Individual Differences in Infant Skills as Predictors of Child-Caregiver Joint Attention and Language

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Abstract

Current research suggests that the extent to which child-caregiver dyads engage in interactions involving episodes of joint or coordinated attention can have a significant impact on early lexical acquisition. In this regard it has been recognized that individual differences in early developing child communication skills, such as capacity to follow gaze and early infant language, may contribute to these child-caregiver interactional patterns, as well as to subsequent language development. To address this expectation, 21 infant-parent dyads were recruited for participation in a longitudinal study. Early infant language, responding to joint attention skill, and cognitive development were assessed at 12 months of age. Child-caregiver joint attention episodes, as well as responding to joint attention skill and child language, were assessed at 18 months of age. Developmental outcome, using the MacArthur Communicative Development Inventories and the Bayley Scales of Infant Development-II, was assessed at 21 and 24 months of age. Consistent with previous findings, results indicated that individual differences in child-caregiver episodes of joint attention were related to language at 18 months. In addition, though, 12 month vocabulary and responding to joint attention skill were associated with some aspects of 18 month child-caregiver interaction, as well as subsequent language development. In general, 12 month child measures and 18 month child-caregiver interaction measures appeared to make unique contributions to language development in this sample. These results suggest the need to further consider the role of infant skills in the connections between child-caregiver joint attention episodes and language development.

Keywords: joint attention; language development; mother-child interaction

Language development occurs within a social context. Effective communicative interactions involve continuous modification to allow for efficient processing of information. Because infants and toddlers are limited in their capacity to effectively process information, adults tend to be the agents of modification, using simplified speech and clear acts of reference in combination to format communication and facilitate lan-

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guage development for the child (Bruner, 1983). This formatting allows the adult to highlight features of the environment that are already salient to the child. Through recurrent interactive episodes, the child is provided with the opportunity to discern the attentional focus of the adult and, hence, can more easily establish the intended referent of adult language (Bruner, 1981, 1983, 1985; Bakeman & Adamson, 1984). This process facilitates the capacity of the child to associate the spoken word with some particular aspect of the current experiential environment. Thus, caregivers structure linguistic interactions, in which children actively participate, creating a format in which the caregiver's specific frame of reference can be established.

One important form of these interactions is the joint attention episode. In a joint attention episode, both members of a dyad are simultaneously focused on an object or set of objects, while maintaining awareness of the other member's parallel focus. During these joint attention episodes, children may be more proficient in their attempts to acquire a working vocabulary. Indeed, the amount of time spent by dyads interacting, within such joint attentional episodes, is directly related to the subsequent vocabulary size of the child (Tomasello & Todd, 1983; Tomasello, Mannle, & Kruger, 1986). Tomasello and Todd (1983) found that longer sustained episodes of joint focus provide an interactive context which leads to larger vocabularies in the children of such dyads. Language development in twins is often delayed, for example, because of the additional time constraints of two infants on one caregiver affording a relatively smaller fraction of time in joint attentional episodes with their caregivers (Tomasello, Mannle, & Kruger, 1986). Hence, the optimal environment for language learning and development in young children may be characterized by greater amounts of time spent with caregivers, within episodes of joint attentional focus.

The particular communicative style employed by caregivers within these episodes of joint attentional focus is also related to early language development. The 'attentional mapping' hypothesis maintains that maternal utterances which follow into the child's current attentional focus relate to increased vocabulary acquisition (Bakeman & Adamson, 1984; Bruner, 1983; Dunham, Dunham, & Curwin, 1993; Harris, Jones, Brookes & Grant, 1986; Tomasello & Farrar, 1986). Tomasello and Farrar (1986) observed that, when a caregiver remark follows the attentional focus of the child, the child does not need to attempt to determine the object of reference. Thus, lexical development may be facilitated by the caregiver's skill in determining and responding to the child's focus of attention. Caregivers' tendency to follow child attentional focus may decrease mapping errors, thereby facilitating language development.

It is also likely, though, that the ability to avoid mapping errors may be related to child skills which contribute to the interactive joint attention process (Baldwin, 1995). Prior to the development of language, infants begin to develop the primary capacities for engagement with others in joint attentional episodes. The ability to accommodate their gaze to correspond with adult focus of attention may begin to develop in some infants as young as 2–6 months of age (Butterworth & Grover, 1990; Scaife & Bruner, 1975). During the 6 to 9 month period of development, however, this ability begins to consolidate, with many infants demonstrating the basic ability to follow the visual regard of others (Butterworth & Cochran, 1980; Butterworth & Jarret, 1991; Corkum & Moore, 1998). Beginning around nine months of age, infants begin to intentionally seek coordination between their own visual regard and that of another person on an object of joint attention (Bakeman & Adamson, 1984). Between the ages of 12 and 18 months, infants develop the capacity to extend joint reference to a 'represented' space which includes referent targets outside their field of view, or behind the infant

(Butterworth & Grover, 1990). Thus, the capacity to share visual attention may depend on the development of underlying mechanisms which allow the infant to rely on social indications of adult point of view.

The infant's ability to look or understand where someone else is looking may be critical to the social coordination of attention necessary for language acquisition (Baldwin, 1993; Bruner, 1983; Butterworth & Grover, 1990). Indeed, individual differences in infants' ability to respond to joint attention, or correctly turn in the direction indicated by a tester, have been observed to be correlated with subsequent language development in the second year (Mundy & Gomes, 1998; Mundy, Kasari, Sigman, & Ruskin, 1995). Recently, individual differences among infants in this skill, as early as six months of age, have been observed to predict language development (Morales, Mundy, & Rojas, 1998). Thus, in addition to caregivers' contributions, research also suggests that infants' skill in following line of regard may play a role in the connection between engagement in joint attention episodes and language outcome.

While it is highly likely that early experiences with the caregiver may affect infant nonverbal communication skills, the early developing communication skills of the infant may also be expected to influence caregiver-child dyadic interactions and, subsequently, impact language development (Mundy & Gomes, 1997; Tomasello, 1988). Although recognized as an important issue (Bakeman & Adamson, 1984; Bruner, 1983; Dunham, Dunham, & Curwin, 1993; Tomasello & Farrar, 1986), research has largely ignored how individual differences in earlier developing infant skills, such as capacity to engage in joint attention or even early lexical development (Dunham & Dunham, 1992), may influence child-caregiver interactional patterns, as well as provide a unique contribution to the prediction of language development.

This study was designed to contribute to a more complete understanding of the dynamic relationship between joint attention, caregiver-child interaction, and the early acquisition of language. Two primary hypotheses were examined. First, following from Tomasello and Farrar (1986), it was expected that total time spent by infant-parent dyads within episodes of joint focus at 18 months would be associated with early language development. The second hypothesis was that individual differences in earlier infant communication skills, such as early receptive language skill or infants' ability to engage in joint attention by following the gaze of a social partner, may be related to later individual differences in child-caregiver joint attention interactions (Dunham & Dunham, 1992; Mundy & Gomes, 1997). This hypothesis raised two additional issues to be explored in this study.

First, both early lexical development and gaze following skills have been related to later language development (e.g., Dunham & Dunham, 1992; Mundy & Gomes, 1998). Therefore, the possibility that early infant language and joint attention skills may be related to individual differences in mother-child joint attention interactions raises the need to explore the degree to which these three domains make unique or non-unique contributions to the prediction of later language development. Second, very little is known about the nature of individual differences in infants' joint attention skills (Mundy & Gomes, 1998). It has been suggested that infant joint attention skills begin to develop between 6 and 12 months, but consolidate between 12 and 18 months (Butterworth & Jarrett, 1991; Corkum & Moore, 1998; Morales et al., 1998; Tomasello, 1995). However, it is not clear which age or ages are optimal for the assessment of individual differences in the development of infant joint attention skills. In this study, a step toward exploring this issue was taken by comparing the predictive

utility of infant joint attention skills assessed at 12 and 18 months, the beginning and end of the hypothesized consolidation period for infant joint attention skill development.

Methods

Sample

Participants were 21 infant-parent dyads (11 girls, 10 boys) taking part in a longitudinal study of social-communication development. The infants came from two-parent families of middle to upper socio-economic status, with maternal education ranging from two years of college to a postgraduate level of education. Infant ethnicity included eight Caucasian (non-Hispanic), three Hispanic, one African-American, and nine infants of multi-ethnic (Hispanic-Anglo) background. Infant data from assessments conducted at 12, 18, 21, and 24 months was used in this study. Descriptive data for the infants at these ages is presented in Table Two.

Measures

All testing was conducted in a sound-attenuated chamber. Infant capacity to follow gaze, across six gaze-and-point following trials with a tester, was assessed at 12 months of age using an abbreviated version of the Early Social-Communication Scales (ESCS; Mundy, Hogan, & Doehring, 1996). During the ESCS administration, the infant and tester were seated directly across from each other at a table. The infant was seated on the caregiver's lap, facing the tester. A standard set of toys was placed next to the tester, in view of the infant. The ESCS was administered over a period of twenty minutes, during which time the tester presented a series of situations and toys designed to elicit requests, directions, shared attention, social interaction, and turn-taking from the child.

At two different points during the ESCS administration, the tester attempted to direct the attention of the child to three pictures of cartoon characters which were placed on the walls, to the left, right, and directly behind the infant. These trials were administered immediately following a brief song and tickling interaction, and began with the tester drawing the child's attention to their face by touching their nose. The critical measure here, to be referred to as responding to joint attention, was the ability of the child to turn their eyes and head in the correct direction when the tester turned their head, called the child's name, and pointed to the left, right, or behind the child. During each point and gaze following trial, the tester said the child's name three times, while maintaining their gaze on a referent target that was 90 degrees to the right or left of the infant, or 180 degrees behind the infant. On left and right trials, a head turn or eye shift of at least 45 degrees off midline in the correct direction was scored as a correct response. On behind trials, the child had to look past their own shoulder. In total, six of these Responding to Joint Attention trials, two in each direction, were interspersed across the twenty minute interaction. The percentage of trials on which infants demonstrate a correct gaze following response constitutes the Responding to Joint Attention score of the ESCS.

Parent-infant free-play interactions were videotaped and coded for episodes of joint attention at 18 months (following the methods of Tomasello & Farrar, 1986). Personal communication with Tomasello was used to clarify nuances in the coding system.

Dyads were provided with a standard set of novel toys and instructed to play as they typically would in their natural setting. Parents were instructed to 'Do what you normally do.' Each free play session was subsequently coded for joint attention episodes, defined as episodes of 3 seconds or more, initiated by either member of the dyad, in which both members were simultaneously focused on the same object and the child indicated awareness of their joint focus. Two measures from this observational system were used in this study, duration, as defined by the total amount of time spent by dyads within such episodes, and frequency, as defined by the total number of these episodes, over the 5-minute play session.

Child vocabulary development was assessed using the MacArthur Communicative Development Inventories (MCDI-1 and MCDI-2; Fenson, Pethnik, & Cox, 1994) at 12, 18, 21, and 24 months of age. Infants receptive and expressive vocabularies at 12 and 18 months, and their expressive vocabularies at 21 months, were assessed using the MCDI-1. Infants expressive vocabulary was assessed at 24 months, using the MCDI-2. The MCDI-1 and MCDI-2 are abbreviated versions of the original MacArthur Communicative Development Inventories and are parent report measures, in which parents rate a checklist of words for understanding and expression by the infant. The checklists consist of eighty-nine and one hundred words, respectively. For each of the words on the list, the caregiver must indicate child understanding and child expression, yielding a total count of receptive and expressive words for each age.

In addition, cognitive development was assessed using the Bayley Scales of Infant Development-II (BSID-II; Psychological Corporation, 1994) at 12 and 24 months of age. The BSID-II is an individually administered examination that assesses developmental functioning. Administration and scoring of test items is done in a standardized fashion, yielding an index score of cognitive development, with a mean of 100 and a standard deviation of 15.

Coding Procedures

On the Responding to Joint Attention index, two independent coders rated videotapes for the direction of the infant gaze or head turn. A gaze or head turn was scored as a correct response if it was in the same direction of the tester's gaze and point. The rating procedure yielded one score, which was the percentage of trials on which the first response was rated as correct gaze following. A sample of 10 subjects was randomly selected for reliability coding. Paired samples correlations calculated for percentage correct were $r = 1.00$, $p < .000$.

Mother-child free-play interactions were also rated by two independent coders for episodes of joint attentional focus. Episodes of joint attentional focus (as defined by Tomasello & Todd, 1983), met the following conditions 1) the onset began with either member of the dyad initiating interaction with the other, 2) both members of the dyad proceeded to engage in simultaneous joint focus on an object, or set of objects, for a period of at least three seconds, and 3) the child indicated awareness of their joint focus through some overt behavior towards the mother, such as a look to her face. An episode was ended by either member shifting attentional focus elsewhere, for a period of at least one second. Several measures from this observational system were used in this study. Over the 5-minute play sessions, duration, as defined by the total amount of time spent by dyads within such episodes, frequency, as defined by the total number of these episodes, and child initiates, defined by the number of episodes initiated by

the child, were used in our analyses. A sample of 10 subjects was randomly selected for reliability coding. Paired samples correlations calculated for duration were $r = .89$, $p < .001$, frequency were $r = .96$, $p < .000$, and child initiates were $r = .90$, $p < .000$, two-tailed.

Results

Responding to Joint Attention Skill

Research suggests that infant Responding to Joint Attention skill consolidates between the 12 and 18 month period (Butterworth & Jarrett, 1991; Corkum & Moore, 1998). Therefore, analyses were conducted to investigate the developmental status of variation in this ability, at both 12 and 18 months. Performance on the Responding to Joint Attention skill measure at both 12 and 18 months is presented in Table 1. Responding to Joint Attention skill was analyzed for growth over time and found to increase significantly from a mean of 66% correct responses at 12 months to a mean of 81% correct responses at 18 months ($t(20) = 1.91$, $p < .05$, one-tailed). However, unlike previous research (Mundy & Gomes, 1998), little evidence of stability was observed between the 12 and 18 month Responding to Joint Attention measure in the present study, ($r(20) = -.22$, $p = .34$).

Table 1. Descriptive Statistics for Responding to Joint Attention Measures

Descriptive statistics for RJA measures	RJA 12 months	RJA 18 months
Mean Percentage Score	.66 (66% correct)	.81 (81% correct)
Standard Deviation	.23	.20
Frequencies of Percentage		
17% correct	2	0
33% correct	0	1
50% correct	3	1
60% correct	2	1
67% correct	7	5
83% correct	3	5
100% correct	3	8
*Frequencies of Number Correct**		
0	0	0
1–2	3	1
3–4	11	10
5–6	6	10

* Frequencies of Number Correct reflects the raw score for trials passed. While this is generally out of a total of six possible trials, due to experimenter error or testing conditions (i.e. child upset), this may reflect out of three or five trials as well. For this reason, we consolidated the frequencies into groups of two for greater accuracy. Further, the percentage score more precisely describes RJA skill.

Receptive and Expressive Language

Previous research has suggested that early in development receptive and expressive language evolvement may reflect partially independent processes (Bates et al., 1989), and these may yield different relations with nonverbal communication skills (Mundy & Gomes, 1998). Therefore, the primary correlation analyses were conducted separately for receptive and expressive language measures. Means and standard deviations for all variables are presented in Table 2. Both receptive and expressive language were analyzed for language growth over time. Reported receptive language on the MCDI increased significantly from 12 to 18 months ($t(20) = 8.45$, $p < .001$), and reported expressive language on the MCDI increased significantly between each time period measured at 12, 18, 21, and 24 months ($F(3, 60) = 94.38$, $p < .001$).

Receptive Language and Time Spent Within Joint Attention Episodes

Pearson correlation analyses were conducted to examine relations among variables in this study. To insure that significant findings were not the result of effects of distributions in small samples, non-parametric Spearman's rho correlations were also computed and presented in the appropriate tables. Few differences of magnitude were observed between the parametric and non-parametric analyses in this study. Therefore, for the most part, the results of the parametric analyses are emphasized in the text.

Table 2. Means and Standard Deviations for Language, Mental Development, Responding to Joint Attention, and Mother-Child Interaction Variables

	Mean	Standard Deviation
Receptive Language: Number of Words		
12 months	31.91	12.24
18 months	56.62	13.06
Expressive Language: Number of Words		
12 months	5.50	3.67
18 months	21.05	13.04
21 months	33.43	14.20
24 months	46.86	18.69
Bayley Mental Development Index		
12 months	97.62	13.35
24 months	92.89	9.41
RJA Percent Correct		
12 months	66.10	22.92
18 months	80.50	19.98
Mother-Child Interaction (18 months)		
Total Frequency of Episodes	10	2
Duration (Total Seconds Within Episodes)	183	45
Child Initiates (Number of Episodes)	2	2

Table 3. Correlations of Language and Mental Development with Responding to Joint Attention and Mother-Child Interaction Joint Attention Episodes[a]

	RJA[b]		Mother-Child JA Episodes[c] (18 months)		
	12 months	18 months	Frequency	Duration	Child Initiates
Receptive Language					
12 months	.34 (.18)	.14 (.18)	.34 (.29)	**.55* (.53)***	.32 (.34)
18 months	–.12 (–.19)	.20 (.17)	.14 (.21)	**.56** (.56)****	–.04 (–.01)
Expressive Language					
12 months	.30 (.30)	–.19 (–.21)	.32 (.26)	.27 (.20)	**.57** (.58)****
18 months	**.49* (.51)***	–.17 (–.22)	.37 (.42)	–.02 (–.02)	.19 (.26)
21 months	**.52* (.50)***	–.13 (–.16)	.31 (.30)	.20 (.20)	.13 (.28)
24 months	.42 **(.46)***	–.21 (–.25)	.28 (.33)	.13 (.19)	.15 (.37)
Responds to JA					
12 months	1.00	–.22 (–.28)	**.60** (.48)***	.19 (.01)	.17 (.12)
18 months	–.22 (–.28)	1.00	–.14 (–.13)	.20 (.19)	–.20 (–.26)
Bayley MDI[d]					
12 months	**.48* (.61)****	.25 (.09)	.06 (.13)	.09 (.07)	.13 (.10)
24 months	**.62** (.54)***	.02 (.17)	.16 (.04)	.20 (.14)	.19 (.18)

$^{*}p < .05$. $^{**}p < .01$.
All reported significance levels are two-tailed.
[a] Spearman Rho correlation in parentheses.
[b] Responding to Joint Attention.
[c] Infant-Parent Joint Attention Interactions.
[d] Bayley-II Mental Development Index.

The amount of time spent by dyads interacting in episodes of joint attentional focus has already been found to relate to the subsequent vocabulary size of the child (Tomasello, Mannle, & Kruger, 1986; Tomasello & Todd, 1983). Consistent with previous results, the amount of time infant-parent dyads spent in joint attention episodes at 18 months in this study was positively associated with reported receptive language on the MCDI at 18 months ($r(21) = .56$, $p < .05$). (See Table 3). One new and important observation was that receptive language on the MCDI at 12 months predicted duration of joint attention episodes at 18 months ($r(20) = .55$, $p < .05$), as well as receptive language at 18 months ($r(21) = .44$, $p < .05$). (See Tables 3 and 4). However, it is important to note that evidence of association between time spent within episodes of joint attention at 18 months and receptive language at 18 months remained moderately strong, even after first considering variance associated with receptive language at 12 months (partial-$r = .46$, $p = .058$). The 12 month responding to joint attention measure was not a correlate of receptive language development in this study.

Expressive Language, Frequency of Joint Attention Episodes, and Responding to Joint Attention

Infants' Responding to Joint Attention skill at 12 months of age was not correlated with receptive or expressive language at 12 months (see Table 3). Responding to

Table 4. Correlations of Language and Mental Development

	Receptive Language:		Expressive Language:			Bayley MDI[a]:		
age in months:	12	18	12	18	21	24	12	24
Receptive Language								
12 months	1.00	**.44***	**.56****	.24	.39	.25	**.45***	.28
18 months	.44*	1.00	.11	–.01	–.03	–.06	–.04	–.07
Expressive Language								
12 months	**.56****	.11	1.00	**.57****	**.53***	**.46***	.40	.23
18 months	**.44***	–.01	**.57****	1.00	**.82****	**.82****	.43	.32
21 months	.39	–.03	**.53***	**.82****	1.00	**.94****	.39	**.53***
24 months	.25	–.06	**.46***	**.82****	**.94****	1.00	.36	**.51***
Bayley MDI								
12 months	**.45***	–.04	.40	.43	.39	.36	1.00	**.67****
24 months	.28	–.07	.23	.32	**.53***	**.51***	**.67****	1.00

[a] Bayley-II Mental Development Index.
* $p < .05$, ** $p < .01$.

Joint Attention skill at 12 months of age was positively associated with reported expressive language at 18 months ($r(20) = .51$, $p < .05$), and 21 months ($r(20) = .50$, $p < .05$). This relation approached significance for the 24 month data ($r(20) = .42$, $p = .09$). The non-parametric correlation for the 24 month data was significant (rho = .46, $p < .05$), (see Table 3). Because Responding to Joint Attention skill, however, was not correlated with expressive language at 12 months, a significant connection to early language scores could not explain the predictive validity of 12 month RJA in this study. For example, ability to respond to joint attention at 12 months remained significant in its association with expressive language at 21 months, even after first considering variance associated with expressive language at 12 months (partial-$r = .46$, $p < .044$). Moreover, it approached significance in its association with expressive language at 21 months even after first considering variance associated with cognitive development as indexed with the Bayley MDI at 12 months (partial-$r = .31$, $p < .067$). The 18 month responding to joint attention measure was not a correlate of expressive language development, nor any other major variable in this study, perhaps reflecting lack of meaningful variability in this skill once it has been consolidated.

Infants' Responding to Joint Attention skill at 12 months was positively associated with number of caregiver-infant joint attention episodes at 18 months ($r(20) = .48$, $p < .05$), but not with duration of joint attention episodes. The association between Responding to Joint Attention skill at 12 months and frequency of joint attention episodes at 18 months remained significant, even after first considering variance associated with cognitive development (Bayley MDI) at 12 months (partial-$r = .71$, $p < .001$). Frequency of joint attention episodes at 18 months also approached significance in relation to 18 month expressive language ($r(20) = .37$, $p = .10$). The non-

parametric correlation for the relation between frequency of episodes and expressive language at 18 months was significant (rho = .42, $p < .05$), (see Table 3). It is worth noting that the relation between Responding to Joint Attention skill at 12 months and expressive language at 18 months continued to approach significance, even after first considering variance associated with number of joint attention episodes at 18 months (partial-$r = .34$, $p = .07$), one-tailed.

Some measures of infant lexical capacity have been shown to predict ensuing lexical development (Dunham & Dunham, 1992), and may relate to episodes of dyadic interaction. Correlational analyses revealed that reported child expressive language at 12 months predicted the number of joint attention episodes initiated by the child at 18 months ($r(21) = .57$, $p < .05$). However, the number of episodes initiated by either member of the dyad was unrelated to measures of subsequent language development. (See Table 3).

Responding to Joint Attention and Mental Development Index

An additional observation revealed that the ability to respond to joint attention at 12 months was not only associated with a parent report measure of language, but also with direct observations of infant task performance on a more general measure of cognitive development, the Bayley-II, at 12 months ($r(19) = .61$, $p < .05$) and 24 months ($r(17) = .54$, $p < .05$). The association between ability to respond to joint attention at 12 months and mental age at 24 months remained significant, even after first considering variance associated with mental age at 12 months (partial-$r = .51$, $p < .043$), or 12 month expressive language scores (partial-$r = .59$, $p < .013$). None of the caregiver-child measures of joint attention episodes were correlated with infant performance on the Bayley index of cognitive development in this study.

Discussion

The results of this study provide further support for the seminal observation of Tomasello and colleagues that individual differences in the capacity of mother-child dyads to establish and maintain episodes of joint attentional focus are related to ensuing language development (e.g., Tomasello & Farrar, 1986). Equally important, though, the results of the present study support the need to consider the role that earlier infant communication behaviors may play in the development of individual differences in dyadic joint attention interactions at 18 months, as well as in subsequent language and cognitive development.

Consistent with the hypotheses espoused by Dunham and Dunham (1992), receptive language skills at 12 months predicted time spent within mother-child interactive episodes of joint attentional focus. Additionally, expressive language skills at 12 months predicted the number of episodes of joint attentional focus initiated by the child at 18 months. Thus, early individual differences in child language skills were related to subsequent episodes of mother-child joint attention interaction in this sample. However, subsequent analyses indicated that 18 month joint attention episodes appeared to have a relation to 18 month language development that was independent of variance shared with prior 12 month language development scores. These data, then, reaffirm the unique significance of the effect that mother-child joint attention joint

interactions in the second year may have on language development (Bruner, 1981; Tomasello & Todd, 1983). It should be noted, though, that sample size constraints may have prevented observation of an independent contribution of 12 month child language to later lexical development, independent of 18 month mother-child interaction measures in this study.

Relations between the 12 month measure of child skill in responding to joint attention and expressive language at 18, 21, and 24 months were also observed in this study. These results replicated previous observations of a link between responding to joint attention and language development in normal samples (Morales, et al., 1998; Mundy & Gomes, 1998; Mundy, et al., 1995). Additionally, these results were consistent with the notion that the 12 to 18 month interval reflects a period of consolidation in gaze following or responding to joint attention (Butterworth & Cochran, 1980). Indeed, infants in this study appeared to approach an asymptote on the RJA measure by the age of 18 months. Perhaps this was associated with a reduction in meaningful individual differences at 18 months and this played a role in the present observation that the 12 month RJA measure appeared to be more consistently related to outcome than did the 18 month RJA measure. A reduction of meaningful individual differences at 18 months may also help to explain why a lack of stability in RJA was observed here, contrary to earlier observations in the 14 to 17 month period (Mundy & Gomes, 1998).

In addition to associations with subsequent language development, infant Responding to Joint Attention skill at 12 months was also observed to relate to some aspects of mother-child interaction at 18 months. However, infant Responding to Joint Attention skill was related to aspects of 18 month mother-child joint attention interactions that did not display significant links to language development in this study. This pattern of data suggests that infant Responding to Joint Attention skill may be related to language development by way of processes that are not entirely overlapping with the processes that link mother-child joint attention interactions to language development.

Additional support for the latter suggestion comes from the observation that the infant Responding to Joint Attention measure, but not mother-child joint attention interaction measures, were related to subsequent performance on the Bayley index of cognitive development. Other research has also observed links between infant joint attention measures and standardized IQ test performance (Ulvund & Smith, 1996) increasing confidence in the reliability of the observation of a link between responding to joint attention and Bayley performance in this study. It is not clear, though, whether correlations between the 24 month Bayley and 12 month RJA measures reflected the large role verbal items play in the Bayley at 24 months. However, the pattern of correlations with the Bayley cognitive index in this study support the general notion that infant joint attention measures may tap aspects of joint attention development that are somewhat distinct from those captured in mother-child interaction measures. These results also suggest that responding to joint attention measures may have considerable basic and applied value in the study of individual differences in developmental outcomes for normal and at risk samples (Mundy & Gomes, 1998; Ulvund & Smith, 1996).

Perhaps individual differences in Responding to Joint Attention skill reflect a basic element of social cognitive competence on the part of the child that is a necessary first step in the capacity of mother-child dyads to establish joint attentional focus (Baldwin, 1995; Mundy & Gomes, 1997). Individual differences in infant responding to joint

attention may reflect an aspect of early development that, while impacted by caregiving, also reflects variance in constitutional aspects of the social-cognitive maturation of the infant. This may involve the maturation of basic attention regulation processes, as well as spatial analytic processes involved in encoding the location of stimuli relative to body and eye (Butterworth & Jarrett, 1991; Mundy, Card, & Fox, submitted). The constitutional contribution to the development of Responding to Joint Attention skill may be envisioned as part of an adaptive, self-organizing system which enables infants to organize and process social interaction information in a manner that optimizes their capacity to gain from social learning situations (Bruner, 1981; Baldwin, 1995; Mundy, 1999).

While this child skill may provide a necessary prerequisite for entry into the rich social learning milieu of the joint attention episode, it may not contribute to the ability of the child to maintain or elaborate on such episodes. Alternatively, caregivers may contribute to the optimization of the content of a joint attention episode through maintaining and elaboration techniques, and this may provide the substantial link between maternal behavior, joint attention, and language development (Tomasello & Farrar, 1986). Indeed, the degree to which the child benefits from episodes of joint attention may depend on how stimulating these episodes are made by the caregiver. It is the caregiver who structures and maintains the episode, through competence in following and elaborating on the attentional focus of the child. Nevertheless, even when the caregiver displays proficiency in this area, the child must still be able to monitor maternal gaze in order to benefit from their joint focus. Conversely, an infant facile with joint attention skills may receive little benefit from this proficiency if paired with an unresponsive caregiver. Hence, the results of this study potentially contribute to the further consideration of a transactional process model which raises questions regarding the manner in which caregiver communicative style and infant joint attention skill may interact in contributing to language development (Mundy & Gomes, 1997; Yoder & Warren, 1998).

Of course, there were numerous methodological issues that suggest the need for caution in interpreting the results of this study. Due to sample size constraints, null findings in this study may have reflected a lack of power to observe significant relations, rather than the true lack of relations between variables. Equally important, the direction of effects of early child language and nonverbal communication on later caregiver-child interaction was ambiguous in this study as it was not clear to what degree early maternal behaviors contribute to the continuity between the 12 month child measures and child-caregiver interaction at 18 months. Nevertheless, the results of this study are heuristic in that they demonstrate the need to look at antecedent processes, either within the context of the infant-parent interaction or within infants themselves, in order to better understand the relationship between episodes of joint attention and language development in the second year of life.

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