First Language, **17** (1997), 271–281. Printed in England

A longitudinal study of early mother-infant interaction and later language competence*

TERRILL F. SAXON, *Baylor University, Texas*

ABSTRACT

Twenty-four mother-infant dyads participated in a longitudinal study of interaction at 6 and 8 months and language competence at 17 and 24 months. Interaction was coded for mothers' use of verbal references to objects as following or redirecting and joint attention. Language competence was measured by the MacArthur CDI. Joint attention at 6 months was positively correlated with later language competence; no 8-month correlations were found. Surprisingly, maternal verbal redirections were positively correlated with joint attention at 6 and 8 months. These findings suggest that joint attention is important with respect to language at an earlier age than previously thought and that early joint attention is not frustrated by maternal redirection as is the case during second year interaction.

Lev Vygotsky (1934/1984) theorized that interaction was fundamental to cognitive development. Recent research focusing on how children learn language suggests interaction to be a fundamental agent in cognitive development. The construct of joint attention has been widely researched as the interactional context of language learning. Joint

* This research was partially supported by an NIH grant (HD29960-03) awarded to Dr John Colombo at the Infant Cognition Center, University of Kansas, and departmental funds granted by Baylor University. I would like to thank Mr John Reilly MSEd for his help in the coding process. I am also grateful to Drs Janet Frick and John Colombo for their original efforts related to this work. I am especially grateful to the families of the infants from the greater Kansas City metropolitan area who participated in this study. A portion of these results were presented at the April 1997 meeting of the Society for Research in Child Development in Washington, DC. Address for correspondence: Terrill F. Saxon PhD, Department of Educational Psychology, School of Education, PO Box 97301, Baylor University, Waco, TX, 76798-7301, USA. Electronic mail should be sent via Internet to Terrill_Saxon@Baylor.edu.

0142-7237/97/1703-0272 $5.00

attention is usually operationalized (e.g., Tomasello & Todd 1983) as the frequency or duration of episodes characterized by the infant and mother being mutually focused on some object (e.g., a toy), while at some point during the episode the infant makes an overture to the partner (e.g., a look to the face); such behaviour is interpreted as the sharing of attention toward the object and is thought to foster language development (Tomasello & Farrar 1986).

Tomasello & Farrar (1986) and Tomasello & Todd (1983) have suggested that joint attention is important in the development of lexical acquisition. It appears that children who engage in more joint attention have larger vocabularies (see also Baldwin 1995). Additionally, some maternal styles of interaction foster such didactic interaction. For example, the children of mothers who direct their child's attention rather than follow it during joint attention learn fewer object labels and personal-social words. Specifically, object labels provided for objects during periods of joint attention were learned more often than object labels provided when such objects were brought into the child's focus of attention by the mother (Tomasello & Farrar 1986).

To explain this phenomenon, Tomasello (1992) posed an 'attentional-mapping hypothesis' in which caregivers and infants are thought to engage in joint attention using a combination of two interactional styles. One style, attention following (AF), occurs when the caregiver *follows* the infant's focus on an object; conversely, attention switching (AS), occurs when the caregiver *switches* the infant's attention from the object on which the infant is focused to another object. The attentional-mapping hypothesis maintains that AS requires the infant to shift attention to the intended referent in order to attend jointly with the caregiver. This shift is not required by AF because the infant is already attending to the object, thus increasing the likelihood of word learning. In dyads older than one year, the evidence (Dunham & Dunham 1992, 1995, Dunham, Dunham & Curwin 1993, Dunham, Dunham, Tran & Akhtar 1991, Tomasello & Todd 1983) indicates lexical acquisition is enhanced if the mother engages in AF rather than AS during episodes of joint engagement; however, children are capable of learning words in less ostensive contexts (Tomasello, Strosberg & Akhtar 1996).

Additional evidence regarding the facilitating effects of AF during joint attention has been presented in a recent study by Landry, Garner, Swank & Baldwin (1996). They subdivided a sample of very low birth weight 6-month-old infants into high-risk (HR) and low-risk (LR) groups and compared them with a group of full-term infants on measures of toy play complexity and joint attention. HR infants were

more likely to increase in toy play complexity if mothers used less attention redirection during interaction (Landry *et al.* 1996). This study is one of a few using such a young sample in joint attention research (for another example see Pecheux, Findji & Ruel 1992). This is important, since second year dyads have been the subjects for most studies of joint interaction and of styles of interaction that foster or frustrate interaction and that relate to later language competence and other cognitive correlates.

In a study of AF and AS and their relationships to joint attention during the first year of life, Saxon, Frick & Colombo (1997) found that 6- and 8-month measures of AF and AS were not correlated with concurrent measures of joint attention. Findings did suggest that mothers established a dominant style of interaction (either AF or AS) by 8 months, and as mentioned already, these styles are important during second year joint attention episodes and subsequent language competence. What is left unexplored is whether *earlier* styles of interaction are also related to later language competence.

The purpose of the present study is to examine relationships between early joint attention episodes, maternal interaction verbal behaviours and later language competence. This is an extension of the study by Saxon *et al.* (1997) in that in their investigation AF and AS variables included more than verbal behaviour (e.g., protoimperatives and other gestures). AF and AS in the present study will be confined to maternal verbal behaviour in the hope of isolating the stylistic component most pertinent to later language competence. Thus, early maternal following and redirecting verbal behaviour will be examined in relation to the child's later language competence.

Three hypotheses are made here. First, it is hypothesized that in the 6- and 8-month dyad, the mother's verbal following will positively relate to joint attention while the mother's verbal redirecting will inversely relate to joint attention. Second, it is hypothesized that joint attention at 6 and 8 months will positively relate to measures of the child's language competence at 17 and 24 months. Finally, it is hypothesized that the mother's verbal following at 6 and 8 months will positively relate to the child's language competence at 17 and 24 months, while the converse is expected for the mother's use of verbal redirecting.

METHOD

Participants

Sample The 65 mother-infant dyads from the study by Saxon *et al.* (1997) were invited to continue in a study of infant language

development. Thirty-two dyads agreed to participate; however, only 24 dyads were included in the analyses: three dyads failed to respond to the language measures at 24 months and five videotapes were irreparably damaged during the coding process of interaction. Thus, subject data for 24 dyads were collected in the laboratory at 6 months of age (M = 6.01 months, SD = 0.15) and again at 8 months of age (M = 8.09 months, SD = 0.12) and collected via mail at 17 (M = 16.71 months, SD = 0.49) and 24 months of age (M = 24.27 months, SD = 0.41).

Demographic information The sample of infants (N = 24) consisted of 7 males and 17 females. Infant subjects were healthy and full-term (mean gestation length = 39.2 weeks, SD = 1.3; mean birth weight = 3434 grams, SD = 379). Mothers averaged 33 years of age (SD = 4.0) and were well-educated (M = 15.4 years of education, SD = 1.9).

Procedure

Infants and their mothers were assessed on four occasions: at 6 and 8 months mothers and infants were videotaped playing, then at 17 months the infant form of the MacArthur Communicative Developmental Inventory (CDI) was used; the toddler form of the CDI was used at 24 months. The CDI is a paper-and-pencil language competence inventory completed by the primary caregiver.

Measuring interaction The procedure for assessing mother-infant interaction was modelled after procedures developed by Rocissano & Yatchmink (1983, 1984) and Tomasello & Todd (1983), with some exceptions to accommodate the younger subjects in this study. A laboratory room was arranged to videotape the play between mother and infant. First, the room was illuminated, and the infant was placed in a seat surrounded by a permanent tray. The mother sat directly across from the infant in another chair, and five toys[1] were randomly placed on the tray. A video camera was positioned on a tripod 2 m away so that the direction of visual attention of the infant toward mother and toys, as well as vocalizations between mother and infant, could be observed as accurately and unobtrusively as possible.

After the mother and infant were seated, the mother was asked to play and interact with her infant as she ordinarily would; she was also

[1] The following five toys were available to the mother and infant: Shelcore® Clutch Ball (red), Playskool Baby-Ernie's Rubber Duckie® (yellow), Mattel-Disney® 'Activities To Go-Kiddie Camera', Mattel-Disney® 'Bambi Rattle Ring', and Mattel-Disney® 'Baby Mickey All Stars-Sports Rattle' (orange).

TABLE 1. *Coding dyadic interaction: joint attention and verbal references to objects*

Variable	Description
Joint attention (JA)	The dyad is interacting with the same object, and the infant looks toward mother and object.
Verbal following (VF)	Infant is focused on a toy visually, touching it, or reaching for it, and mother refers to that toy by name or pronoun or to some feature of that toy.
Verbal redirecting (VR)	Infant is focused on a toy visually, touching it, or reaching for it, and mother refers to a different toy by name or pronoun or to some feature of a different toy.

Note. JA was coded as frequency and duration, and VF and VR were coded as frequencies.

asked to keep some toy(s) available to the infant at all times. The play session was then videotaped for ten minutes.

Coding mother-infant interaction Videotapes were analysed using a frame-by-frame analysis software (VCR Link®) and by making numerous passes through each videotape. The behaviours coded are listed and defined in Table 1. Each videotaped play session between mother and infant was analysed for frequency of maternal verbal following (VF), verbal redirecting (VR), and joint attention (JA). JA was coded by calculating the amount of time that elapsed from the onset of a JA episode, defined as the infant's look to the mother and a subsequent look to the toy, and the termination of JA as indicated by the occurrence of another behavioural category (the coding of JA followed very closely to that of Tomasello & Todd 1983). One minute was allowed to elapse on the videotape before coding began, and behaviour was coded for the next seven minutes of interaction. Interrater reliability was calculated on about 13% (n = 6) of the interaction sessions by correlating coder agreement of occurrences of each behaviour. Coder reliability ranged from 0.72 to 0.95 on all behaviours.

Language competence The MacArthur CDI developed by Fenson, Dale, Reznick, Bates, Thal, Hartung & Reilly (1991) was mailed to participants around the infants' 17- and 24-month birthdays. The CDI has been shown to yield highly reliable and valid scores of language competence for children ranging in age from 8 to 30 months. Internal consistency coefficients are in the high 0.90s (for a thorough exposition

TABLE 2. *Descriptive statistics for mother-infant interaction measured at 6 and 8 months*

	6 months ($N = 24$)		8 months ($N = 24$)		
Turns	*M*	SD	*M*	SD	*t* (23)
JA	12.40	7.94	15.96	8.17	0.10
JA (sec)	64.50	44.98	84.98	49.80	0.11
VF	31.54	16.46	30.75	16.60	0.80
VR	18.75	15.37	21.37	13.61	0.36

Note. All behaviours except JA (coded in seconds) are represented by frequency of occurrences during the interaction; JA = joint attention, VF = verbal following, VR = verbal redirecting.

of the psychometric properties of the CDI, see Fenson *et al.*, 1991). Both versions have numerous subscales, one of which is a 'vocabulary checklist', a long list of words currently used by the infant (judged by the caregiver). Language competence was operationalized as the score on the vocabulary checklist subscale.

RESULTS

Relationships were explored initially by examining scatterplots. No nonlinear relationships were detected; therefore, all subsequent analyses assumed a linear model. Analyses of the data included bivariate correlations and multiple regression. Multiple regression equations were tested for significance using maternal verbal behaviour to predict language competence with the duration of joint attention used as a covariate. No significant *R*s emerged in multiple regression analyses, and thus discussion of results was confined to bivariate correlations. Distributions were examined for statistical outliers, and none were found.

Mother-infant interaction

Descriptive statistics The means and standard deviations for behaviours coded from the mother-infant interaction are depicted in Table 2. As indicated by nonsignificant paired *t*-tests, dyads engaged in the same amount of joint attention, both frequency and duration, at both ages tested. Mothers also remained constant in their use of following and redirection verbal references to objects during play. Descriptive statistics not shown in Table 2 are the mean vocabulary sizes at 17 and

TABLE 3. *Six- and eight-month correlations (N = 24)*

	Interaction variables								Vocabulary production	
	6 months				8 months					
	VF	VR	JA_{dur}	JA	VF	VR	JA_{dur}	JA	17 mos	24 mos
6 months										
VF	–									
VR	0.45*	–								
JA_{dur}	0.31	0.37†	–							
JA	0.31	0.41*	0.83***	–						
8 months										
VF	0.54**	0.24	–0.19	–0.10	–					
VR	0.19	0.54**	0.18	0.16	0.46*	–				
JA_{dur}	0.00	0.14	0.24	0.27	0.05	0.27	–			
JA	–0.05	0.32	0.27	0.28	0.01	0.00	0.89***	–		
Vocabulary production										
17 months	0.07	0.20	0.26	0.51**	–0.12	0.11	0.05	0.16	–	
24 months	0.00	0.08	0.18	0.50**	–0.18	–0.08	0.18	0.24	0.88***	–

Note. JA = joint attention (dur = duration), VF = verbal following, VR = verbal redirecting.
† $p < 0.07$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

24 months; they are 48 words (SD = 43) and 331 words (SD = 172), respectively.

Stability of variables across ages As reported in Table 3, maternal verbal following was stable from 6 to 8 months, as was the mother's use of verbal redirecting; surprisingly, however, neither the frequency nor duration of joint attention was stable across these ages. Relative vocabulary productivity was stable from 17 to 24 months.

Correlations at 6 and 8 months The longitudinal design and the repeated measure of some variables allowed for the examination of cross-lagged correlations (Kenny 1975), as well as intercorrelations among variables. While no significant cross-lagged correlations were found, as shown in Table 3, there are several significant intercorrelations. First, among the joint attention variables, it seems remarkable that while the frequency and duration of joint attention are correlated positively within 6 and 8 months, they are not related across these ages. Second, among the intercorrelations between verbal

following and verbal redirecting, a significant correlation is found between verbal following and verbal redirection at 6 months and at 8 months. This suggests that the mother's use of verbal following is related positively to her use of verbal redirecting. Third, with respect to the hypothesized positive relationships between verbal following, verbal redirecting and early joint attention, no support was found. Instead, the opposite relationships of what was hypothesized received some support. As depicted in Table 3, rather than finding a significant correlation between verbal following and joint attention at 6 months, verbal redirecting was positively correlated with joint attention. This relationship did not appear among the 8-month data. No significant relationships were found between verbal following and joint attention. Fourth, regarding the hypothesized relationships between early joint attention and language competence, some support was found. Shown in Table 3, 6-month measures of joint attention are positively correlated with vocabulary production at 17 months and at 24 months. No other significant correlations were found between joint attention, verbal following or redirecting and vocabulary production.

DISCUSSION

The purpose of this study was to examine how early joint attention might relate to concurrent styles of maternal verbal behaviour (i.e., following or redirecting), and to explore the possible relation between early joint attention, maternal verbal behaviour and later language competence. The present data make a number of specific contributions to the literature on the topics of early mother-infant interaction, maternal behaviour and the relationship between these early interactional behaviours and later language competence.

Stability of variables from 6 to 8 months

First, the mother's use of verbal following references to objects and her use of verbal redirecting references to objects were stable across the two-month period of measurement. Surprisingly, and unlike the finding in a larger sample in the investigation by Saxon *et al.* (1997), joint attention was unstable across these ages. Relative vocabulary productivity was also stable from 17 to 24 months. These data suggest that measures of maternal verbal following and redirecting and vocabulary production tap characteristics that persevere across time and are not due to situational variance. With respect to joint attention, true instability in the sample population may be reflected; however, it is plausible that this variance is attributable to methodological

limitations such as a small sample size and thus a restricted range of measurement.

Relationships between interactional variables within and across ages

Second, it was hypothesized that a positive relationship would be found between mothers' use of verbal following and joint attention, and an inverse correlation was hypothesized between mothers' use of verbal redirecting and joint attention. The data here do not support these hypothesized relationships. Instead, there is some support for the opposite of what was hypothesized. No cross-age correlations were found between any variables. Regarding within-age correlations, while none were found between verbal following and joint attention at 6 or 8 months, there was a positive correlation between verbal redirecting and joint attention at 6 months.

These data suggest that early joint attention is not frustrated by the mother's use of verbal redirectives, nor is she using them less with the advent of more joint attention. The findings here corroborate those of Saxon *et al.* (1997) which suggested that the more general maternal style of attention switching did not negatively relate to joint attention. This finding is significant since, during later bouts of joint attention, maternal use of redirectives have correlated negatively with joint attention and are generally thought to frustrate its emergence (Tomasello & Todd 1983). This does not seem to be the case with the younger infant.

Relationships between interactional variables and later language

Third, it was hypothesized that early joint attention would positively relate to later measures of language and that the mother's use of verbal following and verbal redirecting during early interaction would positively and negatively, respectively, correlate with later language. Support for such relationships is suggested in that joint attention at 6 months was related to vocabulary production at 17 and 24 months. This suggests that early joint attention plays some positive role in later language development; since the relationship does not hold at 8 months, a precise description of this positive role is precluded. However, some speculations can be made. For example, Messer, McCarthy, McQuiston, MacTurk, Yarrow & Vietze (1986) report that young infants' length of sustained manipulation of objects is related to later measures of various cognitive abilities. Thus, if it is assumed that language competence is related to cognitive development, early sustained bouts of joint attention should relate to later language competence. The role of early joint attention could also mark the

capacity of the mother to sustain didactic, label-learning episodes; more of the former should relate to more of the latter. Finally, the measure of early joint attention may assess the dyad's capacity to maintain joint focus which later becomes important during vocabulary acquisition episodes.

It should also be noted that neither maternal verbal behaviour pattern (following or redirecting) related to later language, even though concurrent correlations between verbal behaviours and joint attention were found. This suggests that these children may be doing little, if any, language processing at this early age.

GENERAL CONCLUSIONS

Three general conclusions are drawn from these data. First, early verbal redirecting is positively related to early joint attention. This is contrary to what was hypothesized, but may indicate that interaction with a rather passive partner (e.g., a 6-month-old) is facilitated by a partner who is more active (e.g., verbally redirecting) or signifies to the attentive partner to be more active during interaction. This explanation fits into the Vygotskian perspective of fostering 'collaborative' interaction that requires the more experienced partner to adjust to the less mature (Vygotsky, 1934/1984, p. 191; cf. Bakeman & Adamson's 'passive joint attention' (1984) and Bruner's 'scaffolding' (1960)).

Second, the mother's early verbal strategies measured here are not related to later language measures. This suggests that, while early in the dyad's life the mother's use of some verbal strategy relates to joint attention, the particular strategy does not yet relate to later language competence.

Finally, early joint attention is positively related to later language development. Whereas the mother may use a more active (redirecting) mode of interaction during early interaction, and this positively relates to joint attention, it is the early joint attention that seems more directly linked to later language during this early interaction. This conclusion corroborates previous findings (e.g., Bakeman & Adamson 1984).

As is usually the case, more research is needed to present these conclusions with increased confidence. Such confidence could be gained by examining these variables in an experimental or causal-comparative design and by using a larger sample. It is hoped that future research on this topic will include such efforts.

REFERENCES

Bakeman, R. & Adamson, L. B. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. *Child Development*, **55**, 1278–89.

Baldwin, D. A. (1995). Understanding the link between joint attention and language. In C. Moore & P. Dunham (eds), *Joint Attention: Its Origin and Role in Development* (Hillsdale, NJ: Lawrence Erlbaum), 131–58.

Bruner, J. (1960). *The Process of Education* (Cambridge, MA: Harvard University Press).

Dunham, P. & Dunham, F. (1992). Lexical development during middle infancy: a mutually driven infant-caregiver process. *Developmental Psychology*, **28** (3) 414–20.

—— (1995). Optimal social structures and adaptive infant development. In C. Moore & P. Dunham (eds), *Joint Attention: Its Origin and Role in Development* (Hillsdale, NJ: Lawrence Erlbaum).

Dunham, P., Dunham, F. & Curwin, A. (1993). Joint attentional states and lexical acquisition at 18 months. *Developmental Psychology*, **29** (5), 827–31.

Dunham, P., Dunham, F., Tran, S. & Akhtar, N. (1991). The non-reciprocating robot: effects on verbal discourse, social play, and social referencing at two years of age. *Child Development*, **62**, 1489–502.

Fenson, L., Dale, P., Reznick, J., Bates, E., Thal, D., Hartung, J. & Reilly, J. (1991). *The MacArthur Communicative Developmental Inventories* (San Diego, CA: Singular).

Kenny, D. A. (1975). Cross-lagged panel correlation: a test for spuriousness. *Psychological Bulletin*, **82** (6), 887–903.

Landry, S. H., Garner, P. W., Swank, P. R. & Baldwin, C. D. (1996). Effects of maternal scaffolding during joint toy play with preterm and full-term infants. *Merrill-Palmer Quarterly*, **42** (2), 177–99.

Messer, D. J., McCarthy, M. E., McQuiston, S., MacTurk, R. H., Yarrow, L. J. & Vietze, P. M. (1986). Relation between mastery motivation behavior in infancy and competence in early childhood. *Developmental Psychology*, **22**, 366–72.

Pecheux, M. G., Findji, F. & Ruel, J. (1992). Maternal scaffolding of attention between 5 and 8 months. *European Journal of Psychology of Education*, **7** (3), 209–18.

Rocissano, L. & Yatchmink, Y. (1983). Language skill and interactive patterns in prematurely born toddlers. *Child Development*, **54**, 1229–41.

—— (1984). Joint attention in mother-toddler interaction: a study of individual variation. *Merrill-Palmer Quarterly*, **30** (1), 11–31.

Saxon, T. F., Frick, J. E. & Colombo, J. (1997). A longitudinal study of maternal interaction and visual attention. *Merrill-Palmer Quarterly*, **43** (1), 48–66.

Tomasello, M. (1992). The social bases of language acquisition. *Social Development*, **1**, 68–87.

—— (1995). Joint attention and social cognition. In C. Moore & P. Dunham (eds), *Joint Attention: Its Origin and Role in Development* (Hillsdale, NJ: Lawrence Erlbaum), 103–30.

Tomasello, M. & Farrar, J. M. (1986). Joint attention and early language. *Child Development*, **57**, 1454–63.

Tomasello, M., Strosberg, R. & Akhtar, N. (1996). Eighteen-month-old children learn words in non-ostensive contexts. *Journal of Child Language*, **23**, 157–76.

Tomasello, M. & Todd, J. (1983). Joint attention and lexical acquisition style. *First Language*, **4**, 197–212.

Vygotsky, L. (1934/1984). *Thought and Language* (Cambridge, MA: MIT Press).