Responding to Joint Attention and Language Development: A Comparison of Target Locations

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This study examined the importance of target location (within vs. outside the visual field) on the relation between responding to joint attention and subsequent language development in 47 normally developing infants. The results supported a developmental progression in the infants' ability to locate targets from within to outside the visual field. In addition, individual differences in 15-month-old infants' ability to correctly locate targets outside the visual field was a unique predictor of expressive language at 24 months. Infants' ability to locate targets outside the visual field may demonstrate increasing capacities for attention regulation, representational thinking, and social cognition that may facilitate language learning. The implications of this study are discussed with regard to the usefulness of measures of responding to joint attention for identifying early language and developmental delays.

KEY WORDS: language development, joint attention, assessment, language delay, infancy

The ability of infants to respond to joint attention, or to follow the visual regard of others, may reflect the development of important social, cognitive, and self-regulatory skills associated with the capacity to acquire language (Baldwin & Baird, 1999; Bates, 1979; Bruner, 1977; Moore & Corkum, 1994; Tomasello, 1988, 1995). In fact, several studies have indicated that individual differences in the ability of 6- to 18-month-old infants to respond to joint attention are predictive of language ability at 24 to 36 months (Markus, Mundy, Morales, Delgado, & Yale, 2000; Morales, Mundy, & Rojas, 1998; Mundy & Gomes, 1998; Mundy, Kasari, Sigman, & Ruskin, 1995). These studies, however, used scores of responding to joint attention that did not take target location into account. Infant responses to targets both within the visual field (90° or less to the left or right of the infant) and outside the visual field (greater than 90° to the left or right of the infant) were combined to predict later language development.

Developmental changes in the ability of infants to locate objects outside their visual field implicate target location as an important consideration that may reflect cognitive and social advances important to later language development. The ability of infants to locate the focus of another person's attention follows a predictable developmental path. Before 12 months, responding to joint attention is typically limited to targets within the infant's visual field. Between the ages of 12 and 18 months, infants develop the capacity to locate targets that are outside

their visual field or behind them (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991). This developmental advancement is hypothesized to reflect improvement in the infant's spatial skills as well as the consolidation of social cognitive processes that enable infants to understand the implications of social gaze shifts and gestures. Specifically, for infants older than 12 months, individual differences in the developmentally more advanced task of locating targets outside the visual field may be a stronger predictor of language development than the task of locating targets within the visual field, which emerges at an earlier age.

Method

Participants

Forty-seven healthy, full-term infants (22 boys, 25 girls) were assessed. The infants were participants in a broader longitudinal study of infant social development. Information collected at the 15- and 24-month sessions was included in this study. All families were classified as middle or high socioeconomic status based on a synthesis of the SES evaluations of Hollingshead (1978) and Nam and Powers (1983) as adapted by Eilers et al. (1993). Twenty-one of the subjects were classified as White Non-Hispanic, 19 were Hispanic, 4 were African American, 2 were Asian, and 1 was classified as Other with respect to racial/ethnic background.

Procedure

All assessments were conducted in a university-based child laboratory. Responding to joint attention (RJA) was evaluated at 15 months of age using the Early Social Communication Scales (ESCS; Mundy, Hogan, & Doehring, 1996). During the ESCS, two sets of four pointing trials were administered in which the experimenter attempted to direct the infant's attention (by looking and pointing) to pictures of four cartoon characters placed on the walls to the infant's left, right, left behind, and right behind. The pictures were brightly colored representations of Disney cartoon characters and were approximately 11 inches long and 9 inches wide (some variations in size occurred because of the shape of the individual character). The characters were placed at approximately 60° (left/right) and 150° (left behind /right behind) from the infant's midline (see Figure 1). The percent of trials in which the infant correctly turned his or her head in the direction of the tester's point was calculated for the combined Left and Right trials and for the combined Behind trials. For the Left/Right trials, the direction of the infant's gaze needed to shift beyond the tester's extended finger (approximately 45° off midline) to receive credit for the look. For the Behind trials, the infant needed to turn his or her head more than 90° off midline. All trials were coded from videotape by one individual who was blind to the infants' language and cognitive scores. An additional coder rated the trials of 9 of the infants to establish reliability. Reliability was determined based on agreement of pass/fail for each trial. The two coders demonstrated 94% agreement. Any procedural error observed by the coder resulted in the elimination of that RJA trial from all analyses. Ninety-five percent of all RJA trials were administered properly.

Language ability was assessed at 24 months of age using the Reynell Developmental Language Scales (RDLS; Reynell & Gruber, 1990). The infant's receptive language score was equal to the number of items passed on the Verbal Comprehension scale. The infant's expressive language score was calculated as the sum of the scores for the Structure and Vocabulary scales.

In addition, the general cognitive level of the infants was estimated at 15 months using the Bayley Scales of Infant Development–II (BSID-II, Bayley, 1993). Administration and scoring of items were performed in a standardized fashion, yielding an index score for cognitive development. The testers who administered and scored the RDLS and the BSID-II were unaware of the child's RJA score.

Figure 1. Room setup for the Early Social Communication Scales.

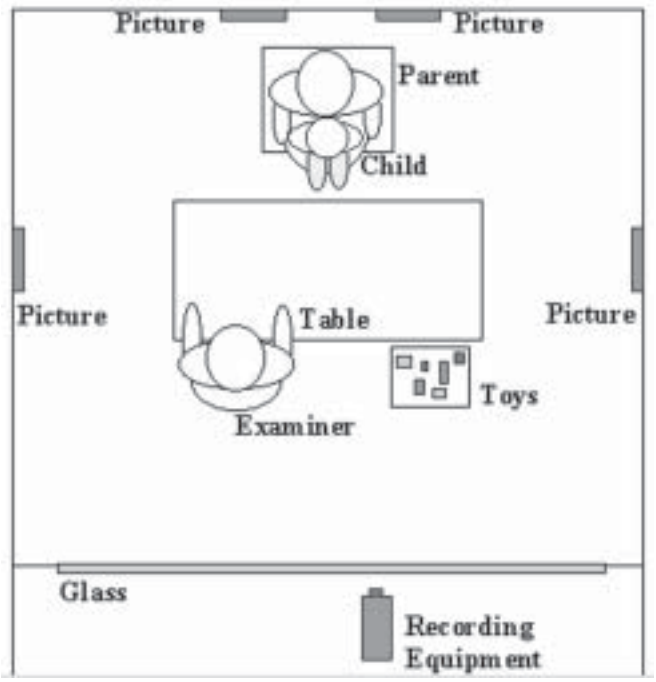

Table 1. Descriptive information for responding to joint attention, cognitive ability, receptive and expressive language.

Measures	*M*	*SD*	Min	Max
ESCS – RJA[a] (15 months)				
Left/Right Trials (% correct)	84.04	22.38	25.00	100.00
Behind Trials (% correct)	39.43	39.61	0.00	100.00
Total (% correct)	62.35	25.90	12.50	100.00
BSID-II[b] (15 months)				
MDI[c]	101.72	9.00	83	117
RDLS[d] (24 months)				
Receptive Language (total score)	20.57	8.02	3	34
Expressive Language (total score)	23.36	5.16	12	32

Note. $N = 47$

[a] Early Social Communication Scales–Responding to Joint Attention measure

[b] Bayley Scales of Infant Development–II

[c] Mental Development Index

[d] Reynell Developmental Language Scales

Results

Descriptive information for RJA, language, and cognitive ability are presented in Table 1. Infants responded correctly on the Left/Right trials ($M = 84.0\%$) to a significantly greater extent than they did on the Behind trials ($M = 39.4\%$) [$t(46) = 8.23$, $p < .01$]. In fact, 45 out of the 47 infants scored 50% or better on Left/Right trials, whereas only 18 of the infants scored 50% or better on Behind trials. In addition, scores of receptive and expressive language were found to be significantly correlated [$r(46) = .55$, $p < .01$]. Because of the moderate size of the correlation, receptive and expressive language were considered to be related, but not orthogonal, variables and were evaluated independently rather than by combining them into a composite language score.

Hierarchical linear regression analyses indicated that performance on the combination of Left/Right and Behind trials significantly predicted expressive language score ($R^2 = .30$, $p < .01$), but only marginally predicted receptive language score ($R^2 = .11$, $p = .09$). Although performance on the Left/Right and Behind trials was significantly correlated [$r(46) = .39$, $p < .01$], when performance on the Left/Right trials was controlled for, infant performance on the Behind trials explained unique variance in expressive language ($B = .07$, $p < .01$; see Table 2). Expressed in terms of partial correlation, percent correct on Behind trials remained significantly correlated with expressive language even after considering the variance associated with accuracy on Left/Right trials [partial-$r(44) = .49$, $p < .01$].

With regard to receptive language, the ability of performance on the Behind trials to uniquely predict variance in language over and above the Left/Right trials only approached conventional significance levels ($B = .06$, $p = .06$; see Table 2). The correlation of percent correct on Behind trials with receptive language approached conventional levels of significance when the

Table 2. Hierarchical regression analysis summary for RJA trials predicting language.

	Expressive Language			Receptive Language		
	F	Adj. R^2	*B*	*F*	Adj. R^2	*B*
Step 1	18.82**	.28		5.17*	.08	
Behind Trials			.07**			.07*
Step 2	9.40**	.27		2.61†	.07	
Behind Trials			.07**			.06†
Left/Right Trials			.02			.02

Note. All reported significance levels are two-tailed.

* $p < .05$

** $p < .01$

† $p < .10$

variance associated with accuracy on Left/Right trials was considered [partial-$r(44) = .28$, $p = .06$].

The examination of the general cognitive ability of the infants provides a source of incremental validity with regard to the relations between the RJA Behind trials and later language ability. The mental development index (MDI) score calculated from the administration of the BSID-II at 15 months was significantly correlated with the concurrent measures of RJA for Behind trials [$r(46) = .41$, $p < .01$] but not for Left/Right trials [$r(46) = .19$, $p = .19$]. MDI scores at 15 months were also significantly correlated with both expressive and receptive language scores on the RDLS at 24 months [$r(46) = .49$, $p < .01$ and $r(46) = .34$, $p = .02$, respectively]. The percent correct on Behind trials remained significantly correlated with expressive language even after considering the variance associated with the general cognitive ability (MDI) [partial-$r(44) = .43$, $p < .01$]. Therefore, infants who identified more targets outside their visual field at 15 months tended to have higher expressive language scores at 24 months, independent of their general cognitive level. For receptive language, however, percent correct on Behind trials was not significantly correlated with receptive language when the variance associated with general cognitive ability (MDI) was controlled for [partial-$r(44) = .21$, $p = .15$].

Discussion

These results are consistent with the previously established notion of a developmental progression in infants' ability to locate targets from within the visual field to targets located outside the visual field (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991). The 15-month-old infants in this study appeared to be quite capable of locating targets within their vis-ual field. Fewer of the infants, however, displayed a consistent ability to locate targets outside their visual field.

Individual differences in the ability of these normally developing infants to locate targets outside their visual field were shown to provide unique information about developing expressive language skills. Success on Behind trials at 15 months may reflect individual differences in the maturation of the social-cognitive abilities that facilitate language learning. For infants to be able to use social information such as gaze direction and pointing to locate an object outside the visual field requires increasingly mature spatial skills, an understanding of the intent of the communicative partner, and the cognitive ability to determine the precise location of the object relative to the body. The increasing capacity to locate an object that is being labeled or described maximizes the opportunity for forming accurate word-object matchings, as well as for increasing the capacity to gain from a wider variety of learning situations. In addition, it is quite possible that infants' ability to monitor direction of gaze within the visual field becomes routinized during the 12 to 18 month period. If so, this may allow the infant to use gaze-following to decrease referential mapping errors (Baldwin, 1995) and to devote increasing amounts of mental capacity to linguistic processing in incidental referential learning situations.

The relation of responding to joint attention with language was not consistent across the receptive and expressive language measures, with significant relations found only for the expressive language measures. Several previous studies have reported significant correlations of responding to joint attention with both receptive and expressive language (Morales et al., 1998; Mundy & Gomes, 1998; Mundy et al., 1995). At least one prior study, however, has reported that responding to joint attention was significantly correlated with expressive, but not receptive, language (Markus et al., 2000). It is important to note, however, that early expressive vocabulary may be more reliably assessed than receptive vocabulary in general (Bates, Bretherton, & Snyder, 1998) and specifically with the RDLS (Reynell & Gruber, 1990).

The presence of ceiling effects for the Left/Right trials represents a limitation of the present study. Infants in the present study were observed at 15 months of age in an attempt to maximize variability in gaze-following for the Behind trials. Because of the developmental changes associated with the ability to respond to joint attention tasks (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991), the infants observed were quite capable of locating a target within their visual field, resulting in reduced variability for the Left/Right trials. Although this limits the ability to examine the relation between Left/Right trials and language development, the findings with regard to the Behind trials raise the issue that the relation between responding to joint attention and language development is likely based on the child's developmental level. This finding is particularly important for establishing the clinical utility of the responding-to-joint-attention trials. Clinically and developmentally, overall performance on a set of responding-to-joint-attention trials may not be as informative as performance based on the location of the targets. Future research is necessary to develop a more complete picture of the developmental influences on the relations between responding to joint attention and language development.

In summary, the results of the present study verify that target location is an important consideration when studying the relation between the ability of infants to respond to joint attention and their subsequent language development. These findings also have implications for

the use of measures of nonverbal communication, particularly responding to joint attention, in infant assessment tools. Responding to joint attention is an efficiently and reliably indexed aspect of infant social cognition that appears to have incremental validity with regard to the prediction of individual differences in early vocabulary development. As such, it may be useful to incorporate measures of responding to joint attention in clinical infant assessment batteries. Before this step can be taken in an optimally effective fashion, however, it will be necessary to have a clear picture of the developmental progression of different aspects of joint attention. It will also likely be necessary to develop an understanding of the window of maximal developmental sensitivity for different types of joint attention measures, as these are likely to vary across the first two years of life. This study provides an illustrative initial step for research of this kind.

Acknowledgments

This study was part of a program of research supported by a grant from the National Institute of Deafness and Other Communication Disorders (DC00484). The authors would like to thank the families involved in this project for their gracious participation.

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Received July 9, 2001

Accepted February 26, 2002

DOI: 10.1044/1092-4388(2002/057)

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