (Miller, Chapman, Branston, & Reichle, 1980; Wetherby & Prizant, 1993), as opposed to only object names. In summary, the internal consistency of the comprehension items and the significant predictive relations between comprehension and language outcome suggest that the CSBS DP comprehension probes are a reliable measure of comprehension in the second year of life, with strong evidence of predictive validity.

Social Pragmatic Theory of Language Acquisition

Taken together, these results are consistent with the social pragmatic theory of language acquisition, particularly as espoused by Tomasello (1988, 2001; Carpenter & Tomasello, 2000). This theory proposes that language skills emerge out of a child's nonverbal understanding of the world, which is developed during multiple shared social experiences in which the child's and adult's attention are jointly focused on events or objects. Tomasello (1988) suggested that early in the language acquisition process, these periods of joint attentional focus are especially important to scaffold the child into language. The current findings suggest that of all the social communication skills that emerge in typical children in this period, the two most important skills of the set measured in this study early in the second year were conventional gestures and acts for joint attention. These two particular skills may impact the behavior of caregivers by helping to establish and maintain these important periods of joint attentional focus in which caregivers are apt to provide rich verbal labels for the objects or events that correspond with the child's attentional focus (Goodwyn et al., 2000), which in turn has been shown to enhance children's early language acquisition (Tomasello & Farrar, 1986). Tomasello (2001) pointed out that once children have acquired some language, it is their language itself that becomes the primary device for further language learning. He proposed that by the time young children have caught on to the process of word learning and have begun to build their vocabularies, learning new words and increasing their initial vocabularies are not "wedded" to specific pragmatic cues such as gaze direction. The mean scores of the children in this study late in the second year indicated they did indeed have some language. Therefore, the finding that at this time only comprehension and inventory of consonants contributed unique variance to language outcome is consistent with this theoretical notion.

Clinical Implications

The findings of this study support those of experimental studies using detailed naturalistic and laboratory observational measures and parent report in other samples of children with typical development (Bates et al., 1988; Fenson et al., 1994). Findings suggest that similar patterns of individual differences can be detected by direct observation using the relatively brief but systematic observational methods used in the CSBS DP Behavior Sample. The findings provide evidence of the predictive validity of specific items of the Behavior Sample, adding to the previous studies showing predictive validity of composite measures (Wetherby et al., 2002, 2003). The

mean scores reported here provide additional normative information for individual items of the CSBS DP for children with typical language outcome, particularly on the inventory items that reflect the range of gestures, consonants, and words that typical language learners may be expected to produce during the Behavior Sample. These supplement the norms provided in the CSBS DP manual (Wetherby & Prizant, 2002) at two important age points in the second year of life.

Future Directions

Future research needs to examine the skills assessed in this study as well as the specific items of the CSBS DP Behavior Sample in children with disabilities to determine how profiles may differ in these populations. The study of children with developmental delays functioning in the prelinguistic stage of development who may be chronologically older than the children in this sample would be useful in determining if and how different developmental delays may influence the primary mechanisms of language acquisition. Investigations of prelinguistic predictors of language outcome in children with Down syndrome (Yoder & Warren, 2004), autism spectrum disorders (McDuffie, Yoder, & Stone, 2005; Wetherby, Watt, Morgan, & Shumway, in press), and developmental disabilities (Brady, Marquis, Fleming, & McLean, 2004) are beginning to address this important area. As mentioned, this study adopted a skills approach focusing on individual differences in the child only, and further research needs to consider how these results converge with studies of parent–child interaction and characteristics of parental responsiveness.

In conclusion, the findings of this study demonstrate patterns of continuity among prelinguistic and linguistic skills that support existing theoretical accounts of language acquisition. The findings provide empirical support for the rich theoretical interpretations of Bates et al.'s (1988) seminal work in language acquisition, but with a larger sample of children using a systematic clinical assessment procedure. Future research is important to further delineate patterns of functioning on these prelinguistic skills in children with atypical development in order to confirm whether the theoretical notions of language acquisition hold for all groups of children.

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