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Joint-Attentional States and Lexical Acquisition at 18 Months

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Two groups of 18-month-old infants were observed during a relatively natural play session with an adult experimenter and several toys. A novel object associated with one of the toys was labeled a *dodo* by the experimenter using either an attention-following strategy (i.e., introducing the label when the infant was focused on the dodo object) or an attention-switching strategy (i.e., introducing the label when the infant was focused on an alternative object). With factors such as frequency of exposure to the object label and infant compliance equivalent across the groups, infants in the attention-following procedure were more likely to correctly identify the dodo object in a subsequent comprehension task. These experimental data corroborate previous correlational observations suggesting that early lexical development is facilitated during interactions in which the caregiver is following rather than leading the infant's focus of attention.

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By the end of the first year, infants can coordinate their visual attention on external objects with an adult during social interactions (Bakeman & Adamson, 1984; Bruner, 1983; Scaife & Bruner, 1975; Tomasello, 1988; Trevarthen & Hubley, 1978). Although there is some disagreement about the age at which these joint-attentional episodes emerge and about the theoretical inferences that can be drawn from the infant's engagement in joint-attentional behavior, these early social episodes of shared attention are generally assumed to influence a wide array of developmental processes emerging during the infant's second year (see Adamson & Bakeman, 1991; Tomasello, 1992, for reviews).

Much of the research on this early milestone of social behavior has examined the influence of joint-attentional episodes on language development, an emphasis generally credited to Bruner (1977, 1983) and the earlier work of Jakobson (1960), Werner and Kaplan (1963), and Vygotsky (1986). Bruner's initial assumptions about the influence of shared attentional episodes on early language development are summarized in the following quotation: "The joint enterprise sets the deictic limits that govern joint reference, determines the need for a referential taxonomy, establishes the need for signaling intent, and eventually provides the context for the development of explicit predication" (Bruner, 1977, p. 287).

Over the past decade, researchers influenced by Bruner's (1977) arguments have attempted to correlate individual differences in various global measures of infant–caregiver shared attentional behavior (e.g., shared routines and games) with various aspects of early language development. In general, their results provide some support for Bruner's assumptions, demonstrating in particular modest positive correlations between measures of shared-attentional behavior and early lexical development (see Adamson & Bakeman, 1991; Bruner, 1983; Dunham & Dunham, 1992; Ninio, 1983; Tomasello, 1988, 1992, for relevant discussions).

More recently, in an effort to elucidate the mechanisms that mediate these global correlations, Tomasello (1988, 1992) proposed a potentially important refinement on Bruner's (1977) earlier arguments. In the context of more microanalytic measures of infant–caregiver interactions, Tomasello noted that caregivers use at least two different strategies to establish joint-attentional episodes with their infants: (a) an attention-following strategy in which the adult follows the existing attentional focus of the infant when establishing a joint-attentional state, and (b) an attention-switching strategy in which the adult requires the infant to switch attention to an object on which the infant is not currently focused. Although both strategies can establish joint-attentional focus, he outlined an *attentional-mapping hypothesis,* which argues that lexical acquisition will be facilitated most effectively by the attention-following strategy. The reasoning behind this hypothesis can be described as follows: "When the adult attempts to redirect the child's attention in referring to an object, if the child is to determine the intended referent she must shift her attention so as to coordinate with the adult's. On the other hand, when the adult's reference follows into the child's already established attentional focus, the child need not actively make such a determination; coordination of attention depends only on the adult's skill at determining the child's focus" (Tomasello & Farrar, 1986, p. 1455). Stated very simply, the reasoning is that the increased attentional demands of the attention-switching strategy will make early word learning more difficult.

As with much of the research generated by Bruner's (1977) earlier formulation, most of the evidence relevant to the attentional-mapping hypothesis is also descriptive and correlational (see Akhtar, Dunham, & Dunham, 1991; Harris, Jones, Brookes, & Grant, 1986; Rocissano & Yatchmink, 1983; Tomasello, 1988; Tomasello & Farrar, 1986; Tomasello & Todd, 1983,

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for relevant discussions). Although these data indicate that an attention-following strategy tends, as predicted, to be positively related to more rapid lexical development, most investigators express appropriate concerns about their methods. The correlational approach permits individual differences in dyadic joint attention to be confounded with other structural differences in the dyadic interaction (e.g., the total amount of verbal input received by the infant), and claims about the direction of causal influence can easily be reversed to argue that infants with more advanced lexical development are simply more adept at attracting and sustaining the adult's attention.

To the best of our knowledge, there has been only one experiment explicitly designed to corroborate this growing body of correlational evidence concerned with the attentional-mapping hypothesis. Specifically, Tomasello and Farrar (1986) trained 10 children, ranging in age from 14 to 23 months, on a basic lexical acquisition task in which each child was presented with four novel objects and each object was identified with a novel verbal label (a *clip,* a *gauge,* etc.). In their procedure, two objects were repeatedly labeled with an *attention-following* procedure, in which the experimenter waited for the child to visually reference and touch the object before labeling it. The other two objects were identified with an *attention-switching* procedure, in which the experimenter waited until the child was not engaged with any of the objects, at which point the referent object was labeled. At the end of each of these rote-learning sessions, the child was asked to retrieve each item the experimenter requested (comprehension test). The results on a forced-choice comprehension test revealed that children averaged 50% comprehension for attention-following labels and 32% comprehension for attention-switching labels; only the 50% level of performance observed in the attention-following procedure was significantly different from chance.

In our opinion, two confounded variables in Tomasello and Farrar's (1986) experiment potentially undermine their interpretation of the results. First, the attention-switching condition required the child not to be playing with any of the objects before the introduction of a label for the target object. This requirement may, therefore, selectively present the label at times during the session when children were simply less motivated to participate in the task (i.e., when they were no longer interested in any of the relevant objects). Consequently, the inferior performance observed in the attention-switching condition could be attributed to either the increased attentional demands of the task or to a confounded loss of motivation to participate in the task. Second, Tomasello and Farrar did not report whether the children successfully switched their attention to the referent object on attention-switching trials. A rigorous test of the attentional-mapping hypothesis requires equivalent exposure to the label–referent pairing in both the attention-following and attention-switching conditions. Then, given an equivalent frequency of exposure to the label–referent pairings in both conditions, the hypothesis predicts inferior word learning when infants are required to switch their focus of attention to the referent. If Tomasello and Farrar's infants actually failed to switch their attention to the referent object on attention-switching trials, the inferior performance observed in the attention-switching condition could be explained more parsimoniously in terms of lack of exposure to the label–referent pairing when an attentional switch was required. Data relevant to this potential confounding were not reported.

The present experiment was designed to provide a more rigorous test of the attentional-mapping hypothesis. We observed two different groups of 18-month-old infants during unconstrained play sessions with an adult experimenter. At appropriate times during this seminatural play session, a novel plastic object was labeled as a *dodo* under either attention-following (Group AF) or attention-switching (Group AS) conditions. With frequency of exposure to the label and motivation to engage in object play equivalent across these two groups, we wanted to know if the children in the attention-switching group were less likely to identify the labeled object on a comprehension test following a brief retention interval.

Method

Subjects

Forty-four infants recruited from birth lists provided by the Grace Maternity Hospital in Halifax, Nova Scotia, Canada, visited the laboratory within 1 week of an 18-month age criterion. In the interest of ecological validity, we placed no major constraints on the behavior of the infants during their play session; consequently, some never performed the specific actions explicitly required to elicit the object label and were dropped from the study ($n = 13$). In addition, 2 infants were lost through experimenter error, and 1 infant fussed from the beginning of the session. The final sample consisted of 28 infants assigned to two treatment groups of 14 each, with 8 male and 6 female infants in each group.

Procedure

All phases of the experiment were videotaped by an assistant positioned behind a partition in one corner of the playroom. The female experimenter conducting the play sessions was naive with reference to the theory and hypothesis.

Phase 1: Experimenter–child play session. After an initial 10-min mother–infant play session during which the child was adapted to the laboratory playroom, the mother was seated in a chair and was asked to complete some information forms. The experimenter then introduced the infant to three new toys and demonstrated the basic functional property of each toy twice. Toy A was a small plastic mailbox. When a plastic chip was placed in the slot, it tumbled down a chute and dropped on a tray under the box. Toy B was a larger maze apparatus including two plastic balls. When a ball was placed in a hole at the top of the maze, it cascaded down a circuitous path and dropped into a tray at the bottom. Toy C was a box with three levers, each controlling the release of the dodo object mentioned earlier (i.e., a block with a small, stylized animal head attached). When a lever was activated, this plastic object dropped through a hole and rolled down a chute into a tray at the bottom.

Next, the experimenter began an 8-min play session. When playing with the child in the attention-following condition (Group AF), the experimenter responded by imitating the child's action each time a functional response was made on any of the three toys. If the child placed a plastic chip in Toy A, the experimenter exclaimed, "Oh wow," smiled at the child, and also placed a plastic chip in Toy A. If the child placed a ball in Toy B, the experimenter exclaimed, "Oh boy," smiled at the child, and placed a ball in Toy B. If the child pressed a lever on Toy C and released a dodo down the chute, the experimenter held up the

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dodo, smiled, pointed to it and said, "That's a dodo," and imitated the action. Under these conditions, each time the child heard the dodo label, the experimenter was *following* the child's focus of attention.

When playing with a child in the attention-switching condition (Group AS), the experimenter again responded each time a functional response was completed on a toy, but in this group, the experimenter's response was not imitative. Instead, each time the child made a response on a particular toy other than the dodo toy, the experimenter responded by activating the dodo toy, picking up the dodo, pointing to it, and saying, "That's a dodo." Note that requiring the children in this attention-switching group to manipulate an alternative toy before presenting the dodo label equates the children's interest and motivation in the task across both Group AF and Group AS (i.e., in both groups, the infant has just finished activating a toy before the delivery of the dodo label).

We also split Group AS into two subgroups to determine if comprehension errors of commission (mapping errors) would be systematically predicted by the particular toy from which attention had been switched (i.e., do the children in Group AS tend to map the label incorrectly on the object from which their attention has been switched). For half of the children in Group AS, each time the child placed a plastic chip in Toy A, the experimenter responded by activating a lever on Toy C (the dodo toy), picking up the dodo, pointing to it and saying, "That's a dodo" (i.e., attention-switching was from the child's focus on Toy A to the experimenter's focus on the dodo toy, C). For the other half of the children in Group AS, each time the child placed a ball in Toy B, the experimenter pressed the lever on Toy C (the dodo toy), picked up the dodo, pointed to it and said, "That's a dodo" (i.e., attention-switching was from the child's focus on Toy B to the experimenter's focus on the dodo toy, C). When infants in each subgroup of Group AS activated either of the two other undesignated toys (i.e., the toys that did not elicit the dodo label), the experimenter maintained the attention-switching dyadic structure in these subgroups by activating an alternative toy and exclaiming appropriately either "Oh boy" or "Oh wow."

Phase 2: Retention interval and comprehension test. After 8 min of infant–experimenter play, a 5-min retention interval was initiated during which the child played alone while the experimenter read a magazine and the mother completed information forms. During this period, the infants could play with the three original toys as well as one new toy that was introduced to help maintain their interest. Overtures toward the mother or the experimenter during this period received a brief smile of reassurance but no verbal response.

Compliance and comprehension tests were conducted at the end of the retention interval. The compliance test was designed to determine if the two treatment conditions differentially affected the tendency to comply with a request to retrieve a known object for the experimenter (i.e., previous interviews with their mothers indicated that all children could comprehend a request to retrieve a ball). When administering this test, the experimenter waited for a natural pause in the child's ongoing play, gazed directly into the child's eyes and said: "[Child's name], where's the ball? Can you find a ball?" If, in response to the requests, the child touched a ball, retrieved a ball for the experimenter, or pointed directly to a ball, the experimenter said, "Thank you, that's very good." If the child did not comply within 10 s, the requests were repeated a second time.

After the compliance test, the experimenter again waited for a natural pause in play, gazed directly into the child's eyes and said: "[Child's name], where's the dodo? Can you find a dodo?" Again, if the child touched a dodo, retrieved a dodo, or pointed directly at a dodo, the experimenter said "thank you, that's very good." If the child did not respond within 10 s, the experimenter repeated the request a second time. Mapping errors of commission were recorded if, during the comprehension test, the child touched, retrieved, or pointed directly at any object or feature of the room other than the dodo.

Results

The question of primary interest in the present study was whether the children in Group AS would be less likely to acquire the dodo label during the play session. Only 2 of the 14 infants in Group AS comprehended the novel label, as compared with 7 of the 14 infants in Group AF; Pearson $\chi^2(1, N = 28) = 4.09$, $p < .04$. These same two groups did not, however, differ on the compliance test. Eight of the 14 infants in Group AS complied with the experimenter's request to find a ball, as compared with 9 who complied in Group AF; Pearson $\chi^2(1, N = 28) = 0.15$, $p > .10$. These results provide additional support for the attentional-mapping hypothesis; as predicted, novel word learning is less likely under attention-switching conditions. However, several other measures need to be examined to address various interpretive and control questions that can arise with this procedure.

Can the Inferior Performance of Group AS Infants be Explained by Less Frequent Exposure to the Referent–Label Pairing?

This question addresses one of the potential confounded variables in the Tomasello and Farrar (1986) experiment. Several aspects of our results argue against this interpretation. First, on average, the two groups of infants heard the novel label equally often during the play session: Group AF, $M = 9.8$, $SD = 7.7$; and Group AS, $M = 9.2$, $SD = 10.1$ (Mann-Whitney $U = 80.5$, $p > .40$). Second, an observer, naive to the hypotheses, examined the videotapes to determine if children also directed their gaze to the dodo each time they heard it. Again, the groups did not differ significantly on this directly coded measure of attention to the label–referent pairing: Group AF, $M = 9.0$, $SD = 7.4$; and Group AS, $M = 6.0$, $SD = 4.2$ (Mann-Whitney $U = 75$, $p > .30$). To establish coding reliability on this measure, a second person coded five randomly selected subjects from each of the two treatment groups, and the two observers agreed on 63 of 66 labeling episodes coded. Finally, when we correlated individual differences in the frequency of exposure to the label and subsequent performance on the comprehension task within each treatment condition, we did not find significant point-biserial associations: Group AF, $r = .27$; $p > .10$; and Group AS, $r = .28$, $p > .10$. Some children learned the dodo label with as few as one or two exposures, whereas others failed to learn the label with as many as 15 or 20 exposures.

Although caution is necessary for several reasons when drawing conclusions from the absence of these associations, the three different lines of evidence just discussed suggest collectively that inferior word learning in Group AS is not easily explained by a lower frequency of exposure to the label–referent pairing (see also Golinkoff, Hirsh-Pasek, Bailey, & Wenger, 1992; Hart, 1991; Heibeck & Markman, 1987; Schwartz & Terrell, 1983, for other data suggesting that early word learning is a "fast mapping" process that is not particularly sensitive to a frequency parameter).

Can the Inferior Performance of Group AS be Explained by More Negative Affect or Less Motivation in the Attention-Switching Condition?

This question addresses the second potential confounded variable in the Tomasello and Farrar (1986) experiment. Again,

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several aspects of our results and procedure argue against this interpretation. First, the present procedure controlled motivational factors by requiring infants in both groups to activate a toy to elicit the dodo label. Consequently, each referent–label paring was introduced during a period of equivalently motivated play in both groups. Second, the toys were compelling, and none of the infants in either group displayed overt signs of distress or negative affect during these play sessions (with the exception of 1 infant who was dropped from the study).

However, to address this issue with a potentially more sensitive measure, a naive observer directly measured proximity-seeking behavior during the play session with the experimenter as an index of the child's ongoing emotional state. *Proximity seeking* was defined as the amount of time children spent within physical reach of their mother, rather than playing with the toys (see Dunham, Dunham, Tran, & Akhtar, 1991, for a discussion of proximity seeking as a measure of negative emotional states). As we expected, there was a relatively small amount of proximity-seeking behavior during the 8-min play session in both groups: Group AF, $M = 13.4$ s, $SD = 20.44$; and Group AS, $M = 29.7$ s, $SD = 49.36$, and this mean difference across treatment conditions was not significant (Mann-Whitney $U = 65.5$, $p > .33$). Similarly, the correlation between the individual differences in proximity-seeking behavior across all children and their comprehension performance was not significant ($r = .15$, $p > .10$). Considered together, these results suggest that affective and motivational differences are not mediating the inferior word learning observed in Group AS.

Is the Inferior Comprehension Performance of Group AS Infants Associated With Mapping Errors of Commission During the Comprehension Task?

The results were very clear on this question. When they failed to identify the dodo, the children also never misidentified a specific object from which they had switched their attention; nor did they misidentify any other object or feature in the room as a dodo. This impressive reluctance to commit mapping errors confirms similar data reported by Baldwin (1991), who used procedures designed to elicit such mapping errors.

Can the Inferior Performance of Group AS be Explained by Differences in General Lexical Development Across the Two Groups?

Although this confounding is unlikely given random assignment of children to treatment conditions, we measured differences in the infants' lexical production using word counts obtained from transcripts of the initial, 10-min mother–infant play session (types were counted, not tokens). As expected, the groups did not differ significantly in lexical production in this playroom setting: Group AF, $M = 9.8$, $SD = 7.7$; and Group AS, $M = 9.2$, $SD = 10.1$ (Mann-Whitney $U = 80.5$, $p > .40$).

Can the Superior Performance of Group AF be Interpreted as an Acquired Preference for the Dodo Toy?

If a selective preference for the dodo toy developed in Group AF during the experimental play session, that preference should be manifested during the solo play session (i.e., the retention interval) prior to the comprehension test. Of the 28 children completing the study, only 11 specifically selected the dodo for play at any time during the retention interval; the other 17 did not interact with this toy in any way during this period. More important, playing with the dodo toy during the retention interval was not associated with performance on the subsequent comprehension test, Pearson $\chi^2(1, N = 28) = 1.47$, $p > .22$. These results argue that the superior comprehension performance of Group AF is not mediated by an acquired, selective preference for the dodo toy.

Can the Superior Performance of Group AF be Attributed to Differences in the Experimenter's Demeanor Across the Two Treatment Groups?

Although the experimenter was unaware of the hypothesis and had been trained to present the label in a stereotyped fashion in both treatment conditions, it is important to ask whether differences in experimenter "enthusiasm" were confounded across the two treatment groups. To address this issue, we asked an independent female observer (who was unaware of treatment conditions and hypothesis) to rate 10 videotaped presentations of the dodo label randomly selected from each of the two groups. Her instructions were to rate the experimenter's "enthusiasm and intensity while presenting the label" using a 7-point scale. The average rating of the label presentations in Group AF was 2.9 ($SD = 0.99$) as compared with an average rating of 3.2 ($SD = 0.92$) in Group AS, $t(18) < 1$. Although there was some variation in the experimenter's demeanor across labeling episodes, her enthusiasm or intensity was not confounded across the two treatment conditions.

Discussion

Although the present experiment involved a relatively small number of infants learning only one new word during a short, relatively natural play session, the data provide important additional support for the attentional-mapping hypothesis. These results also corroborate a growing body of correlational evidence suggesting that early lexical development is facilitated by dyadic social structures in which caregivers follow a child's focus of attention when introducing an object label (e.g., Akhtar et al., 1991; Dunham & Dunham, 1992; Harris et al., 1986; Tomasello & Farrar, 1986). Although both groups of children were engaged in enthusiastic social play with a responsive adult experimenter, infants who were required to switch their attention from an ongoing activity to a different referent object during labeling were less likely to learn a new word during the play session.

These results also indicate that the confounded differences in motivation and frequency of exposure to label–referent pairings we suspected in Tomasello and Farrar's (1986) research are not viable alternative explanations for the differences in word learning they observed. The additional analyses permitted by the procedures used in the present experiment revealed that the inferior comprehension performance of Group AS cannot be explained by (a) differences in the frequency of exposure to the object label during the play session, (b) differences in the fre-

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quency of looking at the object when it was labeled, (c) differences in the tendency to comply with the experimenter's requests following the play session, (d) differences in the infants' preference for the dodo toy following the play session, (e) differences in the infant's general level of lexical development across the two treatment groups, or (f) differences in the experimenter's demeanor when presenting the label across the two treatment conditions.

It is also worth noting that the attention-switching requirement in Group AS did not generate systematic mapping errors. The absence of mapping errors in this experiment is, in some respects, as interesting as the inferior word learning performance in Group AS, and additional research is clearly needed to understand how the infant avoids mapping errors so well. Our data suggest, for example, that infants at this age may be sensitive to the presence of competing cues from the adult in the attention-switching condition (i.e., Is the experimenter referring to the object she is holding or to the object that I am holding?). In the presence of these competing cues, the 18-month-old infant may adopt a strategy of simply aborting the encoding process rather than risk the linguistic implications of a mapping error (see also Baldwin, 1991).

The present data also have implications for previous research concerned with the impact of adult conversational styles on early language development. Although explanations vary, a recurrent theme in the child language literature has been that a "directive" style of maternal language inhibits early lexical development (e.g., Dell Corte, Benedict, & Klein, 1983; Nelson, 1973; Olsen-Fulero, 1982). To the degree that a directive pragmatic style of adult language is also associated with an adult attention-switching strategy during word learning, the present data suggest that the attention-switching structure may be a critical factor in understanding the previously reported effects of a directive pragmatic style on early lexical development. In recent correlational research relevant to this point, Akhtar et al., (1991) pitted caregiver language style measures against caregiver attentional strategy measures in a longitudinal lexical development study, and their data suggest that it is the caregiver's attentional strategy, not the directive language style, that mediates the negative relationship often observed between a directive language style and slower lexical development. These correlational data are clearly compatible with the experimental evidence reported in the present article. Both lines of evidence suggest that an attention-switching strategy has a negative impact on early word learning.

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