

# Give and Take: The Development of Conventional Infant Gestures.

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To understand the development of nonverbal communication, the manual gestures of 11 infants between 9 and 15 months of age were observed while they played with their mothers several times a month. Infants were more likely than their mothers to request objects and less likely to respond to requests for objects, suggesting a relatively acquisitive style of interaction. The proportion of infant requests that involved a vocalization rose with age, suggesting that infants increasingly use vocalizations to emphasize instrumental communications. Infant gazing at mother was most likely during offers that infants initiated without a preceding maternal request. When infants gestured and gazed at mother, they also tended to smile. Unsolicited offers involving gazing at mother and smiling appear to index self-initiated, positive social contact. The results help distinguish between instrumental and social approach functions of nonverbal conventional communication.

This study describes the development of gestures and accompanying communicative signals such as gazing at mother, smiling, and vocalizing. We focus on two proto-imperative gestures, requests for objects ("give me that") and offers of objects ("take this") in infants between 9 and 15 months of age. These gestures are nonverbal, manual actions whose relatively conventional forms are used by infants to influence their partners to perform concrete tasks with objects. They are complimentary (a request is a request for an offer), and may be universal means of directly exchanging physical objects. From a broader developmental perspective, the use of such gestures is associated with later differences in infants' linguistic abilities (Bates, Thai, Whitesell, Fenson, & Oakes, 1989; Butterworth & Morisette, 1996; Mundy, Kasari, Sigman, & Ruskin, 1995).

The period between 9 and 15 months of age involves increases in several sets of communicative actions. There is an increase in the proportion of infants who offer, request, and point and the proportion of infants who comprehend such conventional gestures (Bakeman & Adamson, 1986; Lempers, 1979; Masur, 1983; Mosier & Rogoff, 1994; Murphy, 1978). There is an increase in the proportion of time infants coordinate their attention between gazing at physical objects and at their interactive partners (Bakeman & Adamson, 1984; Masur, 1983). This active engagement is a constituent of the infant's ability to communicate about the object to the partner and to comprehend such communications (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Corkum & Moore, 1995; Masur, 1983; Tomasello, 1995). There is also an increase in intentionally communicative vocalizations (Bakeman & Adamson, 1986; Masur, 1983; Murphy, 1978; Zinober & Martlew, 1985), and the number of vocalizations accompanying infant gestures (Rome-Flanders & Cronk, 1995).

In this study we examine these developments with an eye to associations between different types of infant gestures and communicative behaviors such as gazing at mother, vocalizing, and smiling that occur with the gestures. Specifically, we ask about the pragmatics, development, and potentially different functions of offering and requesting. From a pragmatic perspective, how are infants' gestures embedded in communication with mothers? From a developmental perspective, do rates of infant gesturing (offering and requesting) change with age? With regard to function, what types of gestures are associated with what types of communicative behaviors and how do these associations change with age?

Pragmatics: How Do Infants and Mothers Gesture and Respond to Gestures?

Despite the potential impact of mothers' and infants' gestural actions on each other, there has been little attempt to explore the relationship between the two (cf. Adamson & Bakeman, 1984; Lock, Young, Service, & Chandler, 1990; Reinecke & Fogel, 1994). By observing a pair of complementary gestures in both mothers and infants, we were able to address a set of questions related to the pragmatic context of infant conventional communications about objects. Which partner is more likely to request objects and which to offer? How do infants and mothers respond to each other's requests and offers? Do maternal requests impact specific infant communicative behaviors such as gazing at mother?

Development: Does Infant Gesturing Rise With Age?

In exploring the development of infant gestures, few researchers have employed Bates et al.'s (1979) distinction between gestures with a protodeclarative function (i.e., "look at that") and those with a proto-imperative function (i.e., "give me that"). Focusing on gestures with a proto-imperative function, neither Masur (1982; 1983) nor Blake, McConnell, Horton, and Benson (1992) found significant increases in either infant offering or requesting between 9 and 18 months of age.

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However, these studies included relatively few infants ( $n_s = 4$  and  $5$ , respectively). Bakeman and Adamson (1986) found that the mean quantity of offers of objects increased between 9, 12, and 15 months of age in a group of 28 infants. The differential strengths of large and small sample studies and a possible resolution are discussed later in the Design section of this Introduction.

Different Functions? Which Infant Gestures Occur With Which Communicative Behaviors and How Does This Change With Age?

When infants vocalize while gesturing with their hands, they appear to reinforce and highlight the communicative message of the gesture (Harding & Golinkoff, 1979; Rome-Flanders & Cronk, 1995). The proportion of infant requests accompanied by vocalizations rises with age (Masur, 1982; but see Blake et al., 1992). However, the proportion of infant offers accompanied by vocalizations does not appear to rise with age (Blake et al., 1992; Masur, 1982). In the current study, we attempt to confirm and explain this finding.

By way of explanation, infant requests may be more instrumental, object-directed gestures than infant offers. The instrumental character of requests may be emphasized when requests are accompanied by vocalizations. To address this issue, we compared the proportion of requests and offers associated with a vocalization. Developmental changes in the proportion of requests and offers associated with vocalizations also were compared. If requests are more likely to involve vocalizations, or the proportion of requests involving a vocalization increases with age, this would, arguably, provide evidence that infant requests have or take on a relatively instrumental function.

Infant gestures may also have an expressive function, that of using an object to make social contact with a partner. The sociality of infant offering is suggested by Bakeman and Adamson's (1986) finding that offers were more likely when infants were visually engaged with the same object as their mothers. An expressive function of infant gazing at mother is suggested by Adamson and Bakeman's (1985) finding that infants made a higher than expected proportion of affective expressions when they were in active visual engagement with both mother and an object.

Bakeman and Adamson, however, did not examine the association of affective expressions and attention to mother when infants were using gestures to communicate with mother. It may be that offers typically have a more expressive function for infants than do requests. This idea would be supported if infant offers were differentially associated with gazing at mother or smiling. Specifically, a finding that gazing at mother, smiling, and offering were associated with each other, but not with requesting and vocalizing, would suggest an empirical distinction between the expressive and instrumental functions of infant gestures.

### Design

A review of the literature on development of infant gesturing revealed differences between studies in which a small group of infants were observed monthly (Blake et al., 1992; Masur, 1982, 1983) and studies in which a larger group of infants were observed somewhat less frequently (Bakeman & Adamson, 1986). This difference points to a more fundamental difficulty. Researchers studying small groups of infants often report individual developmental trajectories, but typically cannot use statistical methods to argue for the generality of their findings. Researchers studying larger groups often discern differences in mean levels of a behavior at different ages, but do not examine whether these developments can be discerned in the individual members of their sample (Rogosa, 1995).

Phrased positively, it is of theoretical and practical importance to ascertain whether individual infants show developmental and other effects (Fogel & Thelen, 1987; Thelen & Smith, 1994). This goal impacts both data collection and analysis. Data must be collected frequently from a substantial number of participants. We used a case study approach in which 11 mother-infant dyads were videotaped in free play two to four times a month between 9 and 15 months as part of a larger longitudinal study of social communication (Nwokah, Hsu, Dobrowska, & Fogel, 1994). Data must be analyzed in a manner that makes clear the proportion of infants showing developmental and other effects. We used individual developmental trajectories as a basis for statistical analyses and analyzed the associations between different types of infant gestures and communicative behaviors in a similar fashion.

### METHODS

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### Participants

Participants were 11 adult mothers whose infants had been observed from 4 weeks of age as part of a longitudinal study. Mothers were members of nonseparated, nondivorced families recruited through ads in a local paper in a small midwestern community, and were given an honorarium of \$100 every 6 months. All infants were full-term and healthy at birth; 8 were male and 5 were first born.

### Procedure

During a first visit to a laboratory playroom, when infants were approximately 1 month old, mothers were given the instructions to "play and talk to your baby as you would at home." The coding and analyses presented here began at a median age of 9.5 months, when each infant was first judged capable of sitting in a chair without assistance. Sessions in the laboratory playroom continued weekly until infants were 12 months of age and then once every 2 weeks until 15 months. The mean first age of observation was 43 weeks (Mdn = 41; range 41-49) and infants were seen for a mean of 14 sessions (Mdn = 14; range 11-18) until a mean final age of 66 weeks (Mdn = 66; range 64-67).

Sessions took place in a 3.81 x 3.81 m carpeted laboratory playroom. Infants and mothers played while the infants were seated at a table to the left of and at right angles to mothers who had initial access to a standardized set of toys (two pieces of plastic fruit, a plastic dish set with utensils, a doll and her accessories, and two toy telephones). The mean session length was 615.80 s (Mdn = 612.00, SD = 23.02; range 579-774). To correct for differences in session length, all frequency data were calculated as rates per 10 min, and these rates were used for all analyses.

### Coding

All interactions were videotaped. The output of one or two of three remotely controlled wall-mounted cameras was combined into either a single image or a split-screen image that included a visual time code accurate to the video frame. In a first pass through the videotape, coders noted when the mother or infant requested an object or offered an object to the other partner. Requests were coded when either partner straightened an arm toward an object, pointed to an object, or made a palm-up gesture in a manner that indicated to coders his/her desire that the partner give an object. If a partner only straightened his/her arm toward an object, the object had to be out of arm's reach of the partner in order to convince the coder that only a communicative act would secure the object. Of a total of 192 requests made by infants, only 21% involved the point configuration. Initial analyses did not indicate different developmental trajectories for different types of infant requests (perhaps because of the low frequency of points) and no distinction was employed in the final analyses.

Offers were coded when either partner extended an object he/she was holding toward the partner with the apparent intention of giving the object. Objects might be placed in the partner's hands or held awaiting the partner's response. Coders also noted whether requests for objects appeared to elicit complementary offers. In this case, a partner typically gazed either at the requesting hand or the partner's face, picked up the object if necessary, and then appeared to deliberately place it into or in front of the requesting hand. If the requesting hand had been retracted, a complementary offer had to occur within 2 s of this retraction. We also coded whether offered objects were manually received (taken) during the course of the offer.

The most immediately apparent communicative functions of the infant's manual movements were coded. In more structured communicative situations, context might indicate that the same manual movements had other communicative intentions. For example, an infant's movement to hand her partner a wind-up toy that had stopped functioning might be regarded as a request for assistance (Mosier & Rogoff, 1994; Mundy, Kasari, & Sigman, 1992). In these interactions, toys did not have special features that could be accessed by mothers but not by infants. Perhaps for this reason, ambiguity over whether a partner was offering or requesting was almost never an issue.

On a second pass, a different set of coders assessed whether the infant gazed at the mother's face, smiled, or vocalized in the interval from 2 s before to 2 s after the gesture. These communicative actions were coded immediately before and after as well as during the gestures because it was thought these occurrences would be meaningfully related to the gesture (Desrochers, Morissette, & Ricard, 1995). Infant smiles were coded using the requirements for lip corner raiser of the Facial Action Coding System (FACS, Ekman & Friesen, 1978) as applied to infants (Oster & Rosenstein, in press). Only distinct, nonvegetative vocalizations were coded. Because only 4.4% of infant vocalizations in this sample involved a

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recognizable word, verbal and nonverbal infant vocalizations were combined.

Coders were undergraduate psychology majors who were trained in the coding system until their percentage of agreement with the first author on the occurrence and type of gesture or the occurrence of associated communicative actions equaled or surpassed 80%. Interrater reliability was calculated on sessions chosen randomly during coding with the proviso that each of the 11 dyads contribute at least two sessions to the reliability samples. Interrater reliability on the occurrence of gestures was assessed on 27 of 156 sessions (17%) that included 207 of a total of 1,284 gestures (16%). Interrater reliability of infant communicative actions was assessed on 22 of 156 sessions (14%) that included 215 of a total of 1,284 gestures (17%). Eight sessions comprising 100 gestures were included in both reliability samples.

Intraclass correlations, run separately for infant requests, infant offers, mother requests, and mother offers, showed good reliability with values above .8, ensuring that comparable quantities of each category of gesture (i.e., infant offers) were being coded in different sessions (Shavelson & Webb, 1991). Cohen's kappas were used to assess the reliability of agreement on the time windows extending from 2s before to 2s after each gesture, because this temporal parsing determined when infant communicative behaviors would and would not be coded. Kappas were calculated separately for infant and mother gestures. Agreement for the kappa was equal to the total number of seconds both coders agreed that a particular gesture was occurring or that no gesture was occurring. Disagreement was the total number of seconds remaining in the session (i.e., the number of seconds when coders were in disagreement about whether a particular gesture was occurring). The mean kappa for infant gestures was .70 and the mean kappa for mother gestures was .78. Cohen's kappas also indicated high levels of chance-corrected agreement as to whether mothers' offers were taken by infants ([Kappa] = .95) and as to whether infants' offers were taken by mothers ([Kappa] = .94). Coders also agreed as to whether mothers' requests elicited infant offers ([Kappa] = .67) and as to whether infants' requests elicited mothers' offers ([Kappa] = .92).

Kappas also were calculated separately to assess agreement on the presence or absence of each communicative behavior (gazing at mother, smiling, and vocalizing) over a gesture and its time window. For example, a 2 x 2 table would indicate whether each of two coders saw or did not see the infant gaze at its mother in the time window encompassing each gesture in a given session. The mean kappa across sessions for gazing at mother was .77. The mean kappa across sessions for smiling (calculated on the basis of agreement with a FACS certified coder) was .75. The mean kappa for infant vocalizations was .92.

### RESULTS

#### Pragmatics: How Do Infants and Mothers Gesture and Respond to Gestures?

Descriptions of the rate of mother and infant gesturing are given in Table 1. Mothers offered objects more frequently than did their infants,  $t(10) = 5.90$ ,  $p$  [is less than] .001. Although infants requested objects more than twice as frequently as their mothers and two mothers never requested, high standard deviations rendered the overall difference between mothers and infants nonsignificant,  $t(10) = 1.72$ ,  $p = .116$ . In comparison to their mothers, however, infants were more likely to request than to offer objects. That is, the percentage of infant gestures that were requests (40.4%) was higher than the proportion of mother gestures that were requests (10.2%),  $t(10) = 4.83$ ,  $p = .001$ .

Table 1. Infant and Mother Gestures

	M	Mdn	SD	Minimum	Maximum
Infant offers	1.53	1.06	1.31	0.32	4.04
Mother offers	4.55	4.36	1.53	1.83	7.20
Infant requests	1.12	0.58	1.08	0.13	3.38
Mother requests	0.54	0.37	0.52	0	1.73

Note. Infant and mother offers and requests are reported as rates per 10 min ( $N = 11$ ).

Mothers and infants were each about four times more likely to take an offered object than to not take it. However, mothers responded to 82.5% of their infants' requests for objects by offering an object whereas infants responded to only 44.4% of their mothers' requests for objects. A paired  $t$  test confirmed that in the nine dyads in which mothers as well as infants

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requested objects, infants were less responsive to requests for objects than were their mothers,  $t(8) = 3.35$ ,  $p = .010$ .

### Development: Does Infant Gesturing Rise With Age?

Rates of infant offering rose significantly with age, but rates of infant requesting did not (see Table 2 and Figures 1 & 2). Because absolute rates of each type of gesture were low, we also confirmed that the rise in the rate of total infant gesturing (offers plus requests) was significant.(1)

Table 2. Change With Age

	Proportion increasing	MDN b (per week)	M Correlation
<b>Infant Gestures</b>			
Offers	10/11(**)	.097	.394
Requests	8/11	.035	.170
Offers plus requests	10/11(**)	.162	.452
<b>Proportion of infant gestures involving vocalizations</b>			
Offers	8/10	.014	.256
Requests	8/9(*)	.034	.437
Offers plus requests	10/11(**)	.019	.434

Note. Change with age was calculated individually for the 11 infants. Binomial probability levels indicate the significance of the observed proportion of infants showing an increase with age. Denominators differed because the proportions of offers and requests involving a vocalization could not be calculated for all infants. The median bs indicate change in rate per 10 min.

(\*)  $p$  [is less than] .05.

(\*\*)  $P$  [is less than] .01.

[Figures 1-2 ILLUSTRATION OMITTED]

### Different Functions: Which Infant Communicative Behaviors and Gestures Occur Together and How Does This Change With Age?

Table 3 presents the overall proportions of infant communicative behaviors occurring with infant gestures. We were interested in the associations between infant gazing at mother, infant smiling, infant vocalizing, and type of infant gesture. An initial screen of two-way associations indicated that the likelihood of an infant vocalization accompanying a gesture was not associated with either the type of gesture, the presence of smiling, gazing at mother, or any combination of these factors. A hierarchical loglinear analysis of gazing at mother, smiling, and the type of gesture made by each infant was then conducted (see Table 4). An infant term was used in the loglinear analysis to maintain the Independence of each infant's data and to indicate whether associations between variables differed significantly among participants (Bakeman & Robinson, 1994). The loglinear analysis yielded a model that parsimoniously accounted for associations between these variables (Wickens, 1989). Significant associations were followed up with paired  $t$  tests in order to ensure the generalizability of the findings. (See Wickens, 1993, for a comparable procedure, which yielded equivalent results.)

Table 3. Proportion of Infant Gestures Associated With Infant Communicative Behaviors

Proportion with	M	Mdn	SD	Minimum	Maximum
Gaze at mother	.41	.41	.16	.18	.77
Smiling	.49	.37	.22	.25	.84
Vocalizing	.38	.37	.20	.10	.72

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Note. Infant communicative behaviors are expressed as the proportion of infant offers and requests accompanied by the behavior (N = 11).

Table 4. Hierarchical Selection of the Loglinear Model

Model	Model		
	[G.sup.2]	df	P
<i>[G*GZ*I] [G*S*I] [GZ*S*I]</i>	12.86	11	.303
<i>[G*GZ*I] [G*S*I] [G*S]</i>	26.00	21	.206
<i>[GZ*S*I] [G*S] [G*GZ] [G*I]</i>	37.21	31	.205
<i>[GZ*S*I] [G*GZ] [G*I]</i>	40.96	32	.133
Change from previous model			
Model	[G.sup.2]	df	P
<i>[G*GZ*I] [G*S*I] [GZ*S*I]</i>			
<i>[G*GZ*I] [G*S*I] [G*S]</i>	13.14	10	.216
<i>[GZ*S*I] [G*S] [G*GZ] [G*I]</i>	11.21	10	.341
<i>[GZ*S*I] [G*GZ] [G*I]</i>	3.75	1	.053

Note. The table shows the final steps in the downward movement from a model containing all possible associations to the selected (italicized) model. This is the simplest model yielding a nonsignificant p value. This model, with all embedded lower-order associations displayed, is presented in Table 5.

G = Gesture.

GZ = Gaze at mother.

S = Smile.

I = Infant.

The loglinear analysis resulted in a model (see Table 5) with two effects of particular interest. The Gaze at mother x Gesture association indicated that infants were more likely to gaze at mother when offering objects to her than when requesting objects from her,  $t(10) = 2.78$ ,  $p = .019$ . This association was present in 8 of 11 infants. On average, 50.0% of infant offers and 32.0% of infant requests involved gazing at mother.

Table 5. The Loglinear Model: Associations Between Infant Communication Behaviors and Type of Gesture

Association	Change if removed		
	[G.sup.2]	df	p
Gaze at mother x Smile x Infant	26.37	10	.00
Gaze at mother x Smile			
Gaze at mother x Infant			
Smile x Infant			
Gaze at mother x Gesture	42.47	1	.00
Gesture x Infant	51.76	10	.00

Note. Only the highest-order associations have a p to remove in the hierarchical model (.01 exclusion criteria). Associations describe 455 gestures of 11 infants. Of the 88 cells (2[Gaze at mother x 2[Smile] x 11 [Infant]]) in the model, 14 had values of 0. Simulation studies (Lamtz, 1978; Milligan, 1980) indicate the accuracy of loglinear models of sparse data when two commonly used statistics both indicate that observed data are well explained: [G.sup.2] (32) = 40.96,  $p = .13$ ; [chi square] = 38.23,  $p = .21$ .

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The Gaze at mother x Smile association indicated that when infants gazed at mother in association with gestures, they also were likely to smile,  $t(10) = 3.21$ ,  $p = .009$ . This association was present in 10 of 11 infants (see Figure 3). On average, 62.0% of gestures involving gazing at mother also involved smiling, whereas only 40.0% of gestures that did not involve gazing at mother involved smiling.(2)

[Figure 3 ILLUSTRATION OMITTED]

The loglinear analysis indicated that, after accounting for the effects of other associations, the association between type of gesture and smiling (with a  $p$  to remove slightly greater than .05) was not necessary to explain the data. However, Mundy et al. (1992) noted that certain types of gestures were more likely to involve infant smiling than were others. To investigate this, we compared the proportion of offers and the proportion of requests involving infant smiling, and the proportion involving the combination of infant smiling and gazing at mother. Infant smiling was more likely to occur with infant offers than with requests,  $t(10) = 4.10$ ,  $p = .002$ . In addition, offers were more likely than requests to involve the co-occurrence of gazing at mother and smiling,  $t(10) = 3.69$ ,  $p = .004$ ; see Figure 4.

[Figure 4 ILLUSTRATION OMITTED]

Pragmatic factors affecting infant communicative behaviors. To determine the effect of maternal requests on infant communicative behaviors, infant offers that had been elicited by a maternal request were contrasted with infant offers that had not been elicited by a request. There were eight relevant infants because two mothers never requested and one infant never offered in response to his mother's requests. These eight infants gazed at their mothers in association with 63.5% of their offers in which the mother had not requested an object. However, they gazed at their mothers in association with only 14.0% of the offers in which the mother had requested an object. That is, mother requests substantially lessened the likelihood of infants gazing at mother during ensuing offers,  $t(7) = 6.09$ ,  $p$  [is less than] .001. Mother requests did not significantly suppress other infant expressive behaviors (smiling and vocalizing) associated with offers.

Development of infant communicative behaviors. The proportion of infant requests involving a vocalization rose with age (see Table 2). Periods of requesting without a vocalization typically were followed by periods in which a substantial proportion of requests involved vocalizations (see Figure 2). The rise in the proportion of offers involving a vocalization was not significant (see Figure 1). It is also of note that the proportion of all gestures accompanied by a vocalization (offers plus requests) paralleled the trajectory of infant requests, showing an increase with age. No developmental patterns were evident in the proportion of infant gestures that involved gazing at mother, smiling, or any combination of the two.

### DISCUSSION

This longitudinal investigation was focused on the interactive context of infant offers and requests, and the types of infant behaviors accompanying those gestures. A relatively unique design was implemented in which patterns of communication and their developmental trajectories were examined within 11 infant-mother dyads seen longitudinally for a total of 156 play sessions. Generalizations from the current study are nevertheless limited due to a small sample size, a focus on manual offers and requests, variability in the number of infant gestures, and the use of a laboratory playroom (rather than a home) setting. Nevertheless, several robust effects emerged that have noteworthy conceptual implications.

The proportion of infant requests involving a vocalization rose with age, suggesting that infants become increasingly likely to use vocalizations to emphasize their instrumental desire to attain objects. Infant offers were more likely to involve gazing at mother than were infant requests, but only those offers initiated by the infant were likely to involve gazing at mother. Gestures involving gazing at mother also were likely to involve smiling, suggesting these actions were used to initiate positive social contact with mother. However, neither gazing at mother nor smiling was associated with infant vocalizing. The results suggest an empirical distinction between infant requests used instrumentally to obtain objects and infant offers used to initiate (positive) social contact.

Pragmatics: Infants Request and Mothers Offer

Compared with their mothers, infants were more likely to request than to offer objects. In addition, less than 50% of

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mother requests prompted an infant offer on average, whereas more than 80% of infant requests prompted a mother offer. The higher responsivity of mothers to requests highlights the importance of interactive pragmatics in infant communicative development. Infants may have been more likely to request than their mothers because infants were more likely to have their requests responded to. Mothers may have offered more frequently than infants in order to engage with and direct their infants (i.e., by offering a spoon while verbally encouraging the infant to stir the pot).

### Development: Infant Offers Rise With Age

Despite variability in the number of offers made by different infants and in different weekly sessions, almost all the infants observed in this study showed an increase in offering objects with age. This indicates that the development trajectories of individual infants show the rise in offering formerly found only in group comparisons (see Bakeman & Adamson, 1986). Like Masur (1982), we found that only approximately 75% of infants showed an increase in requests, a proportion that would be significant only if observed in a larger sample. In this, as in other studies (Bates et al., 1979; Blake et al., 1992), the majority of requests involved arm extensions without pointing. Although infants from 9 to 15 months of age develop the capacity to use pointing in a conventional fashion to direct attention, they typically use less elaborated gestures to communicate their desire to obtain objects in everyday interactions.

### An Instrumental Function: Vocalizing and Requesting

Vocalizing associated with gesturing is typically interpreted as an index of an infant's communicative intentions (Bates et al., 1979; Harding & Golinkoff, 1979). As they grew older, 10 of the 11 infants observed became more likely to vocalize in association with their gestures. The proportion of requests (but not offers) associated with a vocalization rose with age (see Blake et al., 1992; Zinober & Martlew, 1985; and Masur, 1982, for similar findings). The increasing association of requests and vocalizations suggests an increasingly instrumental use of requesting by infants.(3)

The referent of a manual offer is less ambiguous than the referent of a manual request. As infants become more clearly intentional and instrumental, they may increasingly use vocalizations with requests in order to compensate for this ambiguity. In doing so, they may be combining linguistic topics (the object referred to) with comments (the request gesture) in a manner that presages more complex language use (Rome-Flanders & Cronk, 1995).

### Gazing at Mother and Gesturing

Like vocalizing, infant gazing at mother during gestures has been considered a signal with which infants clarify that they are intentionally communicating about an object (Bates et al., 1979; Desrochers et al., 1995; Harding & Golinkoff, 1979). This study revealed no developmental rise in gazes at mother that were associated with gesturing (see Bakeman & Adamson, 1986, and Masur, 1982, for similar results). In sum, the ability to alternate visual engagement between an object and mother typically appears after 9 months of age and appears to facilitate infant gesturing. However, there is no clear evidence that infants' propensity to gaze at mother while offering and requesting increases with age. The lack of a clear developmental trajectory suggests that gazing at mother is not a stringent index of communicative intentionality under these conditions. Gazing at mother during gestures may contribute to the development of communicative intentionality rather than indexing its presence (see Corkum & Moore, 1995).

The meaning of infant gazing at mother may be inferred in part from its tendency to occur during infant offers rather than requests (see also Bakeman & Adamson, 1986). This may occur because an infant typically need only look up from the object he/she is offering to gaze at the mother. Infant gazes at mother also were significantly more likely to occur during offers initiated by the infant without a mother request. It is likely that when mothers requested an object, infants assumed her attention to the ensuing offer and omitted a confirmatory gaze at mother (Murphy, 1978). Infants also may have gazed at their mothers during offers in an expressive fashion to initiate social contact with their mothers, a possibility discussed later.

### Links Between Offering, Gazing at Mother, and Smiling

When infants gestured, gazing at mother and smiling were likely to occur together. Adamson and Bakeman (1985) hypothesized that early intentional communication (as indexed by coordinated gazing at mother) is associated with affective displays. They found that the proportion of affective displays occurring during coordinated joint attention was

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greater than expected. However, Adamson and Bakeman did not assess whether co-occurrences of affective displays and coordinated attention involved explicit infant communications (i.e., gesturing). When infant gestures are accompanied by gazing at mother, it suggests an increasing awareness of mother's communicative role in the interaction. In support of Bakeman and Adamson's hypothesis, conventional gestures in which infants showed increasing awareness of their mothers' communicative presence were particularly likely to involve displays of positive affect.(4)

Adamson and Bakeman (1985) also argued that affective displays "are prime candidates for supporting the infants' first attempts to communicate about objects" (p. 591). In support, they described a rise in the proportion of affective displays during coordinated visual engagement. This indicates that episodes in which infants coordinate joint attention between mother and object were increasingly likely to become occasions for positive affect. If affective displays support early communications, however, then early communications should be particularly likely to involve positive affect. Thus it is not clear that Bakeman and Adamson's findings support the hypothesis that positive affect is especially important in the development of early communication about objects.

In the current study, both infant gestures in general and infant gestures that involved gazing at mother were used as measures of infant communication about objects. Neither measure showed a developmental change in its association with smiling. In sum, displays of positive affect frequently co-occur with gestural communications with mother. They are particularly likely if the infant makes visual contact with the mother. But there is no evidence that the importance of displays of positive affect to gestural communication changes between 9 and 15 months.

### An Expressive Function: Gestures as Social Approach Behaviors

Although both offers and requests can be defined as proto-imperative gestures, they are substantively different communications (Bates et al., 1979). When infants request, they use a social means (the partner) to attain a nonsocial end, an object. When infants offer, they use an object as a means to a social end.(5) This formal distinction is mirrored by the observation that infant offers were more likely than requests to be social approach behaviors in which the infant initiated an action in order to share an experience with his or her partner. That is, offers were more likely to involve gazing at mothers than were requests. Specifically, infants typically gazed at mother when offering in order to initiate social contact. Offers that were responses to mothers' requests almost never involved gazing at mother. We also conducted post hoc analyses that indicated infant offers were not only more likely than requests to involve gazing at mother, but that they were more likely to involve smiling, and the co-occurrence of gazing at mother and smiling as well. Infant offers were a locus of social approach behaviors. In offering objects to mother, infants appeared to share and create positive social contact.

### CONCLUSION

We have delineated behavioral evidence for distinguishing between instrumental and social approach dimensions of infant communication in a sample of normally developing infants. Infants' instrumental use of conventional gestures is typified by requesting objects. Infant vocalizations increased the instrumental tone of infant gestures, particularly because the vocalizations were not related to either gazing at mother or infant smiling. The proportion of requests involving vocalizations rose with age, indicating that as infants approach 15 months of age, they use the behavioral precursors of speech instrumentally to communicate their desire for objects.

The second dimension of intentional communication involves social approach behaviors typified by offering accompanied by gazing at mother and smiling. After 9 months of age, infants offer more frequently, display more positive affect (Biringen, Erode, Campos, & Appelbaum, 1995), and are more likely to coordinate attention between mother and an object (Bakeman & Adamson, 1986). However, the likelihood that infants combine these social approach behaviors with conventional gesturing showed no consistent pattern of increase or decrease with age (see Mundy, Sigman, Kasari, & Yirmiya, 1988, for similar results). There is a developmental contrast between the rise in the instrumental use of nonverbal communication, and the absence of a rise or fall in infants' use of gestures to initiate social contact.

The developmental contrast between social approach and instrumental uses of gestures in normally developing infants is mirrored by distinct patterns of psychopathological deficits. Children with autism show specific deficits in social approach behaviors such as offering objects while gazing at a partner and smiling (Mundy, 1995). Children with Down Syndrome show specific deficits in instrumental behaviors such as requesting objects (Mundy et al., 1992). The clustering of

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behaviors related to social approach and instrumental functions of nonverbal communication, the differing developmental trajectories of those clusters, and their association with different developmental psychopathologies provide an empirical basis for a conceptual distinction that may provide insight into future research on infant nonverbal communication.

(1) To test developmental effects, correlations between the rate of gesturing and age were calculated for each infant. A binomial test was then conducted to ascertain the significance of the proportion of infants who showed a rise in a particular type of gesturing with age. Significance levels were equivalent both when hierarchical linear modeling was used (Bryk & Raudenbusch, 1987) and when t tests were used to determine if the mean correlation with age was equal to 0 (see Hays, 1988).

(2) The Gaze at mother x Smile association was hierarchically embedded within the Gaze at mother x Smile x Infant association, indicating variability in the strength of this association (see Figure 3).

(3) At an overall level, requests were not differentially associated with vocalizations. It is likely, however, that if observations had continued until 18 months, the increasing developmental association of requests and vocalizations would have led to an overall tendency for infant requests to be associated with vocalizations.

(4) We did not employ Adamson and Bakeman's (1985) measure of coordinated joint engagement in which infants alternately gazed between mother and an object. The argument can be made, however, that when infants gaze at mother in association with a gesture, they are coordinating visual attention to mother with (manual and perhaps visual) attention to the object of the gesture. Nevertheless, the indices of attention are not identical and care must be taken in their interpretation.

(5) Exceptions can occur when the formal structure of the gesture (the conventional manual morphology of an offer or request) is used for a different function (cf. Goldin-Meadow, 1993). For example, an infant might use an offer to request that the partner do something with the offered object. As noted earlier, this was rarely observed in the interactions we studied. Nevertheless, to the degree to which it did occur, it would attenuate the strength of the differences observed between formally defined offers and requests.

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