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Distinguishing Mother–Infant Interaction From Stranger–Infant Interaction at 2, 4, and 6 Months of Age

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Observers watched videotaped face-to-face mother–infant and stranger–infant interactions of 12 infants at 2, 4, or 6 months of age. Half of the observers saw each mother paired with her own infant and another infant of the same age (mother tapes) and half saw each infant paired with his or her mother and with a stranger (infant tapes). Observers were asked to judge which was the mother–infant dyad in each pair. Observers' accuracy improved as infants aged and was above chance for both mother and infant tapes when infants were 6 months. Differences between mother–infant and stranger–infant dyadic communication patterns also emerged as the infants aged. At 6 months, mother–infant dyads had more symmetrical communication and less asymmetrical communication than stranger–infant dyads.

Infants are perceptually able to discriminate mother from others very early in life. Newborns actively change their sucking behavior to hear their mothers' voices rather than voices of other women (DeCasper & Fifer, 1980). Discrimination based on vision alone occurs by 2 months, if not earlier (Bushnell, 2001; Dixon et al., 1981; Farris, 2000; Masi & Scott, 1983; Walton, Bower, & Bower, 1992).

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However, in daily life, infants rarely encounter their mothers or other people as still images or disembodied voices; rather, infants experience dynamic encounters where mothers' visual characteristics, voice, and movements are perceived as a whole and are distinguishable from those of strangers. Yet when 2-month-old infants are observed in face-to-face interactions with mothers and strangers, they show similar behaviors toward the adults (Bigelow & Rochat, 2006). When viewing 3-month-old infants engaged with off-screen others, observers were unable to determine whether the infants were interacting with their mothers or strangers (Contole & Over, 1981). Infants recognize their mothers from others, but young infants tend to respond to adults' overtures in similar ways regardless of the familiarity of the adults.

Mothers also use similar ways of behaving toward their own and other infants. Repetitive sets of behaviors are common, but with individual differences in form, rhythm, pattern, and intensity of these behaviors (Dixon et al., 1981; Stern, Hofer, Haft, & Dore, 1985). Mothers of young infants use their individual styles of interaction when engaged with their own infants and with other similarly aged infants (Bigelow & Rochat, 2006; Kaye, 1982). Mothers clearly can discriminate their infants from other infants, yet mothers' interactive styles are consistent across infants.

In infants' early months, mothers' behavior is necessary to engage infants' interaction, but not very effective in changing infants' behavior (Kaye & Fogel, 1980). As infants become more capable, they contribute more to interactions and become more consistent in their behavior with mother (Bornstein & Tamis-LeMonda, 1990; de Weerth & van Geert, 2002; Hsu & Fogel, 2003; Lavelli & Fogel, 2002). When shown only infants' behavior, observers can determine when 10-month-old infants are interacting with their mothers (Frye, Rawling, Moore, & Myers, 1983). By this age, mother–infant dyads have developed their own distinctive patterns of engagement (Kaye, 1982). Although these patterns might overlap with those of other mothers and infants, the patterns are unique to each dyad and span soothing, arousing, and playful interactions (Fogel, 1993; Stern et al., 1985).

When do mother–infant interactions first become distinguishable from other adult–infant dyadic exchanges? Are such distinctions evident during the infants' first half-year of life? Are mother–infant interactions easier to distinguish when observing mothers interacting with their own and other infants or when observing infants interacting with their mothers and strangers? On what basis do observers distinguish mother–infant interaction from stranger–infant interaction? These questions were investigated by asking observers to identify the mother–infant dyad when watching videotaped face-to-face mother–infant and stranger–infant interactions of 2-, 4-, and 6-month-old infants. It was predicted that observers would become more accurate in their judgments as the infants aged.

METHOD

Participants

Participants were 243 undergraduate students (95 male, 148 female), who were not parents. Their mean age was 19.3 years (*SD* = 2.3 years).

Stimulus Tapes

Stimulus tapes were made from 12 infants' videotaped mother–infant and stranger–infant face-to-face interactions at three ages. The same 12 mothers and infants were seen in pairs (2 mothers and their infants) longitudinally when the infants were 2 (*M* = 2.23 months, *SD* = 0.38), 4 (*M* = 4.21 months, *SD* = 0.35), and 6 (*M* = 6.52 months, *SD* = 0.37) months old. In each session, one of the infants and one of the adults were taken into a small room with a baby seat fixed to a table and a chair facing the baby seat approximately 1 m away. The infant was placed in the baby seat and the adult sat in the chair. The other infant and adult remained in another room. In the small room, there were three video cameras: one situated above and behind the adult that videotaped the infant, one situated above and behind the baby seat that videotaped the adult (head and shoulders), and one situated on the wall that videotaped a side view of the adult (waist up) and infant (full body). A quadrant split-screen generator merged the images onto one screen (the fourth screen was blank). The adult and infant were videotaped while engaged in 5 min of face-to-face interaction. This was followed by 5 min of face-to-face interaction with the infant and the other adult. The other infant was similarly videotaped with his or her mother and with the other mother. The order of videotaping mother–infant and stranger–infant interactions was counterbalanced.

Thus the mothers of the other infants in the pair of mother–infant dyads acted as strangers to the infants at each age, resulting in mothers interacting with unfamiliar infants as well as infants interacting with unfamiliar adults. Although the paired mother–infant dyads met at each of the three sessions, they were not familiar with each other in any other context; therefore, they were considered strangers throughout the study.

Continuous, uninterrupted 1-min video clips were taken from the tapes (mother–infant and stranger–infant interactions at each age) in which the adult did not verbally identify herself as the infant's mother or as a stranger; for example, "How is Mommy's girl?" "Are we going shopping later?" "You are quieter than my Anna." The length of the video clips was 1 min because rarely was there more than 1 min in the 5-min interactions when the adults did not verbally indicate how familiar they were with the infants.

The video clips were arranged into two sets (mother tapes and infant tapes) of three tapes each (2, 4, and 6 months). Each tape had 12 paired clips. In mother

tapes, the paired clips showed 12 mothers, each interacting with her infant and with the other infant. In infant tapes, the paired clips showed 12 infants, each interacting with his or her mother and with the stranger. Thus the video clips were the same in the mother and infant tapes for each age level, but the video clips were arranged differently in the mother and infant tapes. The order of the mother–infant interaction in the paired clips was counterbalanced. The specific arrangement of the video clips in the tapes is available from the first author on request.

The video clips were scored for adults' duration of gazing at the infant's face, smiling, vocalizing, and touching the infant, and for the infants' duration of gazing at the adult's face, smiling, vocalizing (excluding fussing), and fussing. Table 1 shows the means and standard deviations of these scores. Repeated measures (partners) analyses of variance (ANOVAs) indicated no significant differences (all $p > .05$) in these mother–infant and stranger–infant scores. Interrater reliability was conducted on 12 video clips, evenly divided from across the three infant ages, of adult to infant and infant to adult behaviors. Intraclass correlations, absolute type with raters random, for the adult to infant behaviors were .90 for gaze, .78 for smiles, .70 for vocalizations, and .96 for touch, and for the infant to adult behaviors were .99 for gaze, .84 for smiles, .80 for vocalizations, and .99 for fussing. All the intraclass correlations were significant at the $p < .001$ level.

The stimulus tapes were shown on an 18-in. TV monitor. Participants either saw only the target person (mother in the mother tapes, infant in the infant tapes) or only the view of both partners (side view of the adult and infant). A screen blocking three of the four quadrants of the video image on the stimulus tapes was fitted over the TV monitor so that only the quadrant with the target person or both partners was visible. Thus, there were 12 different stimulus tape presentations: target and partners views of the mother and infant tapes at each of the three infant ages (2, 4, and 6 months).

Procedure

Participants were shown one of the 12 stimulus tape presentations. The mean number of participants watching each of the stimulus tape presentations was 20 (SD = 3.8). In small groups of 3 to 12, the participants were seated in front of the TV monitor. Seating was such that they could see the monitor clearly but they could not see each other's score sheets. They were told that they would be shown pairs of adult–infant interactions. Participants watching the mother tapes were told that one of each pair was a mother with her own infant and one was the same woman with an infant who was not her own. Participants watching the infant tapes were told that one of each pair was an infant with his or her mother and the other was the same infant with a stranger. After viewing each pair of video clips, participants were instructed to judge which pair was the mother–infant dyad.

TABLE 1
Mean Durations and Standard Deviations in Seconds of Adult to Infant Gaze, Smiles, Vocalizations, and Touch[a] and Infant to Adult Gaze, Smiles, Vocalizations, and Fussing for the Stimulus Tapes at Each Age, With Probability and Effect Size Statistics for Comparisons of the Behaviors Between the Mother–Infant and Stranger–Infant Interactions in the Infant and Mother Tapes

	From/to Mother		*From/to Stranger*		*Infant Tapes*		*Mother Tapes*	
	M	*SD*	*M*	*SD*	*p*	$p\eta^2$	*p*	$p\eta^2$
Adult to infant								
At 2 months								
Gaze	58.4	1.7	56.6	3.1	.11	.214	.06	.295
Smiles	29.3	20.7	31.7	16.9	.72	.013	.35	.079
Vocalizations	27.5	6.9	29.7	6.8	.44	.054	.27	.110
Touch	22.7	22.7	16.1	16.8	.46	.050	.35	.078
At 4 months								
Gaze	55.5	4.2	54.3	9.0	.69	.015	.67	.017
Smiles	28.3	13.8	29.8	17.4	.79	.007	.56	.032
Vocalizations	23.5	7.5	26.4	7.4	.12	.206	.09	.239
Touch	25.3	20.6	17.5	22.5	.48	.047	.27	.111
At 6 months								
Gaze	46.7	17.0	51.2	6.8	.42	.060	.48	.053
Smiles	32.8	20.7	30.2	14.1	.75	.009	.62	.024
Vocalizations	26.0	10.1	27.8	8.8	.56	.032	.61	.025
Touch	16.6	19.3	13.7	17.7	.68	.016	.64	.021
Infant to adult								
At 2 months								
Gaze	44.5	19.3	50.9	13.9	.23	.127	.38	.070
Smiles	4.8	7.6	8.8	10.2	.21	.141	.20	.147
Vocalizations	6.2	9.0	2.4	2.5	.17	.164	.22	.133
Fussing	0.2	0.7	0.3	0.8	.72	.013	.72	.013
At 4 months								
Gaze	28.7	21.1	35.3	19.4	.46	.051	.36	.078
Smiles	6.0	7.3	3.5	4.1	.37	.074	.32	.091
Vocalizations	2.9	5.8	2.7	3.8	.93	.001	.93	.001
Fussing	0.8	2.7	2.4	7.9	.29	.100	.51	.041
At 6 months								
Gaze	15.9	10.5	22.9	15.5	.24	.125	.16	.170
Smiles	5.6	7.8	4.5	7.8	.73	.011	.62	.023
Vocalizations	2.7	5.3	0.15	0.2	.12	.205	.11	.213
Fussing	0.4	0.5	0.6	1.3	.56	.031	.58	.029

Note. The number of paired adult–infant interactions at each age was 12. The video clips in the infant and mother tapes were the same, although the arrangements of the clips were different. Thus, the means and standard deviations for the duration of gaze, smiles, vocalizations, touch, and fussing are identical in the infant and mother tapes, but when analyzing the difference in the duration of the behaviors in the mother–infant and stranger–infant interactions in the infant and mother tapes, the *p* and $p\eta^2$ were different.

[a]Only the adults initiated touching their partner.

Score sheets asked for the participants' age, sex, whether they were parents, and then in 12 sections, one for each pair of video clips, participants indicated which video clip showed the mother–infant dyad, how confident they were of their judgment on a Likert scale ranging from 1 (*very sure*) to 7 (*not at all sure*), and whether they recognized the infants or the adults in the video clips.

Each pair of video clips was shown without pause but there was a break (approximately 2 sec) in the video recording between the two video clips. During the pause, the experimenter announced that the second video clip of the pair was about to begin. At the end of a pair of video clips, the videotape was stopped and participants were instructed to fill out their score sheets. After approximately 1 min, the next pair of video clips was shown.

RESULTS

Preliminary analyses for sex of the adult participants yielded nonsignificant results for correct judgments ($p = .82$) and for confidence in judgments ($p = .67$). Thus, sex of the participants was eliminated from further analyses.

An ANOVA with three variables, infant age (2, 4, 6 months), tape (mother tapes, infant tapes), and view (target person, partners), was conducted on the participants' number of correct judgments. There was a significant main effect for age, $F(2, 231) = 26.299$, $p < .001$, and a significant Infant Age × Tape interaction, $F(2, 231) = 8.567$, $p < .001$ (all other $p > .05$). Figure 1 shows the mean number of correct judgments for the mother and infant tapes at each of the three infant ages. When follow-up one-factor ANOVAs (tape) were conducted on the correct judgments for each infant age, a significant effect for tape was found only when observers watched the interactions with 4- and 6-month-old infants. When infants were 4 months old, more correct judgments occurred when watching the mother tape ($M =$ 7.2 [60% correct judgments], $SD = 1.7$) than when watching the infant tape ($M =$ 6.0 [50% correct judgments], $SD = 1.8$), $F(1, 93) = 11.958$, $p < .001$. When infants were 6 months old, more correct judgments occurred when watching the infant tape ($M = 8.4$ [70% correct judgments], $SD = 1.7$) than when watching the mother tape ($M = 7.3$ [61% correct judgments], $SD = 1.7$), $F(1, 77) = 7.097$, $p < .01$.

The correct judgments for the mother and infant tapes at each of the infant ages were tested against chance using binomials, where chance was six correct judgments (range of possible correct judgments 0–12). Participants' correct judgments were above chance when observing 6-month-old infants, mother tape: $z = –2.535$, $p < .02$; infant tape: $z = –4.523$, $p < .001$, but not at the younger ages (all other $p >$ .05).

An ANOVA with the variables infant age, tape, and view was conducted on the participants' mean Likert 7-point scale rating of their confidence in their judgments. There were significant main effects for tape, $F(1, 222) = 4.013$, $p < .05$, and

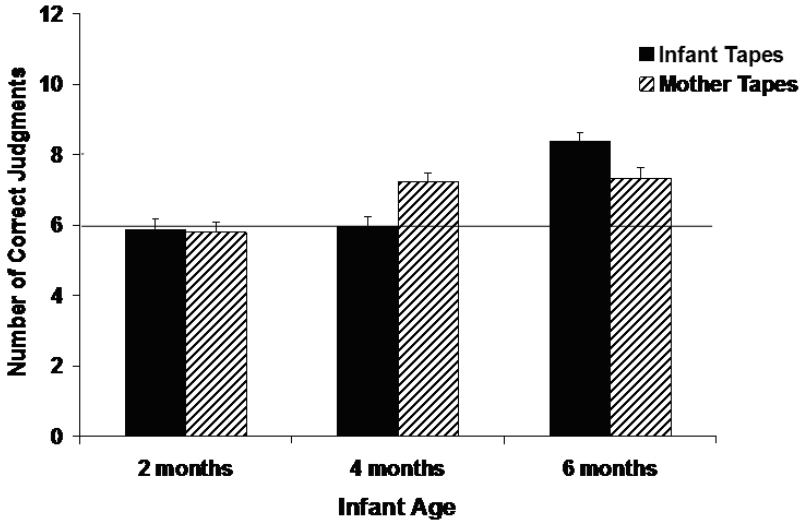

FIGURE 1 Mean number of correct judgments in the infant and mother tapes at each infant age. Horizontal line represents chance at 6 correct judgments (range of possible correct judgments 0–12). Vertical bars represent standard errors.

view, $F(1, 222) = 10.261$, $p < .01$ (all other $p > .05$). Participants had more confidence in their judgments when watching mother tapes ($M = 3.66$, $SD = 0.92$) than when watching infant tapes ($M = 3.45$, $SD = 0.82$) and when watching the target person ($M = 3.73$, $SD = 0.86$) than when watching both partners ($M = 3.37$, $SD = 0.86$). However, the correlation between participants' correct judgments and their confidence in their judgments was nonsignificant, $r(232) = –.005$, $p = .47$, as were separate correlations between participants' correct judgments and confidence in their judgments by tape, view, and infant age (all $p > .15$).

Dyadic Communication in the Stimulus Tapes

To investigate what might have enabled the participants to become increasingly accurate in their judgments as the infants aged, the stimulus tapes were scored for four types of mutually exclusive dyadic communication patterns described in Table 2, adapted from Hsu and Fogel (2003). Coding was continuous, with a change in dyadic communication lasting more than 3 sec instigating a new code. A second coder scored 15 adult–infant interactions, 5 at each infant age; kappa was .80. Figures 2, 3, and 4 show the mean number of seconds the mother–infant and stranger–infant dyads spent in each communication pattern at each age.

Repeated measures ANOVAs with communication pattern, dyad (mother–infant, stranger–infant), and tape (mother tapes, infant tapes) as variables were con-

TABLE 2
Definitions and Examples of Adult–Infant Communication Patterns

Patterns of Dyadic Communication	*Definition*
Symmetrical	Symmetrical communication occurs when both adult and infant are actively engaged with one another or in joint focus of attention. *Examples*: Animated vocal turn taking; the adult walks her fingers up the infant's body and the infant watches the adult's hand with excitement.
Asymmetrical	Asymmetrical communication occurs when the adult is attempting to engage the infant but the infant is passively attending to the adult or her actions. *Examples*: The adult sings to the infant and the infant stares back at the adult; the adult plays with the infant's foot and the infant passively watches his or her own foot.
Unilateral	Unilateral communication occurs when the adult tries to engage the infant, who is not attending or responding to the adult. *Example*: The adult picks up the infant's feet and claps them together while the infant gazes off in another direction (not looking at adult or his or her feet).
Passive unilateral	Passive unilateral communication occurs when the infant is not attending to the adult and the adult is attentive but does not talk to or attempt to engage the infant in an activity. *Example*: The adult watches the infant while the infant plays with and looks at his or her fingers.

Note. The adult, not the infant, was the active initiator of the interactions. There were no instances where the infant was the active partner in asymmetrical or unilateral communication or where the infant was passively attending to the adult in passive unilateral communication.

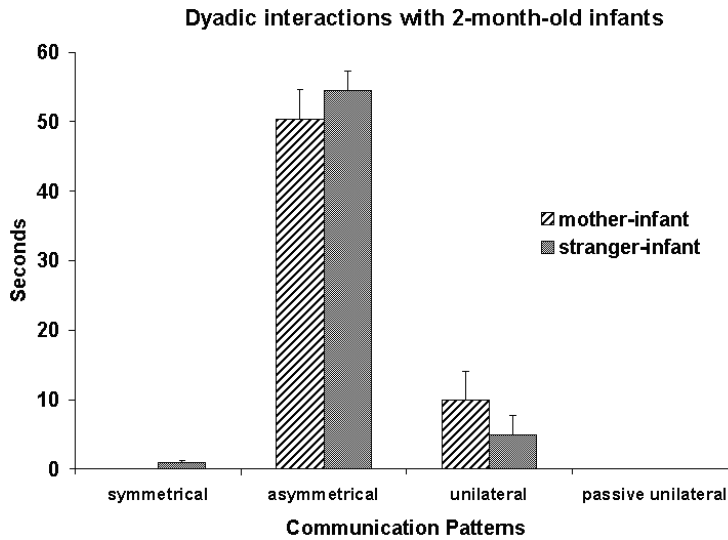

FIGURE 2 Mean number of seconds the mother–infant dyad and stranger–infant dyad spent in each communication pattern when infants were 2 months old. Vertical bars represent standard errors.

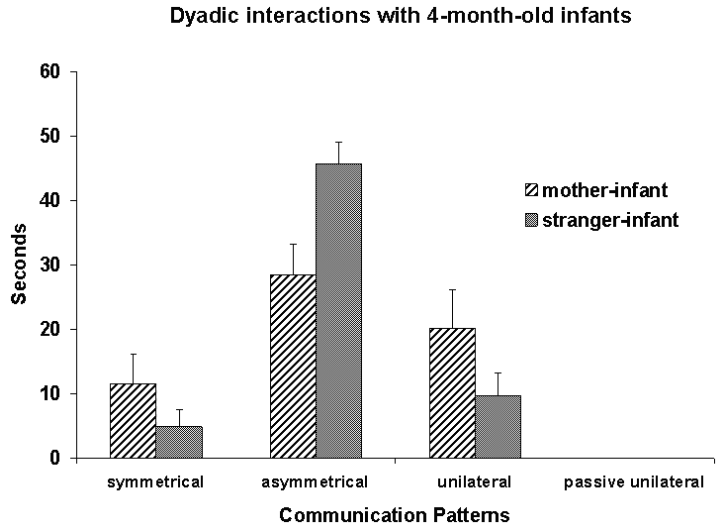

FIGURE 3 Mean number of seconds the mother–infant dyad and stranger–infant dyad spent in each communication pattern when infants were 4 months old. Vertical bars represent standard errors.

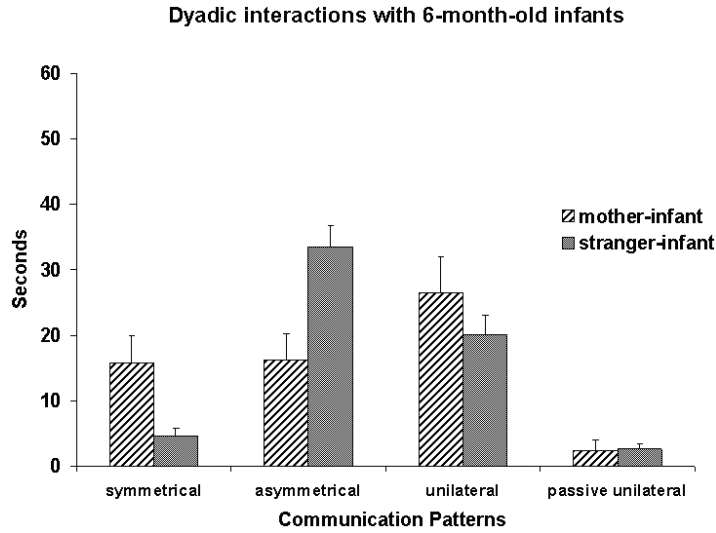

FIGURE 4 Mean number of seconds the mother–infant dyad and stranger–infant dyad spent in each communication pattern when infants were 6 months old. Vertical bars represent standard errors.

ducted on the duration of communication at each infant age. Passive unilateral communication was excluded from data analysis because of its rarity.

At 2 months, there was a significant effect for communication pattern, $F(2, 22) = 84.966$, $p < .001$ (all other $p > .23$). Pairwise comparisons indicated the dyads engaged in more asymmetrical communication than other communication patterns and more unilateral communication than symmetrical communication.

At 4 months, there was a significant Communication Pattern × Dyad interaction, $F(2, 22) = 6.533$, $p < .006$, and main effect for communication pattern, $F(2, 22) = 11.939$, $p < .001$, (all other $p > .78$). Follow-up ANOVAs on the interaction indicated that mother–infant dyads had less asymmetrical communication, $F(1, 11) = 12.15$, $p < .005$, and more unilateral communication, $F(1, 11) = 5.69$, $p < .05$, than stranger–infant dyads.

At 6 months, there was a significant Communication Pattern × Dyad interaction, $F(2, 22) = 5.955$, $p < .009$, and main effect for communication pattern, $F(2, 22) = 5.800$, $p < .009$, (all other $p > .87$). Follow-up ANOVAs on the interaction indicated that mother–infant dyads had more symmetrical communication, $F(1, 11) = 5.50$, $p < .05$, and less asymmetrical communication, $F(1, 11) = 11.05$, $p < .005$, than stranger–infant dyads.

DISCUSSION

The prediction that observers would become more accurate in their judgments as infants aged was supported. However, only when watching interactions with 6-month-old infants did observers distinguish mother–infant dyads from stranger–infant dyads at above-chance levels. Even when infants were this age, the percentage of dyad pairs judged correctly suggests that similarities between mother–infant and stranger–infant interactions still challenge observers' ability to identify the mother–infant dyad. Nevertheless, observers became increasingly successful in distinguishing the mother–infant dyad as the infants got older.

What enabled the observers to do so? Differences in the adults' and infants' duration of gaze, smiles, vocalizations, and physical contact were not the distinguishing features, as they were similar in the mother–infant and stranger–infant dyads at each age level. However, when the dyad, rather than the individual partners, was used as the unit of analysis, differences in communication patterns in the mother–infant and stranger–infant interactions became evident when infants were 4 and 6 months old. At 2 months, dyadic communication was dominated by asymmetry. Infants passively watched as both mothers and strangers engaged them. At this age, unengaged but attentive behavior suggests obligatory looking or inability to self-regulate (Ruff & Rothbart, 1996).

At 4 months, infants were less attentive (more unilateral communication) to their mothers' behavior than to that of strangers, but infants' attention was more

passive to strangers' behavior (more asymmetrical communication) than to their mothers' behavior. At this age, unengaged but attentive behavior reflects emotional states of boredom, passive interest, or wariness (Izard, 1977). Observers made more correct judgments when watching the mother tape than the infant tape. Adults are the active agents in interactions at this age (Hsu & Fogel, 2003). Adults initiate and direct the interactions. They also have individual styles in how they do so, which they use with their own and other same-aged infants (Dixon et al., 1981; Kaye, 1982; Stern et al., 1985). These individual styles might have made it easier to distinguish the mother–infant dyads when watching mothers interacting with their own and other infants (mother tape) than when watching infants interacting with their mother and a stranger, with each adult using different styles of engagement (infant tape).

When the infants were 6 months old, observers' accuracy was above chance levels. At this age, infants' level of attentiveness to the behavior of mothers and strangers was similar (nonsignificant differences in dyads' unilateral and passive unilateral communication). When infants were attentive to the adults' actions, they were more likely to be actively engaged with their mothers (more symmetrical communication) but passively watching the strangers (more asymmetrical communication). Differences in infants' level of engagement with mothers and strangers might have been why observers watching the infant tape, where each infant was paired with his or her mother and a stranger, were more accurate than observers watching the mother tape, although accuracy was above chance for both groups.

Whether observers viewed the target person or both partners did not influence the accuracy of their judgments. This was surprising because viewing both partners gave observers more information about the interactions. However, the target person's engagement in the dyadic interaction was affected by the partner's behavior, and the vocalizations of both partners could be heard when watching the target person, making the effect of the dyadic communication noticeable in both views.

Observers' confidence in their judgments did not improve as accuracy of their judgments improved, as has been found in previous research (Contole & Over, 1981; Frye et al., 1983). Nevertheless, observers had more confidence in their judgments when watching the target person and when watching the mother tapes. Observers might have been more confident when viewing the target person because this view presented less information than the view of both partners and, therefore, there were fewer variables to consider in making the judgment. Observers might have been more confident when watching the mother tapes because they had more experience interpreting adult behavior than infant behavior.

Limitations of the study include having the observers watch the stimulus tapes in small groups rather than individually, the brevity of the dyadic interactions, and the specific dyadic interactions presented. Although the observers were seated so that they could not see each other's score sheets while watching the stimulus tapes, having observers watch the stimulus tapes in individual sessions would have as-

sured that the observers did not influence each other's judgments. Dyadic interactions of 1 min allow observers to easily compare sequentially presented interactions, yet the brevity of the interactions might have influenced the observers' ability to make accurate judgments. Likewise, the particular segments of interaction presented might have influenced the observers' accuracy of judgments. In this study, the 1-min segments presented were restricted by when, in the original 5-min videotaped interactions, the adult did not verbally identify herself as the mother or the stranger. If the original videotaped sessions were longer, more segments of mother–infant and stranger–infant interactions would be available. Yet verbal clues of how familiar the adult is with the infant are frequent in adult–infant interactions. In future studies, adults' speech could be acoustically altered so that tone is preserved but words are unintelligible. Alternatively, observers could be presented with mother–infant and stranger–infant interactions in which the adults are speaking a language unknown to the observers. Such studies would allow for comparisons between longer and more varied adult–infant interactions as well as investigate observers' ability to distinguish mother–infant dyads across cultures.

The period from 2 to 6 months is a crucial time in the development of mother–infant relations, the time that spans infants' emergence of social responsiveness (Rochat, 2001) to the blossoming of the attachment relationship. Early in this period, mothers, with their individual styles of engagement, do most of the work of orchestrating interactions, and initially infants contribute little (Hsu & Fogel, 2003; Kaye & Fogel, 1980). Yet infants are affected by their interaction histories with their mothers (Field et al., 2005; Nadel, Soussignan, Canet, Libert, & Gérardin, 2005). Through the first half-year of life, mother–infant dyadic communication becomes more mutual (Bornstein & Tamis-LeMonda, 1990; Hsu & Fogel, 2003). Differences in the familiar maternal pattern of behavior and strangers' behavior affect infants' level of engagement with strangers; infants are more responsive to mothers relative to strangers throughout this period (Bigelow, 1998; Bigelow & Rochat, 2006). Mother–infant interaction becomes increasingly distinguishable from stranger–infant interaction and more characterized by active dyadic engagement.

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