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Early Predictors of Communication Development in Young Children with Autism Spectrum Disorder: Joint Attention, Imitation, and Toy Play

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Abstract

This study investigated the unique contributions of joint attention, imitation, and toy play to language ability and rate of development of communication skills in young children with autism spectrum disorder (ASD). Sixty preschool-aged children with ASD were assessed using measures of joint attention, imitation, toy play, language, and communication ability. Two skills, initiating protodeclarative joint attention and immediate imitation, were most strongly associated with language ability at age 3–4 years, whereas toy play and deferred imitation were the best predictors of rate of communication development from age 4 to 6.5 years. The implications of these results for understanding the nature and course of language development in autism and for the development of targeted early interventions are discussed.

Keywords

Autism; Language; Communication; Joint attention; Imitation; Play

Introduction

It is well established that there is tremendous variability in outcome in autism. Long-term outcome studies have shown that while a majority of individuals exhibit poor to very poor outcomes, many individuals with autism go on to achieve adequate levels of academic, social, and occupational functioning (Gillberg & Steffenburg, 1987; Lotter, 1978; Nordin & Gillberg, 1998; Sigman & Norman, 1999). In a recent study that followed children with autism from age 2 to 9, as many as 40% were found to have good outcomes based on language and cognitive scores (Stone, Turner, Pozdol, & Smoski, 2003). One of the strongest predictors of positive long-term outcomes for children with autism is the acquisition of spoken language (Bartak, Rutter, & Cox, 1975; Gillberg, 1991; Gillberg & Steffenburg, 1987; Lincoln, Courchesne, Kilman, Elmasian, & Allen, 1988; Lotter, 1978; Rutter, 1970). Early language ability (i.e., meaningful speech by 5–6 years of age) has been associated with both later academic achievement and social competence in individuals with autism (Howlin, Mawhood, & Rutter, 2000; Sigman & Ruskin, 1999; Venter, Lord, & Schopler, 1992). Given the critical importance of early language development for later prognosis, a better understanding of developmental factors that underlie, facilitate, and

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predict language acquisition in autism would shed light on the nature of this disorder and allow for the refinement of targeted early interventions.

Early abilities that have been associated with the development of language and communication skills both in typically developing children and children with autism include joint attention, imitation, and toy play. Joint attention—shared attention between social partners in relation to objects or events—typically emerges by 9–12 months of age (Adamson & Bakeman, 1985, 1991; Adamson & Chance, 1998; Brooks & Meltzoff, 2002; Bruner, 1983; Butterworth & Jarrett, 1991; Carpenter, Nagell, & Tomasello, 1998), with some aspects emerging as early as 6 months of age (Morales, Mundy, & Rojas, 1998). By 12 months of age, most typical infants display all aspects of joint attention, including sharing attention (e.g., through the use of alternating eye gaze), following the attention of another (e.g., following eye gaze or a point), and directing the attention of another (Carpenter et al., 1998). Through joint attention interactions, the infant begins to link words and sentences with objects and events (Baldwin, 1995). Importantly, it is within the context of joint attention episodes that infants also begin to communicate intention by using sounds and gestures, such as reaching to request objects, and pointing and vocalizing to direct attention to objects. Joint attention skills correlate not only with early language learning, but also with later language ability in typically developing children (Carpenter et al., 1998; Meltzoff & Brooks, 2004; Morales et al., 1998, 2000; Mundy & Gomes, 1998).

Children with autism, however, show impairments in joint attention skills as compared to children with delayed and typical development (Bacon, Fein, Morris, Waterhouse, & Allen, 1998; Charman, 1998; Charman et al., 1998; Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Dawson et al., 2002a, 2004; Mundy, Sigman, Ungerer, & Sherman, 1986; Sigman, Kasari, Kwon, & Yirmiya, 1992). Impairments in protodeclarative joint attention behaviors—sharing attention for purely social purposes—appear to be more severe than impairments in protoimperative joint attention (e.g., requesting) behaviors in children with autism (Mundy et al., 1986; Mundy, Sigman, & Kasari, 1990; Sigman, Mundy, Sherman, & Ungerer, 1986). Further, in preschool age children with autism, joint attention is predictive of both current language ability, and future gains in expressive language skills (Bono, Daley, & Sigman, 2003; Charman et al., 2003; Dawson et al., 2004; Landry & Loveland, 1988; Mundy et al., 1990; Mundy, Sigman, Ungerer, & Sherman, 1987; Rogers & Hepburn, 2003; Sigman & Ruskin, 1999; Toth, Dawson, Munson, Estes, & Abbott, 2003). In a longitudinal study of social competence and language skills in children with autism and Down syndrome, Sigman and Ruskin (1999) found that protodeclarative joint attention skills were associated with early language ability for both groups, and predicted both short-term (i.e., 1 year later) and long-term (i.e., 8–9 years later) gains in expressive language ability for children with autism. Initiating protodeclarative joint attention in early childhood (3–6 years of age) was also correlated with later peer interactions (10–12 years of age). Further, protoimperative joint attention skills correlated with early language ability and short-term, but not long-term, gains in expressive language for children with autism. In a recent intervention study that targeted joint attention skills, young children with autism showed greater gains in language 12 months post-treatment compared to controls (Kasari, Freeman, & Paparella, 2004). It may be that joint attention ability lays a foundation not only for the development of language, but also other complex abilities such as pretend play and theory of mind, as argued by developmental theorists (Bruner, 1983; Carpenter et al., 1998; Meltzoff, 2005; Meltzoff & Brooks, 2001) as well as in the literature more specifically focusing on children with autism (Charman, 1997, 2003; Mundy & Crowson, 1997; Sigman, 1997).

Motor imitation ability has also been associated with the development of language and social communication skills. In typically developing infants, the ability to imitate is present at birth. Neonates are able to imitate simple facial movements, such as tongue protrusion and mouth opening (Meltzoff & Moore, 1977, 1997). By 9 months of age, infants are able to imitate actions on objects, both in immediate and deferred contexts (Carver, 1995; Meltzoff, 1988a). Infant imitation appears to serve several general functions, providing the child with shared social experiences, a sense of mutual connectedness, and a means of communication between social partners (Meltzoff, 2005; Trevarthen, Kokkinaki, & Fiamenghi, 1999). Through imitation, infants also learn about others' actions and intentions (Meltzoff, 1999; Uzgiris, 1981, 1999). Deferred imitation serves to index infant recall memory and the child's ability to produce actions based on stored mental representations of social events and action sequences (Klein & Meltzoff, 1999; Meltzoff, 1988b). It has been theorized that a failure to engage in early social imitative play may interfere with the development of joint attention, social reciprocity, and later theory of mind abilities (Dawson, 1991; Meltzoff, 1999, 2005; Meltzoff & Gopnik, 1993; Rogers & Pennington, 1991). Imitation not only plays an important role in early social development, but has also been shown to predict language ability in typically developing children (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979).

While typically developing children demonstrate the ability to imitate others from birth, children with autism demonstrate significant impairments in object imitation, imitation of facial and body movements, and deferred imitation of actions on objects (Charman, 1997; Dawson et al., 1998; Rogers, Bennetto, McEvoy, & Pennington, 1996; Rogers, Hepburn, Stackhouse, & Wehner, 2003; Sigman & Ungerer, 1984; Stone, Ousley, & Littleford, 1997). In children with autism, imitation skills have been found to correlate with early language ability (Dawson & Adams, 1984) and to predict later language ability (Charman et al., 2000, 2003; Stone et al., 1997; Stone & Yoder, 2001). In a recent study, immediate imitation of actions on objects at 20 months correlated with receptive language at 42 months in a small sample of children with autism (Charman et al., 2003). In a similar study, motor imitation at 24 months predicted expressive language ability at 48 months, even after controlling for initial language level, in young children with autism (Stone & Yoder, 2001).

Play—both functional and symbolic—is a third skill domain that has been associated with language and social communication ability. Play provides the child with opportunities for social interaction and social communication, as well as a context for constructing representations of intentional states and knowledge (Bloom, 1993; Lifter & Bloom, 1989, 1998; Piaget, 1952). In typical development, functional, or pre-symbolic, play emerges during the first year, while symbolic play begins to emerge around 1 year of age and becomes increasingly complex over the second year of life. Both functional and symbolic play skills have been shown to correlate with language ability in typical children (Bates et al., 1979; McCune, 1995; Ungerer & Sigman, 1984). Symbolic play is correlated with both receptive and expressive language ability (Clift, Stagnitti, & Demello, 1988; Doswell, Lewis, Boucher, & Sylva, 1994; Lewis, Boucher, Lupton, & Watson, 2000), while functional play is correlated with expressive language level in preschool age children (Lewis et al., 2000). Longitudinal studies have also demonstrated a relation between early play skills and later language ability (McCune, 1995; Ungerer & Sigman, 1984). Ungerer and Sigman (1984) demonstrated that functional play at 13 months correlated with language ability at 22 months. Bates et al. (1979) found that both combinatorial (i.e., manipulative) and symbolic play correlated with gains in language from 9 to 13 months of age, with manipulative play predicting both receptive and expressive language abilities through the 9–13 month period, while symbolic play was related more to expressive language and was a stronger predictor toward the end of the 9–13 month period. McCune (1995) demonstrated that first word acquisition was associated with the emergence of symbolic play, both self-pretend (e.g., drinking from an empty cup) and other-pretend play (e.g., giving a stuffed animal a drink), and that combining actions in symbolic play (e.g., drinking from an empty cup, then giving a doll a drink) was associated with the onset of combining words.

In contrast to typically developing children, children with autism show specific impairments in symbolic play as early as 18 months of age relative to children with delayed and typical development (Baron-Cohen et al., 1996; Charman et al., 1998; Dawson et al., 1998; Mundy et al., 1987; Ungerer & Sigman, 1981; Wing & Gould, 1979). When children with autism do acquire symbolic play skills, their level of symbolic play tends to remain below that of their language level (Amato, Barrow, & Domingo, 1999; Ungerer, 1989; Wing, 1978) and is often less diverse and elaborate compared to that of developmentally delayed and typical children (Ungerer & Sigman, 1981). Associations between play and language have also been demonstrated in young children with autism. Mundy et al. (1987) found that, at 3–6 years of age, receptive language ability correlated with functional play involving a doll, and both expressive and receptive language skills correlated with symbolic play. Sigman and Ruskin (1999) demonstrated that, in 3–6-year-old children with autism, both functional and symbolic play in early childhood correlated with early language ability, and functional play correlated with long-term (i.e., 8–9 years later) gains in expressive language. A recent intervention study that targeted symbolic play skills found that young children with autism showed greater gains in language 12 months post-treatment compared to controls (Kasari et al., 2004).

Although correlational and longitudinal research have demonstrated that joint attention, imitation, and play are associated with the development of language and communication skills in children with autism, the present study represents a unique contribution in two ways: First, the contributions of each of these three early abilities—joint attention, imitation, and toy play—were simultaneously examined as predictors of current language ability in a large sample of preschool age children with autism. Second, growth curve modeling was used to examine the relationship between these early skills and rate of development of communication skills across the preschool and early school age years in children with autism.

Method

Participants

Sixty children with autism spectrum disorder (ASD), comprised of 42 children with Autistic Disorder and 18 children with Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS), participated in the study. Participants were recruited from local parent advocacy groups, public schools, clinics, hospitals, and the Washington State Division of Developmental Disabilities. Exclusionary criteria included the presence of a neurological disorder of known etiology, significant sensory or motor impairment, major physical abnormalities, and history of serious head injury and/or neurological disease. Table 1 presents demographic and descriptive information, including gender, socioeconomic status, chronological age, composite mental age and IQ, and verbal age equivalents for the children who participated in the study. At the beginning of the study, children ranged in age from 34 to 52 months and were followed until 65 to 78 months of age. Ethnicity for the sample was as follows: 43 European-American, 3 African-American, 11 Multi-racial, and 3 Asian/Pacific Islander. Twelve children (20%) displayed an expressive language age equivalence of 36 months or higher on the Mullen Scales of Early Learning. Based on the ADI-R, 20 children were reported to have lost some level of spontaneous, meaningful communicative speech. Eighty-two percent of mothers had some college or a college degree.

Diagnosis of autism was based on the Autism Diagnostic Interview—Revised (ADI-R; LeCouteur, Lord, & Rutter, 2003; Lord, Rutter, & LeCouteur, 1994) and the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000; Lord, Rutter, DiLavore, & Risi, 1999; Lord, Rutter, Goode, & Heemsbergen, 1989). Both instruments assess the symptoms of Autistic Disorder listed in the Diagnostic and Statistical Manual of Mental Disorders, 4th ed. (DSM-IV; American Psychiatric Association, 1994). In addition, clinicians made a clinical judgment of diagnosis based on presence/absence of autism spectrum symptoms as defined in the DSM-IV. Diagnosis of autism was defined as meeting criteria for autism on the ADOS and autism spectrum on the ADI-R and meeting DSM-IV criteria for Autistic Disorder based on clinical judgment. In addition, if a child received a diagnosis of autism on the ADOS and based on DSM-IV clinical diagnosis, and came within 2 points of meeting autism spectrum criteria on the ADI-R, the child was also considered to have autism. Diagnosis of PDD-NOS was defined as meeting criteria for autism spectrum on the ADOS and on the ADI-R, or missing criteria on the ADI-R by 2 or fewer points, and meeting DSM-IV criteria for PDD-NOS based on clinical judgment.

Procedure

The following measures were gathered over the course of three or more sessions when children were 3–4 years old. Each child was individually tested while seated at a table. The child's parent remained in the room, seated behind the child or at the table with the child on the parent's lap. Children were given food snacks and praise as reward for sitting at the table when necessary and provided breaks as needed. The ADOS, ADI-R, and Mullen Scales of Early Learning: AGS Edition (Mullen, 1997) were administered during the child's first laboratory visit, the Early Social Communication Scales (ESCS) was administered during the second visit, and experimental assessments of imitation and functional and symbolic toy play were administered during subsequent visits. The Vineland Adaptive Behavior Scales: Survey Form (Sparrow, Balla, & Cicchetti, 1984) was administered to the parent(s) in person when the child was 3–4 years of age, and every 6 months thereafter by phone up to 6 years, 6 months of age.

Predictor Variables

The Early Social Communication Scales (ESCS; Mundy, Delgado, Hogan, & Doehring, 2003; Seibert & Hogan, 1982) was used to measure both protodeclarative and protoimperative joint attention behaviors. In this procedure, the child was seated at a table across from a familiar examiner. A set of toys including a hat, comb, pair of glasses, book, ball, car, wind-up and hand-operated toys, and a plastic jar was in view, but out of reach of the child. Three wall posters hung 90 degrees to the child's right and left, and 180 degrees behind the child. The examiner presented a sequence of wind-up and hand-operated toys, activating each three times per trial (6 trials). Intermittently, the examiner attracted the child's attention, then turned to point and gaze at each poster while calling the child's name three times (2 trials of 3 probes each), made simple gestural and verbal requests of the child (“Give it to me”), and presented the child with turn-taking opportunities, consisting of a tickle game (2 trials), taking turns with an object (2 trials), and taking turns wearing a hat, comb, and glasses (3 trials). The examiner also gave the child the opportunity to look at pictures in a book and follow the examiner's point (1 trial). This 20-min structured assessment was videotaped from behind a one-way mirror to include a full view of the child and a profile view of the examiner. Behavioral ratings were made from the videotapes by trained observers blind with respect to diagnosis (these same observers also coded tapes of children with delayed and typical development as part of a larger study) and hypotheses. A more complete discussion of the ESCS procedure is available elsewhere (Mundy et al., 2003).

Initiating and Responding to Protodeclarative Joint Attention—Behavioral observations from the 20-min ESCS procedure yielded scores in two categories of protodeclarative joint attention. Initiating Protodeclarative Joint Attention could occur at any time during the assessment and consisted of the number of times the child used eye gaze, alternating eye gaze, showing, and/or pointing behaviors to direct and/or share attention with the examiner with respect to an active toy. Responding to Protodeclarative Joint Attention was the percentage of six trials on which the child accurately oriented with eyes and/or head turn beyond the examiner's finger and in the direction of the examiner's point and gaze to the posters.

Initiating Protoimperative Joint Attention—A frequency score was obtained for Initiating Protoimperative Joint Attention based on observations from the ESCS, which could occur at any time during the assessment and consisted of the number of times the child used eye gaze, reaching with coordinated eye gaze, pointing, and/or giving to request a toy or to request help. Dyadic behaviors (e.g., a reach without coordinated eye contact) were not included in this category.

Reliability of the behavioral coding of the ESCS task occurred in two phases. First, initial reliability was assessed by independent paired ratings using 15 taped ESCS sessions provided by Peter Mundy. Each of five raters (undergraduate research assistants) independently coded the 15 tapes and these ratings were then compared to those obtained by Peter Mundy using intra-class correlation coefficients. The coefficients for the three variables used in the present study—initiating and responding to protodeclarative joint attention and initiating protoimperative joint attention—ranged from .83 to .94. After achieving this initial reliability, the five raters then began coding data for the study using a detailed coding manual developed by the first author based on conversations with Mundy and staff that occurred during the process of obtaining initial reliability. A second phase of reliability was assessed using independent paired ratings made from videotapes for a randomly selected group of participants (10% of total sample). Intra-class correlation coefficients for this second phase of reliability were .80 for initiating protodeclarative joint attention, .75 for responding to protodeclarative joint attention, and .86 for initiating protoimperative joint attention.

Imitation and Deferred Imitation—Immediate and deferred motor imitation abilities were assessed based on a battery developed by Meltzoff (1988a, b) and previously used with children with autism (Dawson et al., 1998) and Down syndrome (Rast & Meltzoff, 1995). The battery consisted of 10 motor imitation items administered in 2 blocks, 5 immediate and 5 deferred. Items involved simple actions on novel objects, such as pressing a light panel with one's forehead, hitting two red blocks together, and inverting and collapsing a camping cup. Block order was counterbalanced and order of presentation of specific items within each block was randomly determined. The child was seated at a table across from a familiar examiner. After gaining the child's attention, the examiner demonstrated each target action 3 times in about 20 s. In the immediate condition, after demonstrating all 5 actions, the examiner then handed the object(s) to the child one at a time and said, “It's your turn.” No other verbal or physical prompts were used to elicit a response. In the deferred condition, after demonstrating all 5 actions, a 10-min delay was introduced during which the child was escorted out of the test room. After the delay, the child returned to the test room and the examiner handed the object(s) to the child one at a time and said, “Here's a toy for you to play with.” In both conditions, the child's behavior was coded during a test period of 20 seconds, which began from the time the child first touched the object(s). Behavioral ratings were made live by a trained clinician and from an immediate review of the videotapes when a judgment could not be made live (this occurred infrequently). The same clinician administered this measure to all children in the study. The dependent measure was the total number of acts imitated, ranging from 0 to 5 for each condition. Intra- and inter-observer agreement were both high. Intra-observer agreement was assessed by having the initial coder rescore a randomly selected 10% of the children from videotape. The coder waited more than 4 months after the first coding and was uninformed as to the initial scoring. For the inter-observer assessment, a second independent coder reviewed the videotapes of the same randomly selected children, while remaining uninformed as to the initial scoring. There were few disagreements: Intra- and inter-observer agreement, as assessed by Pearson *rs*, were respectively .99 and .99 for immediate imitation and 1.00 and .96 for deferred imitation.

Toy Play—In this structured assessment of functional and symbolic toy play skills, the child was seated at a table across from a familiar examiner. Six dolls and sets of stimuli, functional and representational, were presented to the child one at a time, with functional and symbolic conditions (3 dolls and sets of stimuli per condition) counterbalanced across participants. Representational stimuli included a block to represent a sandwich, a plastic lid and bag to represent a blanket and pillow, a tongue depressor to represent a comb, a small plastic object to represent a cup, a shoebox to represent a bathtub, and a blue wooden cylinder to represent a toothbrush. Functional objects for each of these (e.g., a plastic sandwich, a comb, etc.) were also included. For each condition, the child was presented with a doll and object(s) and told, “You can play with these.” Every 20 seconds, if the child was playing with only some of the toys or not at all, the examiner repeated the statement, “You can play with *all* of these” and gestured to all of the toys. No further verbal or physical prompts were provided. After 1 min, the toys were removed from the table and the next doll and object(s) were presented. The dolls were first presented unprompted for each condition. For any target actions not performed by the child, prompted trials were then given. Prompted trials consisted of a verbal and gestural prompt, such as “Wally is hungry, give him a sandwich” while the examiner patted her own stomach, but the examiner did not model the target action on the doll. The child's responses were scored in the following way: target action was performed on the doll, on self, or on another person (both prompted and unprompted trials were credited a score of ‘1’ if the target action was performed); another symbolic action was performed to self or other (these actions were not included in the score); target action was not performed (score of ‘0’). Functional and symbolic play were highly correlated in this sample ($r = .68$) and were therefore summed together to create one total play score ranging from 0 to 6 (score of 0–3 possible for functional play acts and 0–3 for symbolic play acts). The same clinician administered this measure to all children in the study. Behavioral ratings were made live by a trained clinician (and in a few instances of ambiguity from immediate review of the videotapes). Intra-observer agreement was assessed by having the initial coder rescore a randomly selected 10% of the children from videotape (more than 4 months after the first coding, while remaining uninformed as to the first judgments). For the inter-observer assessment, a second independent coder reviewed the same videotapes while uninformed as to the initial scoring. Intra- and inter-observer agreement for the total play score were, respectively, $r = .97$and .96.

Language Measures

Mullen Scales of Early Learning: AGS Edition—Receptive and expressive language age equivalents and standard scores were derived from subscales of the Mullen Scales of Early Learning (Mullen, 1997), which is a standardized measure of cognitive function for infants and preschool age children. The Mullen was administered to each child at age 3–4 years to obtain a measure of overall cognitive ability as well as separate scores for both receptive and expressive language abilities.

Vineland Adaptive Behavior Scales: Survey Form—The Vineland Adaptive Behavior Scales (Sparrow et al., 1984) is a standardized parent interview that includes assessment of communication skills (i.e., receptive, expressive, and written communication). The Vineland was administered by phone every 6 months from age 3–4 to 6.5 years. Although the Vineland norms were based on inperson administration of the instrument, the decision was made to administer the Vineland by phone for this sample in order to lessen the burden on parents. Interviewers were blind to the Vineland responses obtained previously, and each time the Vineland was administered, a new basal and ceiling were obtained. In addition, the same parent was interviewed at each time point. Interviewers followed the procedure as outlined in the Vineland manual, beginning with a broad interview format followed by more targeted questions to gather the information necessary to score each item. The overall communication subscale age equivalent score every 6 months up to 6.5 years of age was used in growth curve analyses, with an average of 6 data points per child. Age equivalent scores were chosen over raw scores as they provide a more meaningful metric with which to interpret change over time (i.e., increase in months rather than Vineland points). Communication ability as assessed by the Vineland was highly correlated with language ability as assessed by standardized language tests, both at the outset of the study and at final follow-up at age 6 years. This suggests that, for this sample, Vineland communication scores were a reasonably good measure of receptive and expressive language ability. At age 3–4 years, the Mullen verbal age equivalent and the Vineland communication age equivalent were correlated .78 (Vineland and Mullen receptive language age equivalents were correlated .48, and Vineland and Mullen expressive language age equivalents were correlated .81). At age 6 years, the Vineland communication standard score and the verbal standard score as measured by the Differential Ability Scales (DAS) were correlated .72.

Results

Means, standard deviations (SD), and ranges for the predictor variables are presented in Table 2. Correlations among predictor variables were moderate, ranging from .20 to .67 (Table 3). The various language variables used in the regression analyses were highly correlated with each other ($r = .89$–.97 among Mullen variables, and .71–.79 between Mullen and Vineland variables). Correlations between predictor variables and initial language ability are shown in Table 4. To determine the unique contributions of each of the predictor variables to concurrent language, multiple regression analyses were conducted. Although predictors were moderately correlated with one another, multicollinearity diagnostics indicated adequate tolerance levels.

Contributions of Joint Attention, Imitation, and Toy Play to Language Ability at Age 3–4 years

Multiple regression analyses were conducted with all of the predictor variables entered in one step, in which case the test of the partial regressions weight controls for all the other predictors in the model. Results are presented in Table 5 and indicate that across a range of language variables—receptive and expressive language, parent report and direct observation —initiating protodeclarative joint attention and immediate imitation were most strongly associated with concurrent language ability in 3–4-year-old children with autism.

Predicting Rate of Communication Development

Next, to examine the degree to which these three early abilities—joint attention, imitation, and toy play—accounted for the variability in *rate of communication development* over the preschool and early school age period, growth trajectories using repeated Vineland measurements were modeled using Hierarchical Linear Modeling (HLM; Raudenbush & Bryk, 2002) with two parameters, an intercept (absolute communication level at 48 months) and a linear slope.[1] Time was thus coded in months and centered around 48. The six

[1]An unconditional model with both linear and quadratic terms was also run. The quadratic term in this model was not significantly different from zero (coeff. = .001134, std error = .0031, $t(59) = .365$, $P = .716$) and showed much less variability than the linear term (variance component: linear term = .34247, quadratic term = .00025), thus the model with the single linear slope was deemed most appropriate for these data.

individual predictor variables were standardized and entered as predictors of individual differences in the growth trajectories (both intercepts and slopes). As shown in Table 6, immediate imitation and toy play abilities were significantly related to individual differences in children's communication ability at 48 months as measured with the Vineland, partially replicating results examining predictors of early language using the Mullen language scores reported above. (Note that the correlations with the Mullen Language Scores were computed at entry into the study when children were slightly younger, 3–4 years of age). The coefficients at the intercept indicate that children whose immediate imitation ability was 1 SD above the mean had communication scores over 3 months higher than those at the sample mean, and children with toy play ability 1 SD above the mean had communication scores 3 months higher than those at the sample mean.

Examining individual differences in the slope (rate of change), it was found that both toy play and deferred imitation were significantly and positively related to rate of acquisition of communication skills over the next 2 years (see Fig. 1). The average rate of change for the sample was .75, meaning that the sample as a whole showed $\frac{3}{4}$ of a month's growth in communication ability for each chronological month that passed. Two skills, toy play and deferred imitation, were related to rate of change. Children who had toy play scores 1 SD above the sample mean (while controlling for all other variables) showed a rate of change of .91 month/chronological month (or 11 months for every year), whereas children with toy play scores 1 SD below the sample mean had a rate of change of only .59 month/ chronological month (7 months for every year). Similarly, children with deferred imitation scores 1 SD above the sample mean showed a rate of change of .96 month/chronological month (11.5 months per year), whereas children with deferred imitation scores 1 SD below the sample mean had a rate of change of only .54 month/chronological month (6.5 months per year). Inasmuch as both these variables—toy play and deferred imitation—predicted unique variability in the rate of change, their additive effect was even greater. Thus, the combination of better toy play ability and more developed deferred imitation skills was associated with faster rates of change in communication skills across the preschool and early school age period. These positive associations remained for deferred imitation ($t = 2.07$, $P < .05$) and nearly so for toy play ($t = 1.81$, $P = .076$) even after controlling for child IQ.

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Discussion

One purpose of the present study was to better understand the contributions of each of three early abilities—joint attention, imitation, and toy play—to early language ability in young children with autism. Previous studies have primarily demonstrated correlations between each of these skill domains, and early and later language ability in children with autism. In the present study, when these three abilities were examined simultaneously, initiating protodeclarative joint attention and immediate imitation abilities were most strongly associated with language skills in 3–4-year-old children with autism.

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A second aim of this study was to better understand the relationship between these early skills and rate of acquisition of communication skills during the preschool and early school age years in children with autism. Using growth curve modeling, it was found that toy play and deferred imitation were associated with higher rates of acquisition of communication skills between 4 and 6.5 years of age. That is, children with autism who had better toy play and deferred imitation abilities at age 4 acquired communication skills at a faster rate than those with less developed toy play and deferred imitation skills. For example, children who performed 1 SD above the sample mean in both toy play and deferred imitation skills had communication acquisition rates that were comparable to typical children (13.4 months of communication growth per 1 year of chronological age). (However, because the children with autism started out at a lower level, their language skills were still below age level at outcome.) In comparison, children who performed 1 SD below the mean in both toy play and deferred imitation skills acquired communication skills at a rate of only 4.5 months per 1 year of chronological age.

These findings have important implications for understanding the nature and course of language development in autism, and for designing targeted early interventions. While initiating protodeclarative joint attention and immediate imitation contributed to language ability at the outset, toy play and deferred imitation were predictive of rate of development of communication skills over the next few years. These findings suggest that while all three abilities might be important for laying a foundation for language development in autism, toy play and deferred imitation skills might contribute to the continued expansion of language and communication skills over the preschool and early school age period. This is not to suggest that joint attention is not related to later language ability in autism. Children with stronger joint attention skills also began with better language at 3–4 years of age. That is, our findings showed that children with better-developed initial joint attention skills also had better-developed initial language ability, and these children continued to show higher language and communication skills across the preschool and early school age years. Overall, however, when joint attention was examined together with imitation and toy play, only deferred imitation and toy play remained significantly associated with rate (i.e., slope) of change in communication skills over time.

We can speculate that joint attention and immediate imitation are important “starter set” skills that set the stage for social and communicative exchanges in which language can develop, as described in the introduction. Once this stage is set and the child begins to learn to use language in a communicative manner, representational skills become important in the continued acquisition of words and phrases during the preschool and early school age period. Toy play and deferred imitation abilities often involve shared attention, but they also index higher level cognitive skills that are important for the continued development and expansion of language and social communication abilities: an active interest, curiosity in, and exploration of the environment; representational thought, memory; and cognitive planning. While joint attention episodes occur in a social context, both toy play (particularly as it was measured here with dolls) and deferred imitation require that the child actively attend to the immediate environment, observe the events and actions taking place, then reproduce these events and socially-mediated actions at a later time. The ability to demonstrate these skills requires an active interest in people and/or things (capturing the child's attention), representational thinking (forming and storing a mental representation), intact recall memory (calling up that representation at a later time), and both cognitive and motor planning skills in order to reproduce the action or event (Klein & Meltzoff, 1999; Meltzoff, 1988b, 1999). Additionally, the child's ability to reproduce actions at a later time reflects not only symbolic thinking and intact recall memory, but also a “shared attitude toward objects,” as the child demonstrates the same actions on objects that he has witnessed of others (Meltzoff, 2005; Meltzoff & Gopnik, 1993). Thus, through toy play and imitation, the child not only comes to an understanding of the world around him—what people do and think and how objects work—but also has the opportunity to demonstrate that understanding.

The results of the present study also have implications for early intervention. All three skill domains—joint attention, imitation, and toy play—are related to the development of language and communication abilities in young children with autism and are therefore important targets for early intervention. A number of studies have shown promising results in facilitating the development of joint attention in children with autism (Klinger & Dawson, 1992; Siller & Sigman, 2002; Whalen & Schreibman, 2003). Kasari et al. (2004) recently conducted a treatment study that examined two interventions, one that targeted joint attention skills and one that targeted play skills. The play intervention focused not only on symbolic acts, but also overall level of play. Children with autism were randomly assigned to one of three groups—the joint attention treatment group, the play treatment group, or the control group—upon admission to the program. The control group participated in a general early intervention program. Results showed that children in the joint attention intervention group showed significantly more pointing and showing, more responses to joint attention, and more child-initiated joint attention in mother–child interactions than at pre-treatment. Similarly, children in the play group showed significantly greater frequencies and types of play acts and higher play levels on both a structured play assessment and during mother–child interactions than at pre-treatment. Further, over a 14-month period, the two experimental groups showed an average of 15–17 months gain in expressive language ability compared to only 7.5 months for the control group. Although this study did not examine pre-treatment differences among groups on a range of variables, the results demonstrate that skills such as joint attention and play may be modified and may contribute to gains in other skill areas, such as expressive language ability, in children with autism.

Another treatment study examined the behavioral profiles of responders and non-responders to Pivotal Response Training (PRT) (Sherer & Schreibman, 2004 in press). Children with responder profiles tended to have better-developed toy play skills at pre-treatment, demonstrated greater gains in language, play, and social skills during treatment sessions than non-responders, and also generalized these skills to no-treatment environments and untrained stimuli. Although the study design used in the Sherer and Schreibman study precludes conclusions as to whether improvement occurred in response to treatment or in response to treatment plus other factors, it does tell us that certain skills, such as toy play skills, might influence the acquisition of language and other abilities that are targeted in the treatment of children with autism.

It should be noted that due to the wide heterogeneity in language skills in autism, meaningful speech, that is, speech that is frequent or consistent, referential, and communicative, is difficult to assess with any one measure. Standardized cognitive tests sample behavior over the course of 1 h, while parent report measures such as the Vineland provide a summary of behavior over a broader time frame and range of settings. Each of these measures captures some, but not all, aspects of meaningful communication. In the current study, the Vineland was shown to be highly correlated with direct assessment of language in this sample, and was therefore deemed a suitable measure of rate of language acquisition over time in young children with autism. The Vineland also allowed for a repeated measure appropriate for growth curve analysis that was not confounded by test practice effects. The broader issue of what measure best captures meaningful or useful speech remains an important one, but one that lies outside the scope of this study.

In summary, the results of the present study shed light on the relationship between early skill domains and the development of language and communication in young children with autism, and suggest specific targets for early intervention. Early abilities involved in social exchange and communication, namely, joint attention and immediate imitation, appear to be important for setting the stage for early language learning in autism, while representational skills, demonstrated through toy play and deferred imitation, contribute to the continued expansion of language and communication skills over the preschool and early school age years. Each of these skill areas represents an important target for early intervention programs that promote communicative competence and improved outcomes for young children with autism.

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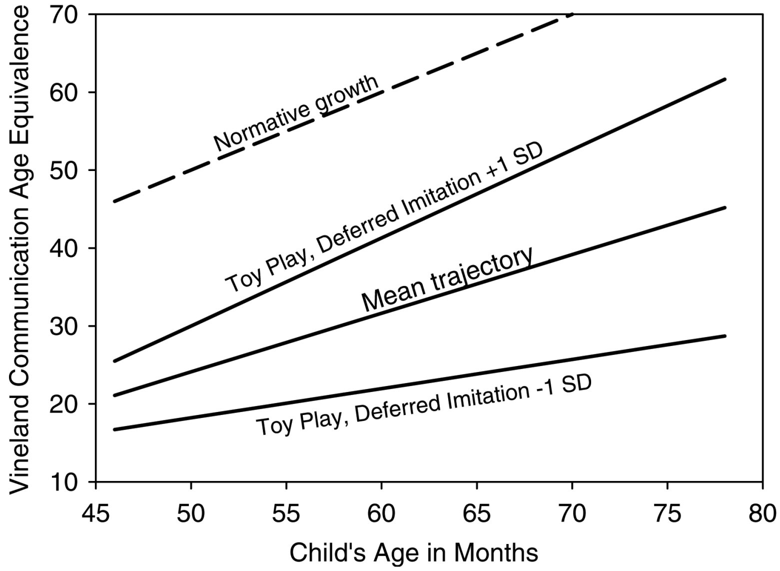

Fig. 1.

Comparison of rates of acquisition of communication skills in children with autism who have toy play and imitation skills either 1 SD above, or 1 SD below, the sample mean

Table 1

Sample characteristics[a]

N	M:F	SES+	CA (mos)	Mullen Composite MA (mos)	Mullen Composite IQ	Mullen Verbal AE (mos)[b]
60	51:9	46.2	43.6	25.4	58.1	22.9
SD		(11.2)	(4.3)	(8.6)	(19.8)	(10.3)
Range		22–66	34–52	11.8–46.8	30–101	8–50

[a]Numbers in the first row represent means; second row, standard deviations (SDs) in parentheses; third row, range

[b]The Mullen verbal age equivalent is the average of the Mullen receptive language and Mullen expressive language age equivalents

Table 2

Descriptive statistics for predictor variables

Predictor	M (SD)	Range
Init Protodecl JA[a]	7.9 (8.7)	0–43
Resp Protodecl JA (%)[b]	.51 (.35)	0–1 (%)
Init Protoimp JA[c]	11.2 (8.8)	0–36
Imitation-Immediate[d]	2.9 (1.7)	0–5
Imitation-Deferred[e]	1.9 (1.6)	0–5
Toy Play[f]	4.0 (2.2)	0–6

[a]Initiating protodeclarative joint attention was a frequency score consisting of the number of times the child used eye gaze, alternating eye gaze, showing, and/or pointing behaviors to direct and/or share attention with the examiner with respect to an active toy

[b]Responding to protodeclarative joint attention was the percentage of six trials on which the child accurately oriented with eyes and/or head turn beyond the examiner's finger and in the direction of the examiner's point and gaze to the posters

[c]Initiating protoimperative joint attention was a frequency score consisting of the number of times the child used eye gaze, reached with coordinated eye gaze, gave objects, and/or pointed to request a toy or to request help

[d]Immediate imitation consisted of the total number of immediate imitation items imitated

[e]Deferred imitation consisted of the total number of deferred imitation items imitated

[f]Toy play consisted of the number of functional and symbolic play acts performed, prompted or unprompted

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Table 3

Correlations among predictor variables: joint attention, imitation, and toy play

	Init Protodecl JA	Resp Protodecl JA	Init Protoimp JA	Symbolic Play	Imitation immediate	Imitation deferred
Functional Play	.31*	.51***	.23	.67***	.43**	.41**
Init Protodecl JA		.43**	.39**	.48***	.28*	.45***
Resp Protodecl JA			.38**	.58***	.44***	.66***
Init Protoimp JA				.24	.20	.20
Symbolic Play					.37**	.50***
Imitation-Immediate						.53***

* $P < .05$

** $P < .01$

*** $P < .001$

Table 4

Relations between joint attention, imitation, and toy play, and language ability

	Init Protodecl JA	Resp Protodecl JA	Init Protoimp JA	Toy Play	Immediate imitation	Deferred imitation
Mullen Verbal AE	.53**	.60**	.23	.54**	.66**	.67**
Mullen Rec Lang AE	.49**	.58**	.20	.50**	.64**	.66**
Mullen Expr Lang AE	.53**	.59**	.25[a]	.56**	.64**	.63**
Vineland Comm AE	.53**	.62**	.30*	.51**	.56**	.65**

* $P < .05$

** $P < .001$

[a] $P = .05$

Table 5

Relations between joint attention, imitation, and toy play, and current language ability in 3–4-year-old children with autism

	Mullen Verbal AE	Mullen Rec Lang AE	Mullen Expr Lang AE	Vineland Comm AE
Init Protodecl JA	.25*	.23*	.25*	.25*
Resp Protodecl JA	.16	.16	.15	.23
Init Protoimp JA	–.06	–.08	–.04	.02
Toy play	.08	.03	.12	–.02
Imitation immediate	.39***	.38**	.37**	.26*
Imitation deferred	.22	.26*	.17	.26
Total R^2	.65	.62	.62	.58

Numbers are standardized betas

*$P < .05$

**$P < .01$

***$P < .001$

Table 6

HLM growth curve analyses predicting rate of acquisition of communicative skills in young children with autism

	Intercept (48 mos.)		Slope (Rate of change)	
	Coeff	***t***	**Coeff**	***t***
Constant	22.61	27.95**	.75	14.34**
Joint attention—protodeclarative				
Initiate	1.10	1.20	–.06	–1.27
Respond	1.30	1.10	.03	.38
Joint attention—protoimperative				
Initiate	–1.28	–1.29	–.01	–.11
Imitation objects				
Immediate	3.20	3.47**	–.01	–.80
Deferred	2.08	1.61	.21*	2.61*
Toy Play	3.02	2.54*	.16*	2.34*

Intercept is Vineland communication score at 48 months

*$P < .05$

**$P < .01$