INDIVIDUAL DIFFERENCES IN JOINT ATTENTION SKILL DEVELOPMENT IN THE SECOND YEAR

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The development of joint attention skills is considered to be critical to early social, cognitive and language development. Joint attention skills refer to the capacity to coordinate attention with others regarding objects and events. While infants and toddlers display systematic, age related gains in joint attention skill development between 6 and 18 months of age, they also may display considerable individual differences in the development of this skill. Little research, however, has been directed toward evaluating the significance of these individual differences. This longitudinal study of 14- to 17-month-olds was designed to examine the hypothesis that individual differences in one type of joint attention skill, the tendency to follow the gaze and pointing of a tester, would be a significant predictor of receptive language development. The second goal of this study was to examine the assumption that different types of joint attention skill reflect the development of a single common cognitive process. The results provided strong support for the primary hypothesis, but equivocal support for the common process assumption. In particular, the results of this study suggested that different types of joint attention skills may reflect partially distinct processes associated with comprehension and expression factors in early social-communication development. The results of this study have implications for current conceptualizations of joint attention development, as well as for understanding the linkage between joint attention and early language development.

joint attention individual differences language development cognition

INTRODUCTION

Joint attention is a fundamental aspect of early social development that may be associated with language development (Adamson & McArthur, 1995; Bruner, 1975, 1977; Bates, 1979; Bakeman & Adamson, 1984; Moore & Corkum, 1994; Tomasello, 1988, 1995). Broadly speaking, joint attention skills involve the ability to coordinate visual attention with

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others regarding objects and events. Much of the research on the connection between joint attention skills and language development has focused on the important role that episodes of joint attention play in child- caregiver interactions (Bruner, 1975; Dunham, Dunham, & Curwin 1993; Tomasello, 1988). To some degree this research has emphasized the caregiver's role in such interactions and has suggested that the tendency of caregivers to follow the line of regard of infants in joint attention episodes is related to enhanced early lexical development (Dunham & Dunham, 1993; Masur, 1981; Tomasello, 1988; Tomasello & Farrar, 1986; Tomasello & Todd, 1983).

In addition to caregiver-child interaction effects, joint attention skills may also be associated with language development because they reflect the maturation of important social, cognitive and self-regulatory capacities within the infant (Butterworth & Cochran, 1980; Corkum & Moore, 1998; Mundy & Gomes, 1997; Tomasello, 1995; Uvlund & Smith, 1996). This hypothesis leads to the prediction that individual differences in infants' joint attention skills, assessed apart from the contribution of caregivers, should also be associated with language development.

Relatively little research has focused on this hypothesis. For example, one important operationalization of joint attention skill is the ability of infants to follow a shift of gaze and/or the head turn of an adult (Scaife & Bruner, 1975). This ability emerges between 6-12 months of age, and consolidates through at least the 18th month of development (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991; Corkum & Moore, 1995). Even though theory would suggest that this type of skill may be fundamental to early language acquisition (Bruner, 1975), few studies have directly examined the relation between this aspect of joint attention skill and language development.

Recently, Mundy, Kasari, Sigman, and Ruskin (1995) reported an interesting set of observations in this regard. A measure of responding to joint attention bids, or the capacity of the child to follow the direction of gaze and pointing of an experimenter, was a significant predictor of receptive language development (r = .70) in a small sample of toddlers. Moreover, evidence of this relation was apparent even after controlling for variance in initial language and general cognitive development. Another potentially important observation in this study was that different types of measures of joint attention were not equivalent in their correlations with language. For example, a measure of initiating joint attention bids (pointing and showing) did not display the same degree of association with receptive language as did the measure of responding to joint attention bids (i.e., following gaze and pointing).

Results that are both consistent and inconsistent with the foregoing observations have been reported. The tendency of toddlers to apprehend the referent of an adult's utterance, presumably through following line of regard, appears to be associated with novel label comprehension (Baldwin, 1995). Alternatively, Desrochers, Morissette, and Ricard (1995) observed that following gaze at 15 months was related to expressive, but not receptive language at 24 months. In contrast, Ulvund and Smith (1996) have reported predictive correlations between this type of joint attention measure and receptive, as well as expressive language development. In addition, Ulvund and Smith (1996) observed significant associations between initiating joint attention bids and both receptive and expressive language. However, this study did not control for covariance between joint attention measures and initial language and cognitive status.

Additional research to clarify the nature of the relations between joint attention measures and language development may be important for several reasons. If a strong association can be documented between language development and an easily measured joint attention skill, such as following gaze and pointing, this may aid in the early identification of language delays in young children (Wetherby & Prizant, 1993). Furthermore, measures of different

types of joint attention skills may vary in their relations with early language development (Desrochers et al., 1995; Mundy et al., 1995). Current theory on early nonverbal communication often emphasizes that the development of different types of joint attention skills, such as pointing to show, versus pointing to request, versus responding to pointing, may reflect a single common cognitive process (e.g., Baron-Cohen, 1995; Bates, 1979; Fenson et al., 1994; Tomasello, 1995). Consequently, researchers often combine different types of joint attention behaviors into aggregate measures in the study of the relations between early gestural communication and language development (Bates, Thal, Whitesell, Fenson, & Oakes, 1989; Fenson et al., 1994). However, such aggregate measures may be unwarranted and diminish the power of research on the relations between gestural joint attention development and language acquisition. This is because different types of joint attention skills may reflect the development of different psychological processes, as well as common processes, in young children (Mundy & Gomes, 1997). For example, different types of joint attention measures appear to have different neurological (Card, Schmidt & Mundy, 1997) and cognitive correlates (Ulvund & Smith, 1996). Therefore, to better understand the nature of joint attention development, and its relations to language development, it may be important to use multiple measures of this skill domain.

This longitudinal study was designed with this assumption in mind. To address the discrepancies between extant studies, the relations between language development and responding to joint attention bids, or initiating joint attention bids, were examined in a sample of toddlers. Based on previous research it was expected that all the joint attention measures would be related to language development (Ulvund & Smith, 1996), but that the responding to joint attention measure would be an especially robust predictor of receptive language development (Mundy et al., 1995). Furthermore, it was expected that this predictive relation would remain significant even after considering variance in initial language or general cognitive development (Mundy et al., 1995). A second goal was to examine the data in this study to determine if they lent support to a common, or heterogeneous process model of joint attention skills development in the second year.

METHOD

Participants

Twenty-four infants ranging in age from 14-17 months were recruited from a university based preschool. This age range encompasses what is commonly considered to be a period of consolidation for joint attention skill development (Adamson & McArthur, 1995; Tomasello, 1995). The use of this initial age range also insured that the children in this study were 18 months of age, or older, at the final assessment. Increased stability in individual differences in early language acquisition may be observed after 18 months of age (Bates, Thal, Whitesell, Ferson, & Oakes, 1989). Toddlers were recruited solely from a university pre-

TABLE 1
Means and Standard Deviations (in parentheses) for the Demographic and Developmental Characteristics of the Sample (N = 24)

Variable	*Mean*
CA*	15.8 (*SD* = 1.0)
MA*	15.8 (*SD* = 1.3)
DQ*	101.5 (*SD* = 8.2)
INITIAL LANGUAGE AGE	
Expressive	16.6 (*SD* = 1.6)
Receptive	19.9 (*SD* = 2.8)
FOLLOW-UP LANGUAGE AGE	
Expressive	19.8 (*SD* = 2.7)
Receptive	21.1 (*SD* = 2.6)
FAMILY INCOME~	10.6 (.77)
MOTHER'S EDUCATION^	7.0 (1.0)

*Age, mental age estimates and language age estimates in months.
~Family Income: 1 < $3000, 2 = $3000-5000, 3 = $5001-8000, 4 = $8001-10,000 5 = $10,001-15,000, 6 = $15,001-20,000, 7 = $20,001-25,000, 8 = $25,001-30,000 9 = 30,001- 40,000, 10 = $40,001-50,000, 11 > $50,000
^Mother's education: 1 < 7th grade, 2 = Junior High, 3 = Some High School, 4 = High School, 5 = Some College, 6 = Two Year Degree or equivalent, 7 = Four Year Degree, 8 = Graduate or professional training

school leading to a sample that was relatively homogeneous with regard to SES (see Table 1). English was the primary language spoken in the home of all the children in this study.

Procedures

All assessments were conducted with the toddler's mother in a testing room in the preschool. In the initial phase of testing toddlers were assessed with three instruments, the Reynell Developmental Language Scales (Reynell & Graber, 1990); the Bayley Scales of Infant Development-II (1994), and an abbreviated version of the Early Social-Communication Scales (Seibert, Hogan, & Mundy, 1982; Mundy & Hogan, 1996). Testing sessions lasted approximately 30 min and a single tester, blind to the primary hypotheses of this study, administered all the measures to all children. No child was administered more than one measure per week. A uniform order of administration was followed with the ESCS first, Bayley-II second and Reynell third. At follow-up, each child was assessed with the ESCS and Reynell across a two week period. The ESCS was included at follow-up to examine the stability of joint attention and other nonverbal communication measures in the second year. The follow-up period was 16 weeks (+/- 10 days for each child).

Measures

The Reynell Developmental Language Scales (Reynell & Gruber, 1990) yielded estimates of receptive and expressive language age. Originally developed in England, a North American standardization for this instrument is available based on 700 one to six-year-old children. These scales have established reliability and validity as an early language measure (Cantwell, Howlin, & Rutter, 1977). The Bayley Scales of Infant Development-II (Psychological Corporation, 1994) provided a measure of general cognitive development. This assessment yielded a mental age estimate (*MA*) and a standardized developmental quotient (DQ).

The abridged version of the Early Social Communication Scales (ESCS; Seibert et al. 1982; Mundy & Hogan, 1996) is a 20 min videotaped structured assessment designed to measure the development of a variety of nonverbal communication skills in the 8 to 30 month period. The tester and child sat facing each other across a small table. A set of toys was visible to the child, but out of reach on the tester's side of the table. Posters were placed on the walls 90 degrees to the child's left and right, and 180 degrees behind the child. A video camera was positioned to capture a 3/4 face image of the child with a profile view of the tester, as well as the position of the toys and posters.

The tester presented the child with a sequence of activated wind up toys (3 trials), hand operated mechanical toys (3 trials), opportunities to play a tickle turn-taking game (2 trials), opportunities to play an object turn-taking game, such as catch with a ball (2 trials), opportunities to take-turns wearing a hat, comb, and glasses (3 trials), and an opportunity to look at pictures in a book with the tester (1 trial). The tester also presented the child with gestural and verbal requests to give toys to the tester. Finally, the tester presented the child with two sets of three trials in which the tester attracted the child's attention, and then turned to visually fixate a wall poster, while pointing at the poster and saying the child's name three times with increasing emphasis. Trials to the left, right and behind the child were conducted in each set.

Observations of the tester-child interaction on the ESCS yielded frequency of behavior scores in six categories: Initiating Joint Attention (*IJA*); Responding to Joint Attention (*RJA*), Initiating Behavior Regulation (*IBR*), Responding to Behavior Regulation (*RBR*), Initiating Social Interaction (*ISI*), and Responding to Social Interaction (*RSI*). Both the Joint Attention and Behavior Regulation behaviors involve the coordination of attention relative to objects and events. Alternatively,

the Social Interaction scales assess turn-taking and interaction maintenance, but not necessarily coordination of attention to objects and events. Therefore, given the focus of this study, only data on the former were examined. Briefly, these are operationalized in the following manner. Initiating Joint Attention (*IJA*) scores refer to the frequency with which the child uses eye contact, pointing and showing to share the experience of an active mechanical toy with the tester. Responding to Joint Attention (*RJA*) refers to the percentage of six trials on which a child correctly turns her visual regard in the direction of the tester's visual regard and pointing gesture. Initiating Behavior Regulation (*IBR*) scores refer to the frequency with which the child uses eye contact, reaching, giving and pointing to elicit aid in obtaining objects or reactivating objects. Responding to Behavior Regulation (*RBR*) refers to the frequency with which a child responds to request from the tester to "Give it to me" as the child is holding or examining a toy. A list of the behaviors observed within each category are presented in Table 2. A more complete discussion of the ESCS procedures is available elsewhere (Mundy & Hogan, 1996; Mundy, Kasari, Sigman, & Yirmiya, 1988).

TABLE 2
A Brief Description of the Early Social Communication Scale Variables

INITIATES JOINT ATTENTION
LOW: 1) Makes eye contact while manipulating toy; 2) Alternates eye contact between active mechanical toy and tester. HIGH: 1) Points to active mechanical toy or distal objects in testing room; 2) Shows objects (raises objects toward the tester's face).
RESPONDS TO JOINT ATTENTION
The percentage of trials the child correctly turns head and eyes in direction of tester's point. On side trials direction of gaze must shift beyond the tester's extended finger (approximately 45 degrees off midline). On behind trials the child must turn their head more than 90 degrees off midline.
INITIATES BEHAVIOR REGULATION
LOW: 1) Makes eye contact when object moved out of reach or reaches to objects out of reach. 2) Makes eye contact while reaching to objects out of reach. HIGH: 1) Points to inactive objects on the table or to the collection of visible but out of reach toys. 2) Gives inactive toys to the tester (e.g. moves toys toward tester's hands).
RESPONDS TO BEHAVIOR REGULATION
The percentage of trials on which the child correctly responds to tester's gestural and verbal request to (e.g."give it to me")

Some of the behaviors within these categories may be too rudimentary to truly involve joint attention. For example, simple behaviors such as Alternating Eye contact on the *IJA* scale or Reaching on the *IBR* scale do not clearly involve an intent to communicate on the part of the child and, hence, may not involve joint attention process (Tomasello, 1995). To address this issue a separate frequency score for high level Initiating Joint Attention and Initiating Behavior Regulation behaviors was computed (see Table 2). Higher level behaviors involve conventional gestures such as pointing, giving and showing or behaviors in combination with eye contact. These behaviors are commonly assumed to reflect communicative intent (see Mundy & Gomes, 1997, for discussion) and previous research with the ESCS indicates they comprise behaviors that emerge later in the repertoire of the child than do the lower level behaviors (Seibert, Hogan, & Mundy, 1984; Mundy et al., 1994). In this study, the tendency of children to use higher-level relative to lower-level behaviors within a domain was scored. Accordingly, a "Consolidation Ratio" for initiates joint attention and initiates behavior regulation was computed for each child: *C-IJA* = Higher-Level Initiating Joint Attention Bids/All Initiating Joint Attention Bids, and *C-IBR* = Higher-Level Initiating Behavior Regulation Bids/All Initiating Behavior Regulation Bids.

The ESCS yields reliable and valid indices of early social communicative development (e.g., Mundy et al., 1988, 1994, 1995; McEvoy, Rogers, & Pennington, 1993; Ulvund & Smith, 1996). In this study interrater reliability was assessed with videotape data from 7 children scored by two independent raters. All Pearson correlations between

TABLE 3
Means and Standard Deviations (in parentheses) for the Early Social Communication Scale Variables (N = 24)

ESCS VARIABLES	*1st Assessment*	*2nd Assessment*
Total Initiates Joint Attention (IJA)	15.9 (8.6)	16.4 (8.5)
Consolidated IJA*	0.19 (0.18)	0.20 (0.19)
Responds to Joint Attention (RJA)	72.4% (30%)	92.4% (13%)
Total Initiates Behavior Regulation (IBR)	30.5 (11.7)	27.6 (12.9)
Consolidated IBR*	0.61 (0.31)	0.60 (0.22)
Responds to Behavior Regulation	72.6 % (32.7)	84.2% (28%)

The ratio of high level Initiates Joint Attention bids/total Initiates Joint Attention, or the ratio of high level Initiates Behavior Regulation bids/ total Initiates Behavior Regulation.

TABLE 4
Correlations Between the ESCS, Language and Developmental Status Measures (N = 24)

	Language and Developmental Status[a]						
ESCS Variable	*1st EXP*	*2nd EXP*	*1st REC*	*2nd REC*	*MA*	*DQ*	*CA*
Total Initiates Joint Attention (IJA)	.04	.22	.14	.15	.25	.31	.08
Consolidated IJA[b]	.22	.51*	.47*	.40*	.16	.03	.38
Responds to Joint Attention (RJA)	.24	.49*	.39	.71**	.50*	.33	.35
Total Initiates Behavior Regulation (IBR)	.09	.33	.17	.20	.30	.35	.10
Consolidated IBR	.36	.49*	.47*	.45*	.57*	.26	.41*
Responds to Behavior Regulation	.27	.15	.40*	.03	.22	.14	.22

*df = 22, p <.05, **df = 22, p < .01
[a]Exp = Expressive language age; REC = Receptive language age; MA = Mental age; DQ = Developmental Quotient; CA = Chronological age.
[b]The ratio of high level Initiates Joint Attention bids/total Initiates Joint Attention, or the ratio of high level Initiates Behavior Regulation bids/ total Initiates Behavior Regulation.

paired ratings ranged from r (df = 5) = .85 to r (5) = .98; t-tests (df = 6) revealed that there were no significant differences between the mean ESCS scores generated by the two testers.

RESULTS

Preliminary analyses revealed that a child's gender, mother's level of education and household income were not significantly associated with the language or nonverbal communication in this sample. These variables were excluded from subsequent analyses. With regard to language development, mean scores for receptive language and expressive language were significantly higher at follow-up than at baseline (t (23) = -7.39, p < .01; t (23) = -9.45, p < .01 respectively, see Table 1). Furthermore, initial and follow-up receptive language scores were correlated (r (22) = .69, p < .001), as were the initial and follow-up expressive language scores (r (22) = .51, p < .01). Finally, the descriptive statistics for the ESCS variables were computed and are presented in Table 3.

Predictors of Receptive Language Development

Initial zero order correlation analyses were conducted as a first step in examining the hypothesized association between *RJA*, observed during the first assessment, and receptive language development observed on the second assessment. The results of these analyses appear in Table 4. As expected *RJA* was a significant predictor of receptive language development. However, this correlation must be interpreted cautiously as an examination of the residuals revealed unequal variances of predicted receptive language scores at

different values of initial *RJA* scores. Thus, observed heteroscedasticity suggested that other variables needed to be considered before interpreting the association between *RJA* and receptive language in this study.

Before moving onto Hierarchical Linear Regression analyses to address this issue, four additional observations should be noted. First, there was one child with extremely low scores on both *RJA* and receptive language. However, the correlation between *RJA* and receptive language remained significant when the data from this child was excluded from analysis (r (21) = .59, $p < .01$). Second, the *RJA* trials involving pointing behind the toddlers were more difficult (mean = 54.2 % , SD = 46.4) than were the trials involving pointing to the toddlers' left or right [mean = 80.2%, SD = 30.4; t (23/arcsine transformation) = 2.62, $p < .02$]. However, *RJA* with receptive language correlation did not appear to be carried only by performance on the more difficult behind trials, as the correlations of follow-up receptive language with side-trial and behind-trial performance were similar, r (22) = .57 and .50, respectively. Third, the consolidation indices of initiating joint attention and behavior regulation bids (*C-IJA* and *C-IBR*) observed during the first assessment were also significant predictors of receptive language (see Table 4). Thus, it was not clear if *RJA* held a unique association with receptive language development relative to other nonverbal measures. Finally, several of the predictors of language development, including *RJA*, were correlated either with receptive language or mental age at the time of the initial assessment. Therefore, it was not clear whether or not the predictive correlations between joint attention measures and language could simply be ascribed to the effects of these initial associations with more general cognitive or language status.

Hierarchical Linear Regression (HLR) analysis was conducted to address several of these issues. The dependent measure in this analysis was receptive language age estimates at the follow-up assessment. Chronological age, initial mental age, and initial receptive language age estimates were entered simultaneously on the first step of the equation. The consolidated Initiates Joint Attention variable was entered on the second step. On the third step the Responding Joint Attention variable was entered. Thus, this analysis was designed to test of the hypothesis that *RJA* shared a unique association with receptive language development apart from: a) variance associated with initial developmental status, b) variance in initial receptive language skill, or c) variance associated with other forms of joint attention skill. The results of the analysis support this hypothesis (See Table 5). Based on ΔR^2 estimates adjusted for sample size, the *RJA* variable accounting for an additional 18% of the explained variance in receptive language development on the third step of this analysis. The standardized partial regression coefficients (β) indicated that only *RJA* and initial receptive language scores made a significant contribution to the prediction of follow-up receptive language when variance associated with all the variables in this equation was considered (see Table 5). The initiating joint attention variable did not account for additional variance in receptive language in this analysis. Essentially identical results were obtained when the initiating behavior regulation variable (*C-IBR*) was substituted for the *C-IJA* variable on step 2.

Predictors of Expressive Language Development

The responding to joint attention, initiating joint attention and initiating behavior regulation measures obtained during the first assessment displayed comparable and significant associations with expressive language at follow-up (see Table 4). However, it was not clear if any of these variables held a unique association with expressive language, nor was it clear whether or not the predictive correlations between the nonverbal communication measures and language could simply be ascribed to the effects of the initial associations of these variables with cognitive status or

language. HLR analysis was again used to address these issues. In this analysis expressive language age at the second assessment was the dependent variable. Initial expressive language age estimates, as well as chronological age and initial mental age were entered simultaneously into the equation on the first step. On the second step the consolidated *RJA* variable was entered. On the third step the *C-IJA* variable was entered. Thus, this analysis was conducted to determine if the *C-IJA* variable shared a unique path of association with expressive language development above and beyond: a) variance associated with initial developmental status, b) variance in initial expressive language skill, or c) variance associated with other forms of joint attention skill. The results of the analysis indicated that the *C-IJA* variable accounted for an additional 12% of the explained variance in expressive language development (See Table 5). Estimates of the standardized partial regression coefficients (β) indicated that only the *C-IJA* scores made a significant unique contributions to follow-up expressive language when variance associated with all the variables in this equation was considered. The unique contribution of the *MA* variable approached significance in this equation. The *RJA* variable, however, did not account for additional variance in expressive language in this equation. Essentially identical results were obtained when the initiating behavior regulation variable (*C-IBR*) was substituted for the *RJA* variable on step 2.

Stability of Individual Differences in Joint Attention

The data in this study provided an opportunity to examine the development and stability of joint attention and other nonverbal communication behaviors in the latter part of the second year. Mean comparisons of the data presented in Table 3 indicated that a significant change in behavior during the longitudinal period of this study was only observed for the *RJA* variable ($t(23) = 3.48, p < .005$). Test-retest stability was observed only for the total *IJA* variable ($r(22) = .42, p < .05$). When one tailed levels were considered, however, marginally significant test-retest correlations were observed for *RJA* ($r(22) = .34, p < .06$), *C-IBR* ($r(22) = .32, p < .07$) and *C-IJA* ($r(22) = .28, p < .10$). Analyses also revealed that, in the follow-up assessment, the *RJA* variable was concurrently correlated with both receptive ($r(22)$

TABLE 5
Hierarchical Regression Analyses for Nonverbal Communication, and Initial Developmental and Language Predictors of Language Outcomes ($N = 24$)

Receptive Language	β	*Expressive Language*	β
STEP 1 (df 3,20) Adjusted $R^2 = .46$		**STEP 1** (df 3,20) Adjusted $R^2 = .40$	
CA	-.10	CA	.12
MA	.29	MA	.47 ^
1st Receptive Age	.61**	1st Expressive Age	.20
STEP 2 (df 4, 19) $\Delta R^2 = -.02$		**STEP 2** (df 4, 19) $\Delta R^2 = .01$	
CA	-.12	CA	.11
MA	.32	MA	.36
1st Receptive Age	.56**	1st Expressive Age	.21
IJA	.12	RJA	.22
STEP 3 (df 5,18) $\Delta R^2 = .18$*		**STEP 3** (df 5,18) $\Delta R^2 = .12$*	
CA	-.09	CA	.11
MA	.09	MA	.44 ^
1st Receptive Age	.47**	1st Expressive Age	.16
IJA	.05	RJA	.12
RJA	.51**	IJA	.37*

^ $p < .075$, * $p < .05$, ** $p < .025$

= .55, $p < .01$) and expressive language (r (22) = .64, $p < .01$). No other ESCS variable was concurrently correlated with language at follow-up.

Associations Among Joint Attention Measures

Finally, the data were considered with regard to the common process hypothesis of joint attention development. The correlations among the ESCS variables in this study are presented in Table 6. Neither of the initiating joint attention variables (*IJA* or *C-IJA*) were correlated with *RJA* in this study. However, the *C-IJA* and *C-IBR* measures were significantly correlated at time 1 (r (22) = .50, $p < .01$), as were the initiating behavior regulation variables (*IBR* and *C-IBR*) with the *RJA* measure. A varied pattern of correlations with cognitive development, as indexed by Bayley Scale *MA* estimates, was also observed (see Table 4). Both *RJA* and *C-IBR* were significantly correlated with MA in the initial assessment. However, the *C-IJA* variable was not correlated with *MA* in this study. Thus, there was little evidence in this study to support the hypothesis that *IJA* and *RJA* reflected a single common process in the second year of development. Alternatively, there was some evidence of a linkage across other measures that hypothetically involve joint or coordinated attention processes.

DISCUSSION

Over twenty five years ago Bruner (1975) observed that a careful and complete consideration of the child's pre-speech communication system is fundamental to understanding early language acquisition. In the ensuing years research has revealed much about preverbal communication, especially with regard to the role of joint attention in mother-child interaction (Baldwin, 1995; Tomasello, 1988, 1995). However, a great deal is still to be learned about the significance of this domain of development. One important issue that has received relatively little attention concerns the meaning and course of individual differences in children's acquisition of joint attention skills. In this regard the present study yielded three important observations.

First, substantial individual differences in joint attention and nonverbal communication skills were apparent well into the second year. Second, for toddlers, early nonverbal communication measures may provide information about subsequent language development that is not provided by contemporaneous measures of language status or cognitive development. Third, after considering initial covariance in language and cognitive status, as well as other joint attention measures, the consolidated Initiates Joint Attention measure was a significant predictor of expressive language. Alternatively, the Responding to Joint Attention measure had a strong predictive association with receptive language. The *RJA* variable was also

TABLE 6
Correlations Among ESCS Measures of Nonverbal Communication Skills (N = 24, df = 22)

ESCS Variables	*IJA*	*C-IJA*	*RJA*	*IBR*	*C-IBR*	*RBR*
Initiates Joint Attention (IJA)	1.00	.02	-.09	.01	.24	.10
Consolidated IJA (C-IJA)[a]	1.00	.27	.09	.50**	.34	
Responds to Joint Attention (RJA)	1.00	.41*	.51**	-.11		
Initiates Behavior Regulation (IBR)	1.00	.28	.04			
Consolidated IBR (C-IBR)	1.00	.18				
Responds to Behavior Regulation (RBR)[a]	1.00					

*p < .05; **p < .025

[a]The ratio of high level Initiates Joint Attention bids/total Initiates Joint Attention, or the ratio of high level Initiate Behavior Regulation bids/ total Initiates Behavior Regulation.

the only significant concurrent correlate of receptive, as well as expressive language, at the time of follow-up language testing.

These observations are based in large part on hierarchical linear regressions with several independent variables and a small sample. Therefore, they must be interpreted cautiously as the probabilities (significance) associated with variables in these equations may be over, or underestimated in this study. Nevertheless, one interpretation of these observations is that tendency to initiate or to respond to joint attention bids may reflect distinct processes and these may contribute to individual differences in discrete components of early language acquisition. Confidence in this interpretation is bolstered by noting that very similar data, at least with respect to *RJA*, has been presented in an independent study (Mundy et al., 1995).

A corollary of this interpretation is that data in this study were not completely consistent with models that solely emphasize the commonality of the cognitive processes that may be shared by joint attention and other nonverbal communication skills (e.g., Bates et al., 1989; Tomasello, 1995). Therefore, it may be useful to consider the degree to which different nonverbal communication skills reflect distinct integrations of processes in early social-communication development (Mundy & Gomes, 1997; Mundy & Willoughby, 1996).

In this regard it is perhaps ironic to note that, while a common process model is prominent in considering preverbal communication, a dual process model of partially independent expression and comprehension processes is common in attempts to understand individual differences in early language acquisition (e.g., Bates et al. 1987; Bates et al. 1989). According to this view the development of language comprehension may reflect the effects of cognitive-symbolic-conceptual process. Early expressive language skill is also thought to reflect these cognitive processes, but may also reflect the integration of cognition with social motivation factors, or other variables related to individual difference in the tendency to initiate social behaviors. Bates et al. (1989) observed that joint attention, or deictic skills, were only correlated with language comprehension and suggested that these behavior domains reflected shared cognitive-symbolic processes. Alternatively, other gestural acts, referred to as enactive naming gestures (i.e., functional and symbolic play acts), were observed to be correlates of expressive language. Bates et al. (1989) suggested that the latter association may have been observed because of shared variance in social motivation and the tendency to initiate social behaviors, as well as shared variance in cognitive processes.

The results of this study suggest that this two process model may be broadened to so that both the early gestural communication domain, as well as the language domain, may be regarded as reflective of the development of distinctive expression versus comprehension processes. According to this perspective, the association between *RJA* and language comprehension may have occurred because of shared variance in symbolic/conceptual thought process. This is consistent with the observation that *RJA* was correlated with an index of general cognitive development (Bayley Scale performance *MA*). However, this may be an incomplete explanation because the association between *RJA* and language remained significant even after controlling for variance in *MA*. This does not rule out a specific symbolic/cognitive hypothesis. It does suggest, however, that other factors may be involved in the association between language comprehension skill development and *RJA*. The current literature on joint attention and the assessment of language comprehension would suggest that these may include, but not be limited to more specific processes such spatial analytic processes (Butterworth & Jarrett, 1991) and attention or self regulatory processes (Baldwin, 1995; Kaler & Kopp, 1990).

Some understanding of the association between *IJA* and expressive language may also be gleaned from the model outlined by Bates et al. (1989). In addition to cognitive factors, individual differences in the display of expressive language skill may reflect social motiva-

tion, or other factors related to individual difference in the tendency to initiate social behaviors (Bates et al. 1989; Slomkowski, Nelson, Dunn, & Plomin, 1992). In our own work we have considered research work on early hemispheric specialization for social-approach behaviors (Davidson & Fox, 1989, 1991), and suggested that the tendency to initiate a joint attention bids may, in part, be affected by social temperament processes (Card, et al., 1997; Mundy, 1995; Mundy & Willoughby, 1996). Thus, the link between IJA and expressive language may reflect aspects of performance that are at least partially independent from cognitive/conceptual process and involve social-motivation and other factors necessary to the initiation of social behaviors (cf . Bates et al. 1989). Of course, the role of cognition in the development of *IJA* should not be underestimated as recent research suggests that, of all the ESCS measures, *IJA* may be a significant predictor of *IQ* in childhood (Ulvund & Smith, 1996). Additional research and theory in this regard may profitably consider the possibility that *IJA* provides a unique integration of socially-oriented cognitive development in young children (Mundy, 1995; Tomasello, 1995).

Finally, in considering the results of this study at least two methodological issue should be considered. A significant correlation between *RJA* and language comprehension was not observed in at least one previous study (Desrochers et al. 1995), and was observed to be associated with a small to medium effect size in another (Ulvund & Smith, 1996). Thus, caution must be exercised in interpreting the effect size of the *RJA* to language correlation observed in this study, especially given the small sample size. However, measurement issues may also be important in comparing these studies, and in future research on nonverbal communication. Desrochers et al. 1995 employed a dichotomous measure of whether or not a child demonstrated responding to joint attention skill by 15 months. Although Ulvund and Smith (1996) used the ESCS, they employed a modified ordinal scoring of the *RJA* scale. Alternatively, this study used an interval level of measurement with regard to responding to joint attention that reflected performance on both left-right trials and more difficult "behind trials." This level of measurement may provide a more powerful index of individual differences of this skill domain. It is quite possible that level of measurement may influence the extent of relations observed between early joint attention skills and language outcome. This issue may be essential to consider in subsequent research.

In conclusion, the relevance of this study may be best understood in the context of the observation that individual differences in the rate of language acquisition are highly variable in the second year (Bates, O'Connell & Shore, 1987). However, these differences are not necessarily stable. Consequently, the early identification of language delay and disorder has proved difficult before the 24 to 36 month period (Wetherby & Prizant, 1993). Previous attempts to use measures of children's nonverbal joint attention skills to predict language have met with only modest success (e.g. Bates et al. 1989; Fenson et al. 1994; Olson, Bates & Bayles, 1984). Perhaps for this reason researchers have not avidly pursued the connections between child measures of joint attention performance and language development. However, much of the previous work has used parent report measures (Bates et al. 1989), or measures of a limited set of skills (Olson et al. 1984), rather than direct observations of a varied set of gestural communication skills. Indeed, many of the previous studies have not included measures of children's response to the joint attention bids at all. Perhaps, the most basic, but important conclusion to be drawn from this study was that this type of relatively simple measurement, in addition to a measure of initiating joint attention skill, may make a substantial contribution to the prediction of language outcomes among young children. This observation may have considerable clinical utility, in addition to the theoretical pertinence. This utility may be emphasized by recent observations that *RJA* may predict lan-

guage development from as early as 6 months in a sample with normal development (Morales, Mundy & Rojas, 1998), and 12 months in an at-risk sample (Willoughby & Mundy, 1997). It is clear, though, that we currently have only the most cursory understanding of the nature and significance of this important domain of development in infancy.

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