MATERNAL RESPONSIVENESS TO INFANT AFFECT: STABILITY AND PREDICTION

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In two short-term longitudinal studies, infant expressivity and maternal responsiveness to infant expressivity were examined. In Study 1, thirty-eight dyads visited a laboratory at 11 and 12 months; in Study 2, seventy-seven dyads were visited in their homes at 9 and 13 months. Mother-infant interaction was coded from videotapes of free play in both studies. Infant expressivity and maternal responsiveness to infant expressivity were stable after the contributions of the other partner were considered. Infant expressivity at 13 months was influenced by 9-month and 13-month maternal responsiveness to infant expressivity. Predictive relations from 9 to 13 months, however, were attenuated when stability in maternal responsiveness was considered, indicating that consistency in maternal responsiveness over time influences later infant expressivity. Maternal responses that matched infant affect were more stable and more predictive of infant expressivity than nonmatching responses, suggesting that matching responses may play a distinctive role in the development of infant expressivity.

mother-infant interaction affect maternal responsiveness emotions

Emotions and expressivity in infants have been increasingly understood as relational processes that motivate engagement with the environment and with others (Campos, Campos, & Barrett, 1989). Studies have linked early positive expressivity and sociability with mother-infant attachment (Belsky, Fish, & Isabella, 1991), joint attention (Garner & Landry, 1994; Mundy, Kasari, & Sigman, 1992), and children's later internalization of maternal rules (Kochanska, 1997), suggesting that expressivity plays an important role in early emotional...
and cognitive development and in children's future socialization. A specific type of contingent maternal response that matches infant expressions is believed to have a particular developmental role in fostering early affiliation and involvement in the dyad (Uzgiris, 1991). In the present investigation, we examined maternal responsiveness to infant expressivity, evaluating the differential influence of maternal matching responses versus contingent but nonmatching responses. Our focus was on late infancy, as emotions and expressivity are especially salient during this period involving special advances in sociability and attachment (Emde, 1988). We begin by discussing infant expressivity and maternal responsiveness to infant expressivity. We then discuss our approach to the assessment of stability in infant expressivity, maternal responsiveness to infant expressivity, and the assessment of maternal influence on infant expressivity over time.

**Infant Expressivity**

Infant affect is expressed through facial expressions, vocalizations, and bodily movement, and these expressions carry both categorical and gradient information. In a categorical approach to expressivity, affective expressions may be classified according to the Darwinian emotions (e.g., sadness, joy, etc.), or expressions may be categorized by valence (i.e., as positive or negative). In a gradient approach, expressions can be rated on continuous dimensions, such as intensity. However, categorical affects often occur with gradient features; these features may give an expression its particular character or nuance. For example, an expression of anger with a high degree of intensity may be perceived as "searing" or, with less intensity, as "smoldering." While gradient and categorical expressions may coincide, they have no intrinsic congruence with each other; both temper tantrums or exuberance may have sudden or "bursting" qualities.

In infants, gradient features of expressivity—such as intensity, tempo, and shape—are dimensions of behavior that vary in degree. **Intensity** is the degree of force or muscular tension involved in an expression. **Tempo** is the timing of the behavior, that is, whether it is abrupt and rapid, or gradual and slow. Changes in **shape** are observed in bodily movement, which can be expansive or shrinking. These gradient expressions are assumed to be expressive, that is, reflective of inner psychological states, according to an everyday understanding of the correspondence between inner subjective qualities of feeling and their expressions in gradient features (Stern, 1993; Trevarthen, 1993). For example, a light, quick, bouncing walk—when perceived unreflectedly—is expressive of lightheartedness, happiness, vitality, and so forth.

Stern, Hofer, Haft, and Dore (1984) found that marked changes in gradient features occur with relative frequency in infant vocal, facial, and bodily expressivity. Similarly, in Bloom's (1993) investigation of relations between affect and early word learning, affective vocalizations and movements with prominent gradient features were found to be more prevalent than categorical affect in infants. Stern has termed gradient features in expressivity "vitality affects," noting that their bodily or kinetic qualities suggest underlying physiological reactions such as muscular tension and release (Stern, 1985).

Stern (1985) has also noted that mothers may respond contingently to gradient features in infant expressivity in such a way as to match their infant's expressions. For example, when a mother softly whispers, "Nice," after her infant gently pats a doll's hair, the mother matches her infant's behavior on the dimension of intensity—a softly delivered comment in response to her infant's soft pat. There is some indication that mothers' capacity to match infant expressivity may be linked to personological characteristics. Haft and Slade (1989) have found that rates of matching responses are associated with mothers' attachment to their own mothers, which suggests that matching responsiveness is associated with...
mothers' abilities to access and integrate their own emotions and experiences.

Stern has suggested that mothers' matching responses support infants' emerging sense of the shareability of affect by conveying to the infant that the infant's mother is close to and shares in the infant's level of experience (Stern, 1985). The gradient features present in infants' expressivity and in mothers' matching responses are core, transmodal qualities that allow the infant to recognize the sharing of affect. Infants' perception of mothers' matching of gradient features forms the basis for the emerging capacity for intersubjectivity, which Stern (1985), like Trevarthen (1993), has argued is innate and emerges with maturation.

Of course, mothers might respond contingently to their infants' expressivity in a number of ways that do not involve matching, such as by simply acknowledging the affect, by introducing a new agenda, by praising the child, and so on. For example, when a mother says "That's right" in response to her infant's light pat or smile—without matching either the valence or dimensional expressivity of the infant's behavior—she is responding in a non-matching yet contingent manner. Of central interest in the present studies is whether matching versus nonmatching maternal responses differentially influence infants' expressivity over time.

**Stability in Infant Expressivity and in Maternal Responsiveness**

Several investigators have identified stability in infants' positive and negative emotions beginning in mid-infancy. Smiling has been found to be stable between 3 and 20 months (Field, Adler, Vega-Lahr, & Scafidi, 1987), and negative and positive affect have been found to be stable between 3 and 7 months (Garcia Coll, Halpern, Vohr, Seifer, & Oh, 1992). Malatesta and her colleagues (Malatesta, Culver, Tesman, & Shepard, 1989) found both positive and negative affect to be stable from 5 to 7.5 months. Others have found positive and negative affect to be stable between 9 and 12 months (Riese, 1988), and negative affect to be stable between 7.5 and 22 months (Malatesta et al., 1989).

Certain maternal behaviors, such as maternal responsiveness, may contribute to this observed stability in infant expressivity by supporting or reinforcing expressions in infants over time. Although expressivity in adults has been shown to be stable (Halberstadt, 1991), maternal expressivity and maternal responsiveness in the context of infant expressivity have received less attention. Two studies of mother-infant interaction, however, are relevant to the topic of stability in maternal responsiveness to infant expressivity over time. In one study, maternal positive affect was found to be stable when infants were between 2.5 months and 5 months and between 5 months and 7.5 months (Malatesta et al., 1989). In another study, high levels of warmth in pregnant women were correlated with higher levels of affectionate responsiveness with their infants at 12 months (Diskin & Heinicke, 1986). However, neither of these researchers directly investigated whether maternal responsiveness to infant expressivity was stable, nor whether such stability might be supported by stability in infant expressivity.

**Relations Between Maternal Responsiveness and Infant Expressivity**

A number of cross-sectional and correlational studies suggest that children's expressivity is predicted by maternal responsiveness and maternal expressivity. Investigators have identified positive relations between maternal and child positive expressivity (Camras et al., 1990), and rates of maternal positive and negative emotion have been found to be associated with rates of children's positive or negative emotion (Halberstadt, Fox, & Aaron, 1989). In a recent study, Lacks and Uğuris (1995) found mothers' expressive style to be associated with infants' tendency to respond expressively to others' expressive signals. Finally, in a cross-sectional study of 3- and 6-month infants (Malatesta & Haviland, 1982), infant
expressivity was found to be more closely associated with maternal expressivity at 6 months than at 3 months, suggesting an increasing congruence within mother-infant dyads that might reflect the influence of maternal expressivity on infant expressivity over time.

Longitudinal investigations of associations between maternal behaviors and infant expressivity, however, have been few. In one longitudinal study, contingent maternal responses predicted infant expressions of interest, joy, and surprise as well as overall expressivity (Malatesta et al., 1986). As mentioned above, Diskin and Heinicke (1986) found that higher prenatal levels of warmth were correlated with higher levels of infant social responsiveness at 12 months. Finally, in a small qualitative case study, three dyads exhibited increasing similarity in patterns of dimensional expressivity over a span of 20 years (Kestenberg & Sossin, 1979).

In summary, studies of infant expressivity and maternal responsiveness to infant expressivity have yielded some preliminary evidence for stability in both mothers and infants. However, neither the stability of infant expressivity nor the stability of maternal responsiveness to infant expressivity has been investigated with regard to the contribution of the dyadic partner, and there has been no examination of whether stability in maternal responsiveness might support mother-to-infant predictive relations. Finally, a particular type of maternal responsiveness that involves matching infant affect, described by Stern (1985) as “affect attunement,” has not been investigated with regard to its stability and prediction of infant expressivity. If maternal matching responses are indeed linked to personological characteristics such as attachment security, matching responses might be expected to show greater stability and to be more meaningful than maternal nonmatching responses.

To address these limitations, we conducted two short-term longitudinal studies. In Study 1 we examined: (1) short-term stability of infant expressivity and maternal responsiveness to infant expressivity over a one-month period; (2) the unique stability of each partner over and above the contributions of the other; and (3) whether matching and nonmatching maternal responses to infant expressivity were differentially stable. In Study 2, we investigated: (1) stability of infant expressivity and maternal responsiveness to infant expressivity over a four-month period; (2) the unique stability of each partner over and above the contributions of the other; (3) predictive associations between early maternal responsiveness to infant expressivity and later infant expressivity; and (4) whether matching and nonmatching maternal responses to infant expressivity were differentially stable or differentially predictive of later infant expressivity.

It was expected that infant expressivity and maternal responsiveness to infant expressivity would be stable even after considering the contributions of the dyadic partner; that earlier maternal responsiveness to infant expressivity would predict later infant expressivity; and that matching responsiveness would exhibit greater stability and stronger prediction to later infant expressivity than nonmatching responses.

**STUDY 1**

**Participants**

Thirty-eight mother-infant dyads (18 male and 20 female infants) were recruited from an advertisement placed in a parents' magazine and from the records of a postpartum exercise class. Infants were on average 11.9 months at the first visit and 13.1 months at the second visit. The socioeconomic status of each family was evaluated using Hollingshead's (1975) Four-Factor Index of Social Position. The distribution of social status for the sample was heavily weighted in the upper social class strata, with nearly 50 percent of participants in the top 10th percentile. Thirty-eight percent of the participants completed college, and an additional 38 percent attended graduate...
school. Mothers’ average age was 33.4 years (SD = 5.34). The sample was Caucasian with the exception of one African-American family.

Of the original 38 participants, four were dropped who did not complete the procedure at both data collection periods. After inspection of the data by means of the Studentized residual, leverage, and Cook’s distances indices associated with each case (Judd & McClelland, 1989), one additional case having a value of 6.0 for the Studentized residual was dropped. Subsequent analyses were therefore based on a total of 33 participants (14 males and 19 females).

Setting

Videotaping took place in a laboratory/playroom at New York University equipped with an assortment of toys, including stuffed animals, balls, a shape-sorter, a cash register, and a key toy.

Procedure

An appointment was made for mothers to visit the laboratory within two to three weeks of their infant’s first birthday. Mothers and infants were brought into the playroom, toys were placed on the floor, and mothers were instructed to do whatever they would like for 10 minutes. The dyad’s interaction was then videotaped. On the second visit, which took place approximately one month later, this procedure was repeated.

Measures

Infant expressivity and maternal responsiveness to infant expressivity were coded from the videotapes from both sessions. We defined infant expressivity as any marked change in valence (i.e., positive or negative) and/or gradient feature (i.e., intensity, tempo, shape, inflection, or rhythm) of the infant’s facial expression, vocalization, or body tension or movement relative to his or her immediately preceding behavior. Using an event-based coding system, we first identified all instances of infant expressivity, called infant displays. Infant displays included gradient features, and the gradient features coded included the following. Intensity was coded if, for example, an infant struggled to place a puzzle piece with a grunting, forcefully straining shove. Tempo was coded if, for example, an infant quickly and exuberantly flung up his or her arms. Patterns in tempo, expressed in rhythmic behaviors, were coded for such behaviors as rhythmic banging. Shape was coded if, for example, an infant puffed out his or her chest and smiled broadly with pride. Inflected patterns in vocal pitch were coded when a distinctive “melody” to vocalizations was observed (e.g., with pitch moving up or down the scale, describing a smooth arc, and so forth). Infant displays also included positive or negative expressions, which involved a marked change in the valence of infants’ affective expressions (i.e., infant smiled, laughed, whined, etc.). Lastly, infant displays also included those instances when the infant displayed some combination of dimensional expressivity with positive or negative expressions (e.g., forceful banging accompanied by smiling).

Once an infant display was identified, coders determined whether the expression was a spontaneous display (i.e., initiated by the infant) or a prompted display (i.e., following some maternal verbal or nonverbal behavior that was intended to elicit infant expressivity, e.g., tickling the infant). Prompted displays were coded no further, as were displays during which either the infant’s or the mother’s face was not visible.

For all remaining infant displays, the maternal behavior immediately following was coded as either no maternal response (i.e., mother continues with the behavior that preceded the infant display) or maternal response (i.e., mother follows the infant display with a contingent verbal or nonverbal behavior) within a 5-second window (Bornstein et al., 1992); however, most instances of maternal responses
occurred within 1 to 2 seconds. Finally, each maternal response was further coded as either a nonmatching maternal response or a matching maternal response. Matching responses included responses that were congruent with one or more gradient features of the infant display (either intensity, tempo, shape, inflection, or rhythm, or some combination of these). For example, if mother followed or joined in with her infant's forceful banging with a loud song, a matching response would be coded because she matched the infant's intensity and rhythm. Nonmatching responses included other contingent behaviors, such as praise, comments, or questions expressed in response to the infant's expressive behavior (Bornstein et al., 1992). The variables used in the analyses consisted of the frequencies of spontaneous infant displays, maternal nonmatching responses, and maternal matching responses.

Tapes were coded by the principal investigator and an additional coder. Each tape required two passes, first, to identify all instances of infant displays and second, to code maternal responses. The tape was run at normal speed, although it was frequently stopped or run in slow motion to determine accurately the onset of infant displays. The additional coder received extensive training using tapes of mother-infant interaction gathered in another study. The two coders then independently coded five tapes from the present study, so that interrater agreement could be computed. Based on these five records, percentage agreement for infant displays (the number of times the coders agreed on the occurrence of an infant display divided by the number of agreements, plus the number of disagreements) was .80. Interrater reliabilities for all categorical variables were assessed by calculating kappa coefficients (Cohen, 1960), an index of agreement for categorical data that corrects for chance. The coefficient for the type of infant display coded (i.e., spontaneous displays, prompted displays, or displays with faces not visible) was .81. For the type of maternal responses (i.e., matching responses or nonmatching responses), the coefficient was .70.

**RESULTS AND DISCUSSION**

Across the two visits, infants produced about 14 displays in each 10-minute free-play session (Visit 1 M = 13.1, SD = 5.7; Visit 2 M = 15.4, SD = 6.7). Mothers responded to 64 percent of these displays (Visit 1 M = 7.9, SD = 3.3; Visit 2 M = 9.8, SD = 4.8); 36 percent of these responses were matching responses (Visit 1 M = 2.8, SD = 2.6; Visit 2 M = 3.6, SD = 2.7) and 64 percent were nonmatching responses (Visit 1 M = 5.1, SD = 2.6; Visit 2 M = 6.1, SD = 3.1). These results were generally comparable to those reported by Stern et al. (1984).

The short-term stabilities of infants' expressivity and maternal responsiveness to infant expressivity were evaluated by zero-order correlations, and partial correlations were used to evaluate the unique stabilities of infant expressivity and maternal responsiveness across the one-month time frame.

Infant expressivity was stable over the one-month period (r = .38, p < .05). The correlation was attenuated to marginal significance, however, when total maternal responsiveness at both the early and later time periods was covaried (partial r = .28, p = .06), suggesting that infant stability across the one-month period was partly supported by stability in total maternal responsiveness across this period. We next examined the differential contributions of maternal matching and nonmatching responsiveness to the stability of infant expressivity. Infant expressivity remained stable when early and later nonmatching responses were covaried (partial r = .39, p < .05); however, infant expressivity was no longer stable when maternal matching responses were covaried (partial r = .15). This suggests that maternal matching responses in particular contributed to the stability of infant expressivity.

When the stability of maternal responsiveness was examined, matching responses were
significantly stable at the zero-order level ($r = .68, p < .01$), but nonmatching responses were not ($r = .02$). Matching responses, moreover, continued to be stable when the contributions of early and later infant displays were covaried (partial $r = .46, p < .05$), suggesting that the stability of matching responses was not mediated by infants’ level of expressivity.

STUDY 2

In a second cohort, we next examined the stability of maternal responsiveness and infant expressivity, this time between 9 and 13 months, again asking whether stability in mothers and infants would be maintained after the contribution of each dyadic partner was considered. We also asked whether 9-month maternal responsiveness would predict 13-month infant expressivity. Specifically, we examined whether early maternal responsiveness uniquely predicted infant expressivity (i.e., over and above the stability of mother and infant), or whether predictive relations between early responsiveness and later infant expressivity were explained by stability in maternal responses over time. Finally, given the stronger stability exhibited by matching responses in Study 1, we also inquired whether matching responses, compared to nonmatching responses, might show a differential prediction to later infant expressivity.

METHOD

Participants

Seventy-seven mother-infant dyads were recruited from private pediatric and obstetric groups in NYC. The infants were on average 9.6 months and 13.7 months, respectively, at the time of the two home visits. The socioeconomic status of each family was evaluated using Hollingshead’s (1975) Four-Factor Index of Social Position. The distribution of social status for the sample was heavily weighted in the upper social class strata, with nearly 50 percent of subjects in the top 10th percentile. Among mothers, 42 percent completed college, and an additional 49 percent received graduate degrees. Among fathers, 32 percent completed college, and 54 percent had advanced degrees. The average age of mothers was 32.3 years, and the sample was entirely Caucasian.

Procedure

One week prior to the first home visit, mothers were mailed questionnaires requesting basic information on their infants’ health history and parents’ demographic-educational information. All questionnaires were collected at the time of the 9-month home visit. At each visit, dyads were videotaped for 10 minutes of collaborative play with a standard set of toys that included a doll with a doll-sized blanket, a doll bottle, a little sponge, a tea set with three place settings, a bus with three passenger dolls, three blocks, a toy telephone, and a set of nesting cups. Mothers were asked to remain with their children, to disregard the experimenter as much as possible, and to do whatever they ordinarily would do when their children were engaged in play. They were told to use their own discretion in playing with or not playing with any of the toys provided.

Measures

The coding system measuring infant expressive displays and maternal matching and nonmatching responses used in Study 1 was used again, with modifications based on the findings of Study 1. In Study 2, infant expressions that included positive or negative affect were coded for valence. Positive and negative expressions without marked gradient features were expected to be relatively rare based on previous investigations (Stern et al., 1984), therefore positive or negative infant displays that included gradient features were coded simply as positive or negative expressions. Infant displays with gradient features
TABLE 1
Maternal Responses and Infant Expressivity at 9 and 13 Months

<table>
<thead>
<tr>
<th></th>
<th>9 Months</th>
<th>13 Months</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>Range</td>
</tr>
<tr>
<td>Maternal Responses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonmatching</td>
<td>5.86</td>
<td>3.77</td>
<td>(0-17)</td>
</tr>
<tr>
<td>Matching</td>
<td>4.63</td>
<td>3.33</td>
<td>(0-15)</td>
</tr>
<tr>
<td>Total</td>
<td>9.04</td>
<td>4.80</td>
<td>(1-23)</td>
</tr>
<tr>
<td>Infant Expressivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>4.75</td>
<td>4.17</td>
<td>(0-21)</td>
</tr>
<tr>
<td>Negative</td>
<td>.66</td>
<td>1.78</td>
<td>(0-10)</td>
</tr>
<tr>
<td>Dimensional</td>
<td>10.08</td>
<td>5.60</td>
<td>(1-23)</td>
</tr>
<tr>
<td>Total</td>
<td>16.41</td>
<td>7.07</td>
<td>(4-33)</td>
</tr>
</tbody>
</table>

*p < .01

RESULTS

Descriptive data on all measures were first obtained, followed by an evaluation of the stability of infant expressivity and maternal responsiveness to infant expressivity over the four-month period. Partial correlations were then used to test the unique stability of infant expressivity and maternal responsiveness to infant expressivity over and above the contribution of the partner. Lastly, hierarchical regression analyses were conducted to assess unique predictive relations between early maternal responsiveness and later infant expressivity.

Descriptive Statistics for Infants and Mothers

Descriptive statistics for mothers are presented in Table 1. At both ages, infants produced about 15 displays in the 10-minute period, with dimensional expressivity comprising over half of these displays, positive displays less than half, and negative displays occurring less than once during the 10-minute period. Rates for infant expressivity at 9 months were not significantly different from rates at 13 months, with the exception of the rates for dimensional expressivity, which decreased between 9 and 13 months. As in Study 1, mothers responded to spontaneous infant displays slightly less than once per
minute in both 10-minute play sessions, the rate reported by Stern et al. (1984). As shown in Table 1, approximately half of these maternal responses were nonmatching responses, and half were matching responses.

**Stability of Infant Expressivity and Maternal Responsiveness**

Zero-order correlations were computed to evaluate the stability of infants' expressivity and of mothers' responsiveness over the four-month time frame (Tables 2 and 3).

The first column of Table 2 indicates that infants were stable in all types of expressivity at the zero-order level. The correlation for negative displays was weaker, perhaps due to the restricted range of this variable. Cohen's z (Cohen, 1988) was used to assess whether the correlation for negative displays was significantly weaker than that for positive displays: it was not ($q = .22$). The second column in Table 2 presents partial correlations for infant expressivity. These correlations covary maternal responsiveness at 9 and at 13 months. Unique stability was examined for infant positive, negative, dimensional displays, and total displays after covarying nonmatching and matching maternal responses. Infant expressivity exhibited unique stability, that is, all

### Table 2

<table>
<thead>
<tr>
<th>Infant Expressivity</th>
<th>Maternal Responses Covaried at 9 &amp; 13 Months</th>
<th>Partial r</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nonmatching</td>
<td>.39**</td>
</tr>
<tr>
<td>Positive</td>
<td>Matching</td>
<td>.31**</td>
</tr>
<tr>
<td>Negative</td>
<td>Nonmatching</td>
<td>.22*</td>
</tr>
<tr>
<td></td>
<td>Matching</td>
<td>.23*</td>
</tr>
<tr>
<td>Dimensional</td>
<td>Nonmatching</td>
<td>.22*</td>
</tr>
<tr>
<td></td>
<td>Matching</td>
<td>.25*</td>
</tr>
<tr>
<td>Total</td>
<td>Nonmatching</td>
<td>.38**</td>
</tr>
<tr>
<td></td>
<td>Matching</td>
<td>.24*</td>
</tr>
</tbody>
</table>

* $p < .05$
** $p < .01$

Two-tailed

### Table 3

<table>
<thead>
<tr>
<th>Maternal Response</th>
<th>Infant Expressivity Covaried at 9 &amp; 13 Months</th>
<th>Partial r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonmatching</td>
<td>Positive</td>
<td>.20*</td>
</tr>
<tr>
<td></td>
<td>Dimensional</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>.20*</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>.19</td>
</tr>
<tr>
<td>Matching</td>
<td>Positive</td>
<td>.33**</td>
</tr>
<tr>
<td></td>
<td>Dimensional</td>
<td>.40**</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>.41**</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>.28**</td>
</tr>
</tbody>
</table>

* $p < .05$
** $p < .01$

Two-tailed
types of infant expressivity remained stable after controlling for both types of maternal responsiveness at 9 months and at 13 months.

The first column of Table 3 indicates that, at the zero-order level, maternal responsiveness to infant expressivity was also stable, with matching responses demonstrating greater stability than nonmatching responses. The Cohen’s $z$ coefficient obtained indicated that there was a marginally significant trend toward greater stability of matching responses ($q = .26, a = .10$). The second column in Table 3 presents partial correlations for maternal responsiveness, covarying infant expressivity at 9 months and at 13 months. Under these conditions, mothers’ matching responses demonstrated unique stability for all forms of infant expressivity, whereas the correlation for nonmatching responses was significant when positive or negative infant expressivity alone was covaried but not significant when total infant expressivity was covaried.

### Predictive Associations

Tables 4a and 4b present predictive relations between maternal responsiveness and infant expressivity. Maternal matching responsiveness at 9 months predicted positive, dimensional, and total infant expressivity at 13 months, but not negative expressivity at 13 months. Nonmatching responsiveness predicted dimensional expressivity only. Total infant displays at 9 months predicted maternal nonmatching and matching responses at 13 months, with most of the prediction accounted for by positive displays.

For each of the significant zero-order mother-infant associations obtained, two sets of regressions were conducted to assess the contributions of maternal responsiveness and of maternal stability to later infant expressivity (Table 5). In the first set, to control for the stability of the infant, 9-month infant expressivity was entered first, followed by 9-month mater-
Maternal Responsiveness to Infant Affect

Table 5
9-Month Maternal Responses Predicting 13-Month Infant Expressivity

<table>
<thead>
<tr>
<th>Maternal Response</th>
<th>Zero-Order r</th>
<th>Infant Expressivity</th>
<th>Variables in Regression Equation</th>
<th>β (R square change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonmatching</td>
<td>Dimensional</td>
<td>.23**</td>
<td>1. 9-Mo. Infant</td>
<td>.11 (.01)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Infant &amp; 13-Mo. Mother</td>
<td>.00 (.00)</td>
</tr>
<tr>
<td></td>
<td>Matching</td>
<td>Positive</td>
<td>.35**</td>
<td>.21 (.04)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Infant &amp; 13-Mo. Mother</td>
<td>.01 (.00)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimensional</td>
<td>.26*</td>
<td>.21 (.04)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Infant &amp; 13-Mo. Mother</td>
<td>.11 (.01)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>.45**</td>
<td>.34**( .09)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Infant &amp; 13-Mo. Mother</td>
<td>.17 (.02)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Positive</td>
<td>.31**</td>
<td>.18 (.03)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Infant &amp; 13-Mo. Mother</td>
<td>-.04 (.00)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimensional</td>
<td>.33**</td>
<td>.24 (.04)</td>
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<td></td>
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<td>2. 9-Mo. Infant &amp; 13-Mo. Mother</td>
<td>-.10 (.01)</td>
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<td>Total</td>
<td></td>
<td>.43**</td>
<td>.30* (.05)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Infant &amp; 13-Mo. Mother</td>
<td>-.01 (.00)</td>
</tr>
</tbody>
</table>

*p = .05
**p < .01
Two-tailed

Table 6
9-Month Infant Expressivity Predicting 13-Month Maternal Responses

<table>
<thead>
<tr>
<th>Infant Expressivity</th>
<th>Zero-Order r</th>
<th>Maternal Response</th>
<th>Variables in Regression Equation</th>
<th>β (R square change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Matching</td>
<td>.22*</td>
<td>1. 9-Mo. Mother</td>
<td>.03 (.00)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Mother &amp; 13-Mo. Infant</td>
<td>-.12 (.01)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>.27**</td>
<td>1. 9-Mo. Mother</td>
<td>.11 (.01)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Mother &amp; 13-Mo. Infant</td>
<td>-.07 (.00)</td>
</tr>
<tr>
<td>Nonmatching</td>
<td>.26*</td>
<td></td>
<td>1. 9-Mo. Mother</td>
<td>.23 (.03)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Mother &amp; 13-Mo. Infant</td>
<td>-.08 (.00)</td>
</tr>
<tr>
<td>Matching</td>
<td>.21*</td>
<td></td>
<td>1. 9-Mo. Mother</td>
<td>-.02 (.00)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Mother &amp; 13-Mo. Infant</td>
<td>-.11 (.01)</td>
</tr>
<tr>
<td>Total</td>
<td>.31**</td>
<td></td>
<td>1. 9-Mo. Mother</td>
<td>-.02 (.00)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. 9-Mo. Mother &amp; 13-Mo. Infant</td>
<td>-.14 (.01)</td>
</tr>
</tbody>
</table>

*p = .05
**p < .01
Two-tailed

Results indicated that matching responses predicted a significant 9 percent of the variance in total infant expressivity over and above 9-month infant expressivity. In addition, there was a nonsignificant trend for matching responses to predict positive expressivity and dimensional expressivity over and above infant stability. In contrast, however, nonmatching responses did not predict infant dimensional expressivity over and above 9-month infant expressivity. In the second set of regression equations, in which 9-month infant expressivity and 13-month maternal responsiveness were both considered (i.e., infant stability and maternal stability), neither matching responses nor nonmatching responses continued to predict 13-month infant expressivity. However, a small effect was demonstrated for matching responses on total infant expressivity.
Finally, two sets of regressions were conducted to assess the contributions of infant expressivity to later maternal responsiveness, as presented in Table 6. Results indicated that infant expressivity did not predict maternal responses. There was, however, a nonsignificant trend for total infant responses to predict nonmatching maternal responses over and above 9-month maternal responses. In the second set of regressions, in which 9-month maternal responses and 13-month infant expressivity were both entered in the first step, this trend was not evident.

**DISCUSSION**

In these two studies, we sought to compare a special type of contingent maternal responsiveness, matching responses, with nonmatching responses in terms of influence on infant expressivity. Because we wished to investigate whether either type of maternal responsiveness predicted infants' expressivity, we also investigated stability in maternal responsiveness and in infant expressivity in order to examine the possibility that stability in mothers was important for influencing their infants' later expressivity.

Though many studies of infant expressivity have focused on infant facial expressions using a categorical approach (e.g., Ekman, 1982; Izard, 1982), a growing number of studies have suggested that gradient features of vocal and movement expressivity also play important roles in the sharing of experience in social interaction. For example, affective vocalizations appear to have unique gradient signatures in parameters such as loudness, tempo, and pitch contour that facilitate affective recognition in the absence of facial cues (Kappas, Hess, & Scherer, 1991), and gradient features of movement and vocalizations have been linked to perceived rapport and positive affect in adults (Bernieri & Rosenthal, 1991).

In the present investigations, the gradient features of infants' expressivity, as well as the valence of their expressions, generally exhibited continuity in mean levels over short time frames, and mothers' responses to infant expressivity also exhibited continuity, with levels of infant expressivity and maternal responsiveness commensurate in two independent samples. An exception to the general pattern of continuity in infants and mothers was the finding that dimensional expressivity significantly decreased over time. It may be that with sensorimotor development, certain affective experiences become less frequent, as once-effortful behaviors become more automatic. For example, for the younger infant, reaching for a toy may involve straining effort and tensed muscles to bridge across space. Such an infant feels the pull of gravity and the challenge of reaching across space, and several gradient features might be observed in the infant's action, such as high intensity, decelerated tempo, and lengthening shape (as well as a positive expression upon accomplishing a challenging task). The older infant, however, may reach for the same toy in a smooth and effortless fashion.

In the present study, we asked whether infants and mothers were stable over and above the contributions of their partners. Stability in infant expressivity, over both the one-month and the four-month time frames, was overall not dependent on the contribution of maternal responsiveness to infant expressivity. This finding suggests that infant expressivity has a trait or dispositional component independent of parental influence or that, at least by 9 months, infants' emotional tendencies are beginning to stabilize. Infant expressivity as a stable trait has been included in many measures of temperament (e.g., Rothbart & Derryberry, 1981), and investigators have speculated as to whether emotion might in fact provide a core of continuity in development (Campos, Campos, & Barrett, 1989). Investigators have found temperament, usually measured by global or impressionistic parent questionnaires, to be associated with observed negative expressivity; however, associations between temperament and observed positive expressivity are weak (e.g., Malatesta & Havi-
Maternal Responsiveness to Infant Affect

While infant expressivity may be important to later development, at least certain forms of expressivity may be independent of temperament or other core dispositional variables.

With regard to maternal responsiveness to infant expressivity, we found that overall matching responses, but not nonmatching responses, were stable in both studies over and above the contributions of infant expressivity. Expressive styles in adults have been linked to various personality factors, such as empathy and extroversion (Halberstadt, 1991). Maternal matching responses have been linked to personological characteristics of mothers, as Haft and Slade (1989) have found that rates of matching responses are associated with mothers' abilities to access and integrate their own emotions and experiences regarding their own mothers. If mothers' patterns of matching responses are closely linked to traitlike or personality factors, they are perhaps less flexible or plastic with regard to infant influences.

Early maternal responsiveness overall predicted later infant expressivity, although its stability over time carried this effect. However, matching responses continued to exert a unique, albeit small, effect on later infant expressivity in addition to a combined early and later effect. The finding that consistent maternal responsiveness overall influenced infants' later expressivity is consistent with other research on familial contributions to infant expressivity. Family environment has long been believed to influence children's expressive development (Sroufe, 1983), and a few studies have demonstrated links between maternal and infant expressivity (Camras et al., 1990; Halberstadt, 1986; Halberstadt, Fox & Aaron, 1989; Malatesta & Haviland, 1982), though maternal responsiveness to infant expressivity has not been studied.

In particular, matching responses were found to have a small unique effect, as well as a combined early and late effect on later infant expressivity. Overall, our findings support a distinctive role for maternal affective matching responses in the development of infant expressivity. In both samples, matching responses were more stable over short time periods. In Study 2, matching responses exhibited continued stability after infant effects were considered, and they generally showed stronger predictive associations to infant expressivity across time. Also, though there was a trend toward a predictive association between early infant expressivity and later maternal responsiveness for nonmatching responses, matching responses appeared to be more resistant to this infant effect. In a discussion of infant expressivity, Trevarthen (1993) notes that although the range and typology of emotional expressions are thought to be innate, the flexibility and frequency of expressivity have been shown to be related to the responsiveness of the infant's caregivers. The special function of matching responses as facilitating interaffective interaction may render these types of maternal responses especially influential with regard to infant expressivity.

Viewing emotions as closely connected to the processes that drive and regulate engagement with the environment and with others (Campos, Campos, & Barrett, 1989; Trevarthen, 1993) affords an understanding of how infants are transformed into selves able to share experiences and purposes. Ongoing expressivity, a flow of gradient features and valences of expressions, contains information about shifts of feeling and nuance of experience, in each self and between selves. The close-textured yet nonverbal reciprocity involved in interaction attuned to this flow constitutes the earliest intersubjective sharing, when "affects are both the primary medium and the primary subject of communication" (Stern, 1985; p. 133). Findings here suggest that infants are developing expressive styles in the context of attuned mother-infant interaction; the interaction that supports infants' own emerging capacity for intersubjectivity.

Acknowledgments: This research is based on the first author's master's thesis and doctoral dissertation at New York University. We thank Lisa Cyphers and Mark Glassman for
statistical consultation; Wendy Haft and Arietta Slade for training in coding mother-infant interaction; Diane Ruble, Michael Westerman, and Joan Welkowitz for their comments on an earlier version of this manuscript. We also thank two anonymous reviewers whose attentive suggestions greatly improved the manuscript.

NOTES

1. The coding system used in the present study was derived from the Affect Attunement Scale, devised by Haft and Slade (1989).

2. Two modifications were made to our coding system for Study 2. In Study 1, following earlier studies on affect attunement (Haft & Slade, 1989; Stern et al., 1984), imitative responses (mothers' direct mimicking of infant behavior) were distinguished from matching responses (matching one or more gradient features of infant behavior). We found no evidence to support this distinction in Study 1, therefore in Study 2 imitative responses were collapsed into the summary measure of matching responses. In Study 1, shaping matches (e.g., mothers' matching infant behavior that involved growing or shrinking in bodily movement) included maternal smiles in response to infant smiles (i.e., matching the growing shape in the face). However, as most shaping matches involved infant smile-mother smile, in Study 2 these were assumed under the category of positive/negative matches.

REFERENCES


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