

Responding to Joint Attention Across the 6- Through 24-Month Age Period and Early Language Acquisition

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This study examined individual differences in the development of the capacity of infants to respond to the joint attention bids of others (e.g., gaze shift, pointing, and vocalizing) across the first and second year. The primary aim of the study was to determine if responding to joint attention (RJA) in the first and second year was related to subsequent vocabulary acquisition and whether a specific period of development during the first 2 years was optimal for the assessment of individual differences in this skill. The study was also designed to determine if RJA provided unique predictive information about language development over and above that provided by parent reports of early vocabulary acquisition. Findings indicated that RJA at 6, 8, 10, 12, and 18 months was positively related to individual differences in vocabulary development. Furthermore, both a 6- to 18-month aggregate measure of RJA and a parent report measure of language development made unique contributions to the predictions of vocabulary acquisition. Finally, individual differences in RJA measured at 21 and 24 months were not related to language development.

Over the past two decades research and theory have highlighted the important role of joint attention in early language acquisition (Bakeman & Adamson, 1984; Baldwin, 1995; Dunham & Dunham, 1992; Mundy & Gomes, 1997; Scaife & Bruner, 1975; Tomasello & Farrar, 1986). Joint attention refers to the capacity of an infant to coordinate her attention with a social partner vis-a-vis an object or event. Episodes of joint attention are thought to promote language acquisition because these types of object-mediated social interactions help infants identify the intended referent of

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parents' language, thus facilitating word-object mappings (Dunham & Dunham, 1992; Ninio & Bruner, 1978; Tomasello, 1988). As such, individual differences in joint attentional skills, such as the capacity to follow another's direction of gaze, may significantly affect language acquisition because of the influence these skills may have on the mapping process (Baldwin, 1995). The association between individual differences in the capacity to engage in joint attention and language development may be studied using a variety of perspectives and paradigms.

One prominent approach is to observe the degree to which infant-caregiver dyads engage in episodes of joint attention during interactions and then to relate details of these observations to aspects of language development (Dunham & Dunham 1992; Harris, Jones, Brookes, & Grant, 1986; Rocianno & Yatchmink, 1983; Tomasello & Farrar, 1986; Tomasello & Todd, 1983). For example, Tomasello and colleagues (Tomasello & Farrar, 1986; Tomasello & Todd, 1983) examined the relations between mother's regulation of children's attentional states during joint interactions and vocabulary acquisition. These researchers found that children of parents who initiated joint interaction by redirecting their child's attention had smaller vocabularies than children of parents who initiated joint interaction by following into their child's focus of attention. Notably, this approach has tended to emphasize the parent's role in attention regulation and its effects on language development to the exclusion of how individual differences in children's ability to follow direction of gaze may moderate the effects of attentional redirection during joint interaction.

An alternative, more psychometric approach has also been used to examine the associations between individual differences in the capacity to engage in joint attention and language acquisition. This approach focuses on the assessment of individual differences in the infants' capacity to demonstrate behaviors indicative of joint attention skill in a structured assessment situation, often with an unfamiliar tester (e.g., Bates, 1979; Coggins & Carpenter, 1981; Mundy & Gomes, 1998; Seibert, Hogan & Mundy, 1982; Snyder, 1978; Wetherby, Prizant, & Hutchinson, 1998). There are several basic assumptions attendant to the latter paradigm.

First, it is assumed that individual differences in the development of the capacity for joint attention are effected by both maturation and environmental/interactional processes (Mundy & Sheinkopf, 1998). In this regard, joint attention skills are thought to emerge gradually and incrementally over the first 2 years in response to a dynamic integration of basic information processing, social-cognitive, self-regulatory, and social-emotional factors that infants bring to bear in social interaction with caregivers and others (Dunham & Dunham, 1995; Mundy & Gomes, 1997; Mundy & Sheinkopf, 1998; Mundy & Willoughby, 1996, 1998). This view diverges from, but complements, other contemporary theory, such as a neo-Piagetian approach emphasizing the epistemologic significance of joint attention and a stage-like developmental progression (Tomasello, 1995) or research on operant social learning mechanisms in joint attention (Moore & Corkum, 1994). Finally, theoretical notions arising from the skills approach suggest the integration and synthesis of basic processes in joint attention development may yield a domain of development that provides unique information about the current and future developmental status

of the child (Mundy & Gomes, 1997). Operationally, this means that joint attention measures may be expected to be predictive of outcomes above and beyond other infant measures, which may share common cognitive or social processes. If valid, this perspective has implications for basic and applied research on joint attention development.

Recent research on Responding to Joint Attention skill (RJA) offers some support for this perspective. Responding to joint attention skill refers to the capacity of the infant to follow the gaze, head turn, pointing gesture, or a combination thereof of a social partner. The measurement of this skill was one of the first operationalizations of joint attention (Scaife & Bruner, 1975). However, it was not until 1995 that research suggested that individual differences in this type of skill, as measured in the second year, may be a significant correlate of early vocabulary acquisition (Mundy, Kasari, Sigman, & Ruskin, 1995; Desrochers, Morissette, & Ricard, 1995). Subsequent research has suggested that RJA may be an especially strong correlate of early receptive language skills (Mundy & Gomes, 1998). Responding to joint attention has been observed to predict language development into the third year in "at risk" samples from 12 through 13 months (Ulvund & Smith, 1996; Willoughby, Mundy, & Claussen, 1997) and may predict language development from as early as 6 months of age (Morales, Mundy, & Rojas, 1998). Furthermore, RJA measured at 12 months may relate to components of mother-child joint attention interactions at 18 months, yet make a unique contribution to the prediction of language relative to mother-child interaction measures of joint attention (Markus, Morales, & Mundy, 1998). Finally, it is important to note that RJA has been observed to predict language development above and beyond variance shared with early standardized measures of cognition or language development (Mundy & Gomes, 1998; Mundy et al., 1995).

These studies suggest that a measure of RJA skill development may be a particularly useful index in early social communication assessments used to identify children at risk for language delays. This may be especially true because RJA measures are brief and easily implemented alone or in the context of a broader assessment battery. Nevertheless, little information is available on the factors that may affect the assessment utility of these measures. For example, several studies suggest that the capacity to respond to joint attention develops throughout the second year with the child increasingly capable of correctly fixating targets that have been indicated by others to the left, right, and behind the toddler (Butterworth & Cochran, 1980; Butterworth & Jarret, 1991; Morissette, Ricard, & Gouin-Decarie, 1995). It is often the case, however, that measures of infant development have an optimal developmental window for assessment of individual differences that are predictive of subsequent outcomes (Bornstein, Slater, Brown, Roberts, & Barrett, 1997). Theory suggests that joint attention skills consolidate in the 12- to 18-month period (Adamson & McArthur, 1995). Thus this period may be optimal for the clinical assessment of RJA. No study, however, has addressed this important issue.

It is also not clear whether the assessment of RJA provides unique information about development relative to other measures of early communication skill development. Responding to joint attention has been observed to predict subsequent lan-

guage development above and beyond standardized measures of cognition, language, and even other forms of joint attention skills (Mundy & Gomes, 1998; Mundy et al. 1995). However, recent research has suggested that parent reports of early vocabulary development may provide a particularly informative measure of early and subsequent language and communication development (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994). Therefore, it may be especially important to examine the predictive validity of RJA measures relative to parent-report measures of lexical development.

These issues were addressed in this study. In a previous brief report from this longitudinal study it was found that individual differences in RJA may be observed as early as 6 months of age and that these were related to subsequent language development (Morales et al., 1998). In this study, we present data on the development of RJA skill at 6, 8, 10, 12, 15, 18, 21, and 24 months of age. The growth and stability of RJA skill were examined, as were the relations between RJA and language development at 30 months of age. Parent reports of 24-month vocabulary acquisition were also assessed, and the data were analyzed to determine whether both RJA and parent report of prior vocabulary made independent predictions of language development at 30 months of age.

Three hypotheses were tested. Speculation regarding the primary consolidation period of joint attention skills (Adamson & MacArthur, 1995) suggested that individual differences in RJA, through 18 months of age, would be predictive of language development. Thus we expected that infants who performed better on an RJA measure would evidence greater gains in vocabulary acquisition at 24 and 30 months than children who did not. Skill theory (e.g., Mundy & Gomes, 1997) suggested that RJA would provide unique information about language development and, therefore, would predict language development above and beyond contemporaneous parent-report data on vocabulary development. Finally, psychometric theory suggested that an aggregate measure of RJA, combined across different developmental points of assessment, would provide a better predictor of language development than a measure of RJA obtained on a single occasion of assessment (Epstein, 1980; Halverson & Post-Gordon, 1984; Riese, 1987; Seifer, Sameroff, Barrett, & Krafchuk, 1994; Wachs, 1987).

METHOD

Overview

This is the second report of a longitudinal study investigating early communicative development in 22 infants. Laboratory assessments of infants' ability to respond to joint attention were conducted at 2-month intervals when infants were between 6 and 12 months of age, and at 3-month intervals when infants were between 12 and 24 months of age. Thus RJA assessments were presented when infants were 6, 8, 10, 12, 15, 18, 21, and 24 months of age. Mothers reported on children's expressive language development when infants were 24 and 30 months old, and laboratory assessments of expressive and receptive language were conducted when infants were 30 months of age.

Participants

The sample of 22 infants (and their parents) participating in this study included 10 boys and 12 girls who came from two-parent middle to upper middle socioeconomic status families (Hollingshead, 1978). Maternal education ranged from 2 years of college to postgraduate level with median educational level being 4 years of college. Eight of the infants were White (non-Hispanic), three were Hispanic, one was African American, and ten were of multiethnic background (e.g., Hispanic and Anglo).

Procedure

Setting. Each RJA assessment was carried out in a 3-m \times 3-m sound-attenuated laboratory playroom. The furniture in the laboratory for the 6-month procedure consisted of one infant high chair and one adult chair located in the center of the laboratory. The furniture in the laboratory for the 8- to 24-month procedure consisted of two chairs and one table located in the front half of the laboratory. Three wooden targets were mounted on the walls of the laboratory at infant eye level. The first target was positioned 90° to the left of the infant, the second target was positioned 90° to the right of the infant, and the third target was positioned 180° behind the infant. Infants and mothers were videotaped using two wall-mounted cameras. One camera was stationed behind the mother facing the infant, and the other camera was stationed behind the infant facing the mother.

6-Month Procedure. The 6-month assessment of RJA was administered within the context of a parent-child interaction. In this procedure, the infant was seated in a high chair, and the parent was seated facing her infant. Each session began with a 7-minute face-to-face interaction. The interaction consisted of two 3-minute free-play paradigms and one 1-minute still-face paradigm designed to explore other issues in this longitudinal study (e.g., Fullmer & Messinger, 1997; Yale, Messinger, Cobo-Lewis, Oller, & Eilers, 1999).

Immediately after this sequence, RJA was assessed using an adapted version of the Early Social Communication Scales RJA Task (Mundy, Hogan, & Doehring, 1996). This procedure consisted of two sets of a "Toy, Tickle, Look" sequence. In the Toy segment, mothers were instructed to hold a mechanical toy at shoulder height so that infants could clearly see it, yet not touch it. Mothers were then instructed to activate the toy three times with brief pauses between each activation. In the Tickle segment, mothers were asked to gently tickle their child three times with brief pauses between each tickle episode. After the Toy and Tickle segments, mothers were instructed to present three consecutive Look trials to their infant in which they turned and fixed on a target that was 90° to the right or left of the infant or 180° behind the infant. During each head turn trial, parents said their child's name emphatically three times, but they maintained their gaze on the referent target throughout the trial. After each trial, mothers returned their gaze to midline before executing the next trial.

8- Through 24-Month Procedure. Responding to joint attention was assessed at 8, 10, 12, 15, 18, 21, and 24 months with the Early Social Communication Scales

RJA Task (Mundy et al., 1996). In this procedure, the child was seated at a table in the parent's lap. A tester was seated directly across the table from the child and parent. Each RJA Task began with the tester clapping, singing, and obtaining the child's attention to her face. The tester then presented a set of three consecutive trials in which she turned, fixated, and pointed at a target that was 90° to the left or right of the infant and 180° behind the infant. During each head turn trial, the tester said the child's name emphatically three times. After each trial, the tester returned her gaze to midline before executing the next trial. The RJA Task was repeated a second time during the course of the Early Social Communication Scales assessment.

Coding Procedure. Three independent coders, who were blind to the language data collected in this study, rated videotapes for direction of the first infant gaze or head turn in the horizontal plane to occur during each trial. A gaze or head turn was scored as a correct response if it was in the same direction of the adult's head turn. A gaze or head turn was scored as an incorrect response if it was in the opposite direction of the adult's head turn. The rating procedure yielded two infant response scores: the total number of trials in which an infant's first response was correct and the total number of trials in which an infant's first response was incorrect. Six trials were presented when infants were 6, 8, 12, 18, 21, and 24 months of age. However, because of the length of the test battery at 10 and 15 months, only three RJA trials were presented at each of these ages.

Infant response scores were used to compute a percent RJA score for each infant. For 6-month olds, this score was calculated by dividing the total number of trials a correct response was displayed by the sum of the total number of trials that a correct response was displayed and the total number of trials that an incorrect response was displayed. For 8- to 24-month-old infants, the Early Social Communication Scales procedure yielded a percent RJA score. This score was calculated by dividing the total number of correct responses by the total number of trials presented.

A random sample of 14 infants was selected for reliability coding. Generalizability coefficients were calculated for percent RJA scores, first correct infant response, and first incorrect infant response. G coefficients were .99, .99, and .96, respectively.

Language Measures. The MacArthur Communicative Development Inventory (MCDI; Fenson et al. 1994) was used to assess individual differences in children's expressive vocabulary development at 24 and 30 months. The MCDI is designed to assess a range of communicative skills in infants and toddlers. Infants' basic expressive vocabulary was assessed using the MacArthur Short Form Vocabulary Checklist: Level II (Fenson et al., 1994).

Two standardized measures of lexical development were administered at 30 months: the Peabody Picture Vocabulary Test—Revised (PPVT-R; Dunn & Dunn, 1981) and the Expressive Vocabulary Test (EVT; Williams, 1997). The PPVT-R is designed primarily to assess children's receptive vocabulary, whereas the EVT is designed primarily to assess children's expressive vocabulary. Both measures have

Table 1. Descriptive Statistics for Responding to Joint Attention Variables

| Age | M | SD | Range |
|--------|-----|-----|----------|
| 8 mos | .19 | .21 | .00-.67 |
| 10 mos | .39 | .22 | .00-.67 |
| 12 mos | .66 | .22 | .17-1.00 |
| 15 mos | .75 | .30 | .00-1.00 |
| 18 mos | .81 | .20 | .33-1.00 |
| 21 mos | .80 | .19 | .33-1.00 |
| 24 mos | .88 | .14 | .50-1.00 |

well-established reliability and validity as early language and vocabulary measures (Dunn & Dunn, 1981; Williams, 1997).

RESULTS

Growth of Responding to Joint Attention

A repeated measures analysis of variance was conducted to examine age-related changes in RJA and to evaluate possible differences in the development of RJA associated with infant gender. The 6-month RJA data ($M = .69$, $SD = .31$) was excluded from this analysis because of differences in laboratory protocol. In the repeated measures analysis of variance, infant gender (2) was included as the between-subjects factor with age of assessment (7) as the within factor. A significant main effect was found for age; $F(6,102) = 28.96$, $p < .001$. The effects of infant gender did not significantly influence RJA in this sample.

Post hoc paired samples t tests were conducted to assess at what age differences in the capacity for RJA were most evident. The basic descriptive statistics for RJA are presented in Table 1 for 8- to 24-month olds by age group. These analyses revealed significant differences in RJA skills observed between the 8- and 10-month and the 10- and 12-month age periods; $t(1,19) = 3.36$, $p < .01$, and $t(1,19) = -3.40$, $p < .01$, respectively.

Stability of Responding to Joint Attention

To examine the stability of individual differences in RJA across the 6- to 24-month age period, Spearman-rho correlational analyses (one tailed) were conducted. Nonparametric correlational analyses were conducted to attenuate the effect outliers may have on distributions or correlational analyses in a small sample. Analyses indicated that RJA at 8 months was positively related to RJA at 10, 15, and 18 months ($\rho(21) = .36$, $p < .05$; $\rho(22) = .38$, $p < .05$; and $\rho(21) = .59$, $p < .01$, respectively). Findings also indicated that RJA at 10 months was positively related to RJA at 18 months ($\rho(20) = .40$, $p < .05$) and that RJA at 12 months was positively related to RJA at 15 months ($\rho(21) = .41$, $p < .05$). Marginal positive relations were found between RJA at 6 months and RJA at 12 and 24 months ($\rho(21) = .32$, $p < .08$, and $\rho(21) = .33$, $p < .07$, respectively) and between RJA at

21 and 24 months ($\rho(21) = .32, p < .08$). Thus some evidence was found for stability in this skill across the 6- to 24-month age period.

Relations Between Individual Differences in the Capacity to Respond to Joint Attention and Language Development

Spearman-rho analyses (two tailed) were also conducted to examine the associations between individual differences in the capacity to respond to joint attention and language development. Children's 6- to 24-month RJA scores were correlated with their 24- and 30-month raw MCDI scores and with their 30-month standardized EVT and PPVT-R scores. The results of these analyses appear in Table 2. To provide additional information relevant to subsequent multiple regression analyses, Pearson's r coefficients are presented in parentheses. There was little variation in the results of nonparametric versus parametric analyses of the relations between RJA and language development. Hence for the reasons enumerated above, we will continue to emphasize the results of the nonparametric analyses.

As seen in Table 2, significant associations were found between 6-, 8-, 10-, 12-, and 18-month RJA measures and vocabulary acquisition. In particular, RJA at 6, 8, and 10 months was significantly and positively correlated with receptive vocabulary at 30 months. Also, there were a number of significant associations between RJA and expressive vocabulary at 24 and 30 months. Responding to joint attention at 6 and 12 months was positively correlated with parent-reported expressive vocabulary at 24 months, and RJA at 6 months was positively correlated with parent-reported expressive vocabulary at 30 months. Responding to joint attention at 10 and 18 months was positively correlated with expressive language at 30 months as measured by the EVT.

Summary Score. In an effort to generate a more reliable index of children's RJA skill, and thus an optimal predictor of language, children's RJA scores were aggregated across the 6- to 18-month age period. Each child received an average RJA performance score which was computed by dividing the sum of 6- to 18-month RJA scores by 6. As seen in Table 2, the 6- to 18-month RJA composite measure was significantly and positively correlated with both parent report and structured assessment indices of children's expressive and receptive vocabulary at 30 months.

Relations Among Language Measures

Although there were significant associations between measures of RJA and language acquisition, there was also a significant association between the 24- and 30-month MCDI and a marginal association between the 24-month MCDI and the PPVT-R ($\rho(20) = .45, p < .05$, and $\rho(20) = .37, p < .06$, respectively). One goal of this study was to evaluate the degree to which RJA displayed incremental validity in the prediction of language development relative to parent reports of language development. Because RJA was related to both 24- and 30-month language measures, it was not clear from these data if RJA provided information about 30-month language over and above that provided by the 24-month parent-report language measure. To evaluate this issue, hierarchical regression analyses were conducted

Table 2. Predictive and Concurrent Correlations Between Responding to Joint Attention and Language Measures^a

| Responding to Joint Attention | | | | | | | | | | | |
|-------------------------------|---------------|-------------|--------------|-------------|------------|-------------|-------------|--------------|---------------|--|--|
| | 6 months | 8 months | 10 months | 12 months | 15 months | 18 months | 21 months | 24 months | Comp. RIA | | |
| MCDI | | | | | | | | | | | |
| 24 months | .43* (.45*) | .07 (.10) | -.22 (-.25) | .46* (.42†) | .28 (.45*) | -.25 (-.22) | .02 (-.15) | -.24 (-.28) | .33 (.36) | | |
| 30 months | .57** (.57**) | .18 (.26) | .30 (.18) | -.06 (.14) | .35 (.50*) | .16 (.06) | -.19 (-.22) | -.22 (-.10) | .55* (.69**) | | |
| EVT | | | | | | | | | | | |
| 30 months | .09 (.46*) | .41† (.34) | .46* (.25) | -.01 (.41†) | .35 (.38†) | .48* (.03) | -.12 (-.12) | -.38† (-.04) | .66** (.68**) | | |
| PPVT | | | | | | | | | | | |
| 30 months | .44* (.41†) | .45* (.49*) | .59** (.56*) | .06 (.08) | .24 (.26) | .29 (.26) | -.05 (-.12) | -.11 (-.10) | .65** (.62**) | | |

Note: ^a Pearson-product moment correlations are in parentheses.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table 3. Results of Hierarchical Regression Analyses of 30-Month Vocabulary Measures on Prior Vocabulary Measures and RJA Skills

| <i>Criterion/Predictors</i> | <i>B</i> | <i>SE B</i> | β | <i>R</i> ² |
|-----------------------------|----------|-------------|---------|-----------------------|
| 30-Month MCDI-e | | | | |
| Step 1 | | | | |
| 24-Month MCDI-e | .44 | .17 | .54* | .29 |
| Step 2 | | | | |
| 24-Month MCDI-e | .23 | .16 | .28 | |
| RJA Aggregate | 70.73 | 25.04 | .56** | .54 |
| 30-Month EVT | | | | |
| Step 1 | | | | |
| 24-Month MCDI-e | .23 | .17 | .31 | .10 |
| Step 2 | | | | |
| 24-Month MCDI-e | .00 | .16 | .00 | |
| RJA Aggregate | 76.63 | 23.89 | .68** | .47 |
| 30-Month PPVT | | | | |
| Step 1 | | | | |
| 24-Month MCDI-r | .24 | .17 | .33 | .11 |
| Step 2 | | | | |
| 24-Month MCDI-r | .03 | .17 | .05 | |
| RJA Aggregate | 67.62 | 25.72 | .60* | .39 |

* $p < .05$; ** $p < .01$.

to determine the extent to which associations between RJA and language measures were the result of children's prior linguistic skills. In each case, the 24-month language measure was entered first, followed by the 6- to 18-month RJA aggregate variable. The results of these analyses are presented in Table 3.

The results of the regression analyses indicated that individual differences in RJA across the 6- to 18-month period made a unique contribution to 30-month vocabulary acquisition over and above the 24-month parent-reported vocabulary measure. After controlling for 24-month language status, RJA made a significant contribution to the prediction of 30-month expressive and receptive language. In other words, children who demonstrated a greater capacity to follow direction of adult visual gaze across the 6- to 18-month period had larger expressive and receptive vocabularies at 30 months than children who demonstrated this capacity to a lesser extent.

DISCUSSION

The primary goals of this study were to examine the growth and stability of RJA skills in the first 2 years of life and to determine whether RJA was related to subsequent vocabulary acquisition at all points of development or whether a specific period of development was optimal for the assessment of individual differences in this skill in the first 2 years.

With regard to the growth of RJA, descriptive data supported the expectation that developmental changes would be greatest during the 6- to 18-month period

(Butterworth & Jarrett, 1991; Corkum & Moore, 1998; Morissette et al., 1995). The ability of infants in this sample to follow direction of gaze increased steadily over this period with the most significant changes occurring between 8 and 10 months of age and 10 and 12 months of age. Moreover, performance on the RJA task used in this study began to reach what may be asymptotic levels around 18 months with most infants demonstrating correct responses on 60% or more of the trials. The findings are consistent with theory suggesting that infant joint attentional skills consolidate sometime between the 12- through 18-month period (Adamson & McArthur, 1995; Tomasello, 1995). However, we should caution that joint attention skill development may not be a unitary construct. The capacity to initiate joint attention bids through showing or pointing may reflect processes other than RJA skill development (Desrochers et al., 1995; Mundy, Card, & Fox, 1999; Mundy & Gomes, 1997). Hence, these data do not necessarily speak to the consolidation period of all joint attention skills.

Some support for stability in RJA skills across the first 2 years of development was also observed. Stability in RJA skills was evidenced by significant intercorrelations between RJA variables taken at different time points as well as by a coherent pattern of significant correlations between RJA variables and language measures taken at 24 and 30 months of age. These results are in agreement with previous research demonstrating modest stability in RJA measures (Mundy & Gomes, 1998; Mundy et al., 1998).

Our results also were consistent with expectations regarding the relations between RJA and language outcome. Findings indicated that individual differences in RJA at 6, 8, 10, and 18 months were significantly related to language outcome at 30 months, whereas RJA at 12 months was significantly related to language outcome at 24 months. Of particular interest was the finding that an aggregate measure of RJA skills predicted language development at 30 months over and above a parent report measure of language status at 24 months. When 24-month parent report data were controlled, the associations between individual differences in RJA skills during the 6- to 18-month period and language outcome at 30 months remained significant. Hence, RJA maintained a unique path of association with language development. These findings are consistent with research demonstrating a link between RJA and language outcome (Mundy & Gomes, 1998; Ulvund & Smith, 1996; Willoughby et al., 1997) and support the hypothesis that the assessment of RJA during the 6- to 18-month period of development may provide information about subsequent language development not provided by contemporaneous measures of language development or cognitive status. With regard to the observations in this study it may be important to remember, however, that the short form of the parent report MCDI measure was used. If the full MCDI had been used, the results of this study may have differed.

The relations between individual differences in RJA skills at 6, 8, and 10 months of age and language acquisition are particularly noteworthy in light of current research examining the age of onset of joint attention. Research investigating this issue has been somewhat mixed. Some studies have reported that infants demonstrate the ability to follow direction of gaze by 6 months (Butterworth & Jarrett, 1991; Scaife & Bruner, 1975), whereas others reported this skill was not present

until at least 10 to 12 months (Corkum & Moore, 1998; Morissette, et al. 1995). Corkum and Moore (1998) suggested that the discrepancy in findings may be attributed to differences in the stringency of operational definitions used across studies. However, a substantial number of 6-month-old infants may reliably demonstrate RJA even using a stringent operational definition (Morales et al., 1998). Moreover, because the validity of early RJA measures as indices of joint attention development is supported by their association with subsequent language development, an alternative explanation of this discrepancy may be important to consider.

A review of the relevant literature (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991; Corkum & Moore, 1995, 1998; Lempers, 1979; Morales, 1999; Morissette et al., 1995; Rollins, Marchman, & Metha, 1998; Scaife & Bruner, 1975), coupled with the present findings, suggests that discrepancies in the observed age of onset of RJA may be attributed to differences in the methodology. It may be that, as the ecological validity of the paradigm used to evaluate RJA diminishes, so too does the likelihood of finding evidence of RJA before 10 months of age. In our view, there are at least three factors that may influence the ecological validity of an RJA paradigm in the first year.

One factor concerns whether a familiar parent or unfamiliar experimenter present the referential bid to be followed by the infant. Of the five studies reporting the presence of RJA at 6 months (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991; Morales et al., 1998; Morales, 1999; Scaife & Bruner, 1975), four used targets and used parents in place of experimenters to assess infant RJA skills (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991; Morales, 1999; Morales et al., 1998). Furthermore, research on 1- through 7-month olds suggests that infants oriented more toward strangers during interaction than toward mothers (Lamb, Morrison, & Malkin, 1987). The relative novelty of the tester versus a parent may effect the ability of the infant to disengage visual attention from the former, and the capacity to disengage attention from visual stimuli may be a critical element of RJA performance (Mundy et al., 1998).

A second ecological factor may be whether vocal as well as visual information regarding the referential bid is provided by the parent or tester. The plausibility of impact of this factor is supported by a considerable literature suggesting that auditory information contributes to the organization and depth of processing of visual attention (Bahrick & Lickliter, 1998; Smith, Quittner, Osberger, & Miyamoto, 1998). Thus the presence or absence of vocalization in conjunction with referential acts may have a direct effect on joint attention development (Flom, Burmeister, & Pick, 1998). The third issue concerns whether infants are aware of the referential targets before RJA trials. This last issue is supported by research indicating that infants as young as 8 months who had not initially demonstrated spontaneous gaze-following behavior did so after a procedure that made them aware of the presence of targets in the laboratory (Corkum & Moore, 1998).

It is important to note that in previous research it has been suggested that RJA may be more strongly associated with receptive rather than expressive language (Mundy & Gomes, 1998). The data in this study, however, suggest that this may not be the case. Responding to joint attention may be equally predictive of both early expressive and receptive language and vocabulary measures. However, before

a clear conclusion on this issue may be drawn, methodological issues may again need to be considered. For example, in the Mundy and Gomes (1998) paper the RJA measures were obtained at 14 to 17 months, and variance associated with concurrent measures of both cognition and language were considered to examine the unique contributions of RJA to subsequent language development. The consideration of each of these sources of variance, as well as the ages at which RJA was assessed, may have substantially affected the pattern of relations observed in that study. Furthermore, the Mundy and Gomes (1998) study, like the current study, used a modest sized sample. Hence, estimates of relations among variables may be expected to vary as a result of the limits of power in these studies.

Indeed, this observation leads to a final conclusion. There are now sufficient data to conclude that early infant-focused RJA measures provide useful information about subsequent individual differences among children in the early phases of lexical acquisition (Desrochers et al., 1995; Mundy et al., 1995; Mundy & Gomes, 1998; Ulvund & Smith, 1996). However, future research using larger samples will be necessary to examine other factors that may influence children's ability to engage in joint attention. For example, how may individual differences in general intelligence or rate of development be related to joint attention skill development? To what extent may parent behavior influence children's ability to follow direction of gaze, and how would this relationship vary according to differences in parenting and interaction patterns as a function of race and ethnicity? Ultimately, a detailed understanding of the nature and extent of the association between early joint attentional skill development and outcome awaits further research with larger samples. Until then, the practical implications of our findings are fairly clear. This research suggests that parents and practitioners of infant day care should regularly engage infants in activities (e.g. object-mediated play) that promote the development and refinement of RJA skills. Such practices during the course of the first year should prove beneficial to language growth.

REFERENCES

- Adamson, L. B., & McArthur, D. (1995). Joint attention, affect, and culture. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 205–222). Hillsdale, NJ: Erlbaum.
- Bahrick, L., & Lickliter, R. (1998). *Intersensory redundancy guides attentional selectivity and perceptual learning in infancy*. Manuscript submitted for publication.
- Bakeman, R., & Adamson, L. B. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. *Child Development*, 55, 1278–1289.
- Baldwin, D. A. (1995). Understanding the link between joint attention and language. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 131–158). Hillsdale, NJ: Erlbaum.
- Bates, E. (1979). *The emergence of symbols: Cognition and communication in infancy*. New York: Academic Press.
- Bornstein, M. H., Slater, A., Brown, E., Roberts, E., & Barrett, J. (1997). Stability of mental development from infancy to later childhood: Three “waves” of research. In G. Bremner, A. Slater, & G. Butterworth (Eds.), *Infant development: Recent advances* (pp. 191–215). Sussex, UK: Psychology Press, Erlbaum.

- Butterworth, G., & Cochran, E. (1980). Towards a mechanism of joint visual attention in human infancy. *International Journal of Behavioral Development*, 3, 253–272.
- Butterworth, G., & Jarrett, N. (1991). What minds have in common in space: Spatial mechanisms serving joint visual attention in infancy. *British Journal of Developmental Psychology*, 9, 55–72.
- Coggins, T. E., & Carpenter, R. L. (1981). The communicative intention inventory: A system of observing and coding children's early intentional communication. *Applied Psycholinguistics*, 2, 235–251.
- Corkum, V. L., & Moore, C. (1995). Development of joint visual attention in infants. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 61–84). Hillsdale, NJ: Erlbaum.
- Corkum, V. L., & Moore, C. (1998). The origins of joint attention. *Developmental Psychology*, 34, 28–38.
- Desrochers, S., Morrisette, P., & Ricard, M. (1995). Two perspectives on pointing in infancy. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 85–102). Hillsdale, NJ: Erlbaum.
- Dunham, P., & Dunham, F. (1992). Lexical development during middle infancy: A mutually driven infant-caregiver process. *Developmental Psychology*, 28, 414–420.
- Dunham, P., & Dunham, F. (1995). Optimal social structures and adaptive infant development. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 159–188). Hillsdale, NJ: Erlbaum.
- Dunn, L. M., & Dunn, L. M. (1981). *Peabody Picture Vocabulary Test—Revised*. Circle Pines, MN: American Guidance Service.
- Epstein, S. (1980). The stability of behavior: II. Implications for psychological research. *American Psychologist*, 35, 790–806.
- Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D. J., & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, 59(5, Serial No. 242).
- Flom, R., Burmeister, R., & Pick, A. (1998, April). *An ecological approach to joint attention and language development*. Paper presented at the Eleventh Biennial International Conference on Infant Studies, Atlanta, GA.
- Fullmer, C., & Messinger, D. (1997, April). *Coordination of infant behavior in response to parental still-face*. Poster session presented at the Biennial Meeting of the Society for Research in Child Development, Washington, DC.
- Halverson, C. F., & Post-Gorden, J. C. (1984). Measurement of open-field activity in young children: A critical analysis. In E. Pollitt & P. Amante (Eds.), *Energy intake and activity*. New York: Liss.
- Harris, M., Jones, D., Brookes, S., & Grant, J. (1986). Relations between the non-verbal context of maternal speech and rate of language development. *British Journal of Developmental Psychology*, 4, 261–268.
- Hollingshead, A. B. (1978). *Two-factor index of social status*. New Haven, CT: Yale University Press.
- Lamb, M. E., Morrison, D. C., & Malkin, C. M. (1987). The development of infant social expectations in face-to-face interaction: A longitudinal study. *Merrill-Palmer Quarterly*, 33, 241–254.
- Lempers, J. D. (1979). Young children's production and comprehension of nonverbal deictic behaviors. *The Journal of Genetic Psychology*, 135, 93–102.
- Marcus, J., Morales, M., & Mundy, P. (1998, April). *Early gaze following, receptive language, and subsequent child-caregiver joint attention episodes*. Poster session presented at the Eleventh Biennial International Conference on Infant Studies, Atlanta, GA.
- Moore, C., & Corkum, V. L. (1994). Social understanding at the end of the first year of life. *Developmental Review*, 14, 349–372.
- Morales, M. (1999, April). *Responding to joint attention at 6-months and outcome in infants with typical development*. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Albuquerque, NM.
- Morales, M., Mundy, P., & Rojas, J. (1998). Following the direction of gaze and language development in 6-month-olds. *Infant Behavior and Development*, 21, 373–377.
- Morrisette, P., Ricard, M., & Gouin-Decarie, T. (1995). Joint visual attention and pointing in infancy: A longitudinal study of comprehension. *British Journal of Developmental Psychology*, 13, 163–175.

- Mundy, P., Card, J., & Fox, N. (1999). *The development of joint attention and acortical activity in the second year*. Manuscript submitted for publication.
- Mundy, P., & Gomes, A. (1997). A skills approach to communication development: Lessons learned from research with children with developmental disabilities. In L. Adamson & M. Ronski (Eds.), *Research on communication and language disorders* (pp. 107–132). New York: Paul Brooks.
- Mundy, P., & Gomes, A. (1998). Individual differences in joint attention skill development in the second year. *Infant Behavior and Development*, 21, 469–482.
- Mundy, P., Hogan, A., & Doehring, P. (1996). *A preliminary manual for the abridged Early Social-Communication Scales*. Coral Gables, FL: University of Miami. Retrieved July 30, 1996 from: <http://www.psy.miami.edu/faculty/pmundy>.
- Mundy, P., Kasari, C., Sigman, M., & Ruskin, E. (1995). Nonverbal communication and early language acquisition in children with Down syndrome and in normally developing children. *Journal of Speech and Hearing Research*, 38, 157–167.
- Mundy, P., & Sheinkopf, S. (1998). Early skill acquisition and developmental disorders. In J. Burack, B. Hodapp, & E. Zigler (Eds.), *Handbook of mental retardation and development* (pp. 183–209). New York: Cambridge University Press.
- Mundy, P., & Willoughby, J. (1996). Nonverbal communication, joint attention, and social-emotional development. In M. Lewis & M. Sullivan (Eds.), *Emotional development in atypical children*, (pp. 65–87). New York: Wiley.
- Mundy, P. & Willoughby, J. (1998). Nonverbal communication, affect, and social emotional development. In A. Wetherby, S. Warren, & J. Reichle (Eds.), *Transitions in pre-linguistic communication: Pre-intentional to intentional and pre-symbolic to symbolic* (pp. 111–134). NJ: Brookes.
- Ninio, A., & Bruner, J. (1978). The achievement and antecedents of labelling. *Journal of Child Language*, 5, 1–15.
- Riese, M.L. (1987). Temperament stability between the neonatal period and 24 months. *Developmental Psychology*, 23, 216–222.
- Rocissano, L., & Yatchmink, Y. (1983). Language skill and interactive patterns in prematurely born toddlers. *Child Development*, 54, 1229–1241.
- Rollins, P. R., Marchman, V. A., & Mehta, J. (1998, April). *Infant gaze following, joint attention, and vocabulary development*. Poster session presented at the Eleventh Biennial International Conference on Infant Studies, Atlanta, GA.
- Scaife, M., & Bruner, J. S. (1975). The capacity for joint visual attention in the infant. *Nature*, 253, 265–266.
- Seibert, J. M., Hogan, A. E., & Mundy, P. C. (1982). Assessing interactional competencies: The Early Social-Communication Scales. *Infant Mental Health Journal*, 3, 244–245.
- Seifer, R., Sameroff, A. J., Barrett, L. C., & Krafchuck, E. (1994). Infant temperament measured by multiple observations and mother report. *Child Development*, 65, 1478–1490.
- Smith, L., Quittner, A., Osberger, M., & Miyamoto, R. (1998). Audition and visual attention: The developmental trajectory in deaf and hearing populations. *Developmental Psychology*, 34, 840–850.
- Snyder, L. S. (1978). Communicative and cognitive abilities and disabilities in the sensorimotor period. *Merrill-Palmer Quarterly*, 24, 161–180.
- Tomasello, M. (1988). The role of joint attention in early language development. *Language Sciences*, 11, 69–88.
- Tomasello, M. (1995). Joint attention as social cognition. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 103–130). Hillsdale, NJ: Erlbaum.
- Tomasello, M., & Farrar, J. (1986). Joint attention and early language. *Child Development*, 57, 1454–1463.
- Tomasello, M., & Todd, J. (1983). Joint attention and lexical acquisition style. *First Language*, 4, 197–212.
- Ulvund, S. E., & Smith, L. (1996). The predictive validity of nonverbal communicative skills in infants with perinatal hazards. *Infant Behavior and Development*, 19, 441–449.
- Wachs, T. D. (1987). Short-term stability of aggregated and nonaggregated measures of parental behavior. *Child Development*, 58, 796–797.
- Wetherby, A., Prizant, B., & Hutchinson, T. (1998). Communicative, social/affective, and symbolic profiles of young children with autism and pervasive developmental disorders. *American Journal of Speech and Language Pathology*, 7, 79–91.
- Williams, K. T. (1997). *Expressive Vocabulary Test*. Circle Pines, MN: American Guidance Service.

- Willoughby, J., Mundy, P., & Claussen, A. (1997, April). *Joint attention, other nonverbal communication skills, and language development in infants at risk due to prenatal cocaine exposure*. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Washington, DC.
- Yale, M. E., Messinger, D. S., Cobo-Lewis, A. B., Oller, D. K., & Eilers, R.E. (1999). An event-based analysis of the coordination of early infant vocalizations and facial actions. *Developmental Psychology*, 35(2), 505–513.