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Infant response in the still-face paradigm at 6 months predicts avoidant and secure attachment at 12 months

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Abstract

We tested the hypothesis that attachment security at 12 months can be predicted from infant response to the mother's still-face interaction during the first half-year. Subjects were 66 primiparous mother-infant pairs drawn from the working- and middle-socioeconomic strata (SES). Half of the mothers had experienced a postpartum depression. Infants were observed longitudinally in the still-face paradigm at 2, 4, and 6 months and in the Strange Situation at 12 months. Positive expressions in response to the still-face at 6 months predicted secure attachment at 12 months. Absence of positive expressions predicted avoidant attachment. In infants of postpartum depressed mothers, hours of nonmaternal care positively correlated with secure attachment. Variables associated with infant proneness to distress and sociability were unrelated to attachment security. These results suggest that attachment formation is underway by 6 months of age and that indicators of 12-month attachment security can be detected as early as 6 months. Similar mechanisms of affect regulation and coping may underlie infant response in the still-face and Strange Situation procedures.

According to attachment theory, an infant's internal working model represents the infant's relationship history with her primary caregiver. From this perspective, infant behavior in the Strange Situation is not merely a response to the primary caregiver's absence, but rather is guided by the history of their daily interactions in various contexts. To test this hypothesis, studies have evaluated whether features of mother-infant interactions prior to 12 months pre-

dict infant attachment between 12 and 18 months. Initial studies produced mixed results (see Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983), but more recent work has typically found a positive relationship between measures of mother-infant interaction in the first year and subsequent infant attachment (Belsky, Rovine, & Taylor, 1984; Egeland & Farber, 1984; Isabella & Belsky, 1991; Lewis & Feiring, 1989; Malatesta, Culver, Tesman, & Shephard, 1989). In one or more of these studies, mothers' positive affect, sensitivity, reciprocal interaction, and moderate levels of contingent interaction during the first year predicted infant attachment security.

Lamb and others (Kagan, 1987; Lamb, Thompson, Gardner, Charnov, & Estes, 1984) have criticized the logic of testing the attachment-development hypothesis in this way. They have argued that infant behavior during the Strange Situation is influ-

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enced by the infant's current relationship with her mother or by individual differences in infants, such as proneness to distress or sociability. These possibilities are difficult to rule out. Mothers' affective behavior and responsiveness are moderately stable over the first year (Cohn & Campbell, in press; Malatesta et al., 1989). Stability in infant behavior, although lower than is found in mothers (Cohn & Campbell, in press; Malatesta et al., 1989), is also evident (Belsky, Fish, & Isabella, 1991; Martin, 1981). Thus, longitudinal correlations between early mother-infant interaction variables and subsequent infant attachment classification may still reflect an association between concurrent aspects of the mother-infant relationship and attachment classification. More generally, because the direction of influence between mothers and infants is bidirectional (Cohn & Tronick, 1988; Lester, Hoffman, & Brazelton, 1985; Martin, 1981), it is difficult to make inferences about infant characteristics in free play or other dyadic interactions in which the behavior of both mothers and babies is free to vary (Schaffer, 1984).

To make valid inferences about infant characteristics, it is necessary to control the mother's behavior and then evaluate infant response. This, of course, is the logic of the Strange Situation, but with few exceptions it has not been applied to the assessment of attachment formation. That this is a potentially fruitful approach is suggested by two studies. Kiser, Bates, Maslin, and Bayles (1986) found that a discriminant function derived from infant response to still-face and normal mother-infant interactions (Tronick, Als, Adamson, Wise, & Brazelton, 1978; see following) in the first half-year predicted attachment classification at the end of the first year. A composite variable based on infant agitation and negative vocalizations in the still-face interaction was one of seven variables with significant discriminant loadings. Tronick, Ricks, and Cohn (1982), in a pilot study, found that 6-month-old infants who positively elicited their mothers in response to their becoming

still-faced were more likely to be classified as securely attached at 12 months. A central hypothesis is that the history of the mother-infant relationship was responsible for the relationships found in these studies.

Past data are consistent with the premise that infants' response to the mother's still-face and its variants, such as "simulated depression" (Cohn & Tronick, 1983), index the quality of their interactive history. Tronick et al. (1982) found that infants who positively elicited in the still-face paradigm had mothers who used more elaboration in a face-to-face interaction, and infants who made few elicits had mothers who were either overcontrolling or undercontrolling. Field (1984) discovered that infants of mothers with high levels of depressive symptoms showed fewer changes in affect expression between a normal and a still-face interaction. Unlike infants of nondepressed mothers, they were equally withdrawn in response to normal and still-face interactions. These studies suggest that infant response to the still-face assesses the infant's relationship history with the mother.

By 6 months of age, and possibly earlier, infants begin to form stable representations of their relationships with significant others (Stern, 1985, 1989). These representations, or internal working models (Bowlby, 1980), provide the infant with expectations of the other's behavior and contribute to the stability of relationship patterns. Bowlby (1980) emphasized the role of internal working models in the attachment system, but the concept of internal working models is more general and can pertain to any of the major motivational systems (Stern, 1989). Little is known about the interrelationships of internal working models across motivational systems, but it is likely that they are moderately correlated, especially when they involve a common attachment figure, occur early in development, and involve closely related systems, such as play, or affect sharing, and attachment. Our hypothesis is that infant behavior in the still-face paradigm is an index of the infant's developing internal working model of the attachment relationship.

In this report, we test the hypothesis that positive elicits to the mother's still-face in the first half-year predict secure attachment at 12 months. Infants were longitudinally at 2, 4, and 6 months of age, and we developed expectations about the behavior of partners (Brownell, 1988). Attachment formation is believed to be underway by 6 months (Bowlby, 1950) and predicted that positive elicits to the still-face at 6 months, and possibly as early as 4 months, would be related to attachment security. By including 2-month assessments, we were able to estimate stable infant sociability within the first half-year.

Subjects were chosen from a study of postpartum depressed and nondepressed mothers. Depression in mothers and young children is associated with less positive and more negative interactions, less synchrony, and lower maternal sensitivity to infant attachment and attachment behavior (Cohn, Matias, Campbell, & Hopkins, 1990; Cohn & Tronick, 1988; Cohn, Matias, Tronick, Lyons-Ruth, Connell, 1986; Field, 1984; Field, 1985; Garcia, Vega-Lahr, Goldsmith, Guy, 1985; Lyons-Ruth, Connell, Stahl, 1987; Lyons-Ruth, Zoll, Cohn, & Grunebaum, 1986; Radke-Yarrow, Goldberg, Kuczynski, & Chapman, 1985; & Gelfand, 1990). These factors may be internal depression a likely risk factor for secure attachment (Cicchetti & Abert, 1990; Cummings & Cicchetti, 1990; Radke-Yarrow et al., 1985).

By including infants of depressed mothers, we hoped to increase the ratio of secure to secure attachments. In most studies, only about 30% of infants are insecurely attached. This ratio is difficult to discover because processes leading to insecure attachment. Increased statistical power can be achieved by studying a sample in which the proportion of secure attachments is more nearly balanced. The developmental psychopathology approach, with its attention to the differences between normal and atypical development (Cicchetti, 1990), provides a

more likely to be classified as avoidant at 12 months. A central finding is that the history of the relationship was responsible for the attachment patterns found in these studies. This is consistent with the premise that infant response to the mother's still-face is a function of her characteristics, such as "simulated still-face" (Cohn & Tronick, 1983), index of her interactive history. Tronick found that infants who position themselves in the still-face paradigm had used more elaboration in a previous interaction, and infants who had mothers who were overcontrolling or undercontrolling. This study covered that infants of mothers with higher levels of depressive symptoms showed more changes in affect expression and a still-face interaction. Infants of nondepressed mothers were equally withdrawn in response to still-face interactions. These findings suggest that infant response to the still-face is a function of the infant's relationship with the mother.

By 6 months of age, and possibly earlier, infants begin to form stable representations of attachment relationships with significant others (Bowlby, 1955, 1989). These representational working models (Bowlby, 1980) are the infant with expectations about behavior and contribute to attachment relationship patterns. Bowlby emphasized the role of internal working models in the attachment system, and the role of internal working models in other systems and can pertain to any of the motivational systems (Stern, 1985). What is known about the interrelationships of internal working models across systems, but it is likely that they are highly correlated, especially in infancy. They have a common attachment history in development, and related systems, such as play, language, and attachment. Our hypothesis is that infant behavior in the still-face paradigm is an index of the infant's internal working model of the relationship.

In this report, we test the hypothesis that positive elicits to the mother's still-face in the first half-year predict secure attachment at 12 months. Infants were assessed longitudinally at 2, 4, and 6 months. Between 4 and 6 months of age, babies begin to develop expectations about the social behavior of partners (Brownell, 1986), and attachment formation is believed to be underway by 6 months (Bowlby, 1969). We predicted that positive elicits to the still-face at 6 months, and possibly as early as 4 months, would be related to attachment security. By including 2-month assessments, we were able to estimate stability of infant sociability within the first half year.

Subjects were chosen from a larger study of postpartum depressed and nondepressed mothers. Depression in mothers of infants and young children is associated with less positive and more negative affect, less synchrony, and lower maternal sensitivity to infant attachment and affiliative behavior (Cohn, Matias, Campbell, & Hopkins, 1990; Cohn & Tronick, 1989; Cohn, Matias, Tronick, Lyons-Ruth, & Connell, 1986; Field, 1984; Field, Sandburg, Garcia, Vega-Lahr, Goldstein, & Guy, 1985; Lyons-Ruth, Connell, Zoll, & Stahl, 1987; Lyons-Ruth, Zoll, Connell, & Grunebaum, 1986; Radke-Yarrow, Cummings, Kuczynski, & Chapman, 1985; Teti & Gelfand, 1990). These factors make maternal depression a likely risk factor for insecure attachment (Cicchetti & Aber, 1986; Cummings & Cicchetti, 1990; Radke-Yarrow et al., 1985).

By including infants of depressed mothers, we hoped to increase the ratio of insecure to secure attachments. In normative studies, only about 30% of infants are insecurely attached. This ratio makes it difficult to discover processes leading to insecure attachment. Increased statistical power can be achieved by studying groups in which the proportion of secure and insecure attachments is more nearly balanced. The developmental psychopathology approach, with its attention to the interface between normal and atypical development (Cicchetti, 1990), provides a powerful

means of assessing developmental processes. We followed this approach and studied comparable numbers of depressed and nondepressed mother-infant pairs. In this way we were able to rigorously assess processes related to attachment security and evaluate whether they differ in normative and in at-risk (depressed) groups. Another advantage of this approach is that it has the potential to identify those children who are most at risk for insecure attachment. Infant response to the still-face paradigm may permit more specific predictions of risk status.

Method

Subjects and diagnostic assessments

Subjects were 66, white, primiparous, working- and middle-SES mother-infant pairs who were participating in a longitudinal study of postpartum depressed and nondepressed women. Mothers averaged 29 years of age. Depressed and nondepressed mothers did not differ on any of the demographic criteria (i.e., age, race, parity, and mother's and father's occupation and education). Further details about subject characteristics can be found in Campbell, Cohn, Flanagan, Popper, and Meyers (in press). All the mothers were interviewed by telephone at 6 weeks postpartum and administered an abbreviated version of the Schedule of Affective Disorders and Schizophrenia (SADS) (Endicott & Spitzer, 1978) and a depression-screening questionnaire, the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). Mothers who met screening criteria for depression and comparison nondepressed mothers were then visited in their homes at 2 months. At that time, the SADS-L was administered to confirm a diagnosis of depression within the first 2 postpartum months (or, in the case of controls, absence of depression or other diagnoses). SADS interviews were administered again at 4, 6, 9, and 12 months. Details of subject recruitment and diagnostic assess-

ments are reported elsewhere (Campbell & Cohn, in press; Cohn et al., 1990).

Eighty-six percent of the depressed mothers met Research Diagnostic Criteria (Spitzer, Endicott, & Robins, 1978) for probable or definite major depression; 14% met criteria for minor depression. All interviews were audiotaped, and reliability was assessed over the course of the study. Inter-rater agreement on diagnosis was 100%.

Procedure

All assessments took place in the families' homes at 2, 4, and 6 months. As part of a larger battery of observational procedures, mothers were asked to play with their babies for 3 min, turn aside for 15 s, and then maintain a still-face for 2 min. If the baby cried for 30 s, the assessment was terminated early. At each age, approximately 10% of the babies became too upset during the initial free-play interaction to continue with the still-face portion. Missing data were unrelated to depression status. Interactions were videotaped using two cameras and a split-screen procedure (Tronick, Als, & Brazelton, 1980). We report findings from the still-face interaction.

Questionnaire measures included the Infant Characteristics Questionnaire (ICQ) (Bates, Freeland, & Lounsbury, 1979) and a brief interview about employment and the number of hours per week that the baby received nonmaternal care. We included both the ICQ and nonmaternal care as control variables.

Coding of infant behavior in the still-face interaction. Coders blind to diagnostic status and other identifying information coded infant facial and vocal affective expression and direction of gaze from videotape using descriptors based on Tronick's Monadic Phases (Cohn & Tronick, 1987; Tronick et al., 1980). *Negative elicit* consisted of expressions of fuss, grimace, or cry. *Positive elicit* consisted of smiles or play-face expressions. Interobserver agreement, based on comparison coding of 20% of the videotapes, was $\kappa = .82$.

Attachment. When the infants were between 12 and 13 months of age they were brought to the university and assessed in the Strange Situation, according to the procedures outlined by Ainsworth, Blehar, Waters, and Wall (1978). Prior to coding the Strange Situations, our two coders established criterion reliability on tapes provided by Dr. Jay Belsky (Belsky et al., 1984) at Pennsylvania State University.

Both coders scored all Strange Situations. In cases of disagreement on major classification, a faculty member who had trained in Dr. Belsky's laboratory scored the Strange Situation. All cases of possible D classification or other coding dilemmas were sent to at least two nationally recognized experts. Final classifications were reached by majority agreement.

Data analysis. At each age we analyzed attachment classification in a logistic regression (Hosmer & Lemeshow, 1989) using negative and positive elicits, 2-month diagnostic status, hours in nonmaternal care, total score on the ICQ, and one interaction term, diagnostic status by hours in nonmaternal care, as independent variables. Total score on the ICQ was the sum of all items, with the exception of item 7 ("first bath"), which was the only item with missing values. Following Tronick et al. (1982), positive and negative elicits, as noted before, were analyzed as binary rather than continuous variables (i.e., occur vs. not-occur).

Results

Preliminary analyses

Course of depression. The percentage of postpartum depressed mothers meeting diagnostic criteria for depression decreased to 40% at 4 months, 15% at 6 months, and then remained relatively unchanged through 12 months. Depressive symptoms persisted through 12 months in many of the mothers. At 6 months, 48% of mothers who no longer

met diagnostic criteria for depression had some depressive symptoms. At 12 months, 35% of mothers who no longer met diagnostic criteria still had some depressive symptoms. (Additional information about the diagnostic course of depression may be found in Campbell et al., in press.) In the analyses reported here, depression refers to diagnostic status at 2 months, unless noted otherwise.

Nonmaternal care. The mean number of hours of nonmaternal care per week increased from 10.8 at 2 months to 15.5 at 4 months, $F(1, 60) = 8.24, p < .01$, and increased to 19.5 hr per week at 6 months, $F(1, 60) = 2.97, p < .10$, and remained at that level through 12 months. (Standard deviations were 16.5–18.3 hr/week; range was 0–55 hr at each age.) From 4 to 6 months through 12 months, hours per week of nonmaternal care were highly stable ($r = .82, p < .01$). (All p values for correlations are two-tailed.)

Infant proneness to distress. The mean score on the highly (internally) reliable measure of maternal perceptions of infant difficulty was infant proneness to distress. Alpha coefficients for total score were .85, .88, and .89 at 2, 4, and 6 months, respectively. Stability from 2 to 4 months: $r = .85, p < .01$. Stability from 4 to 6 months: $r = .88, p < .01$. Stability from 2 to 6 months: $r = .89, p < .01$.

Mean ICQ scores decreased from 2 to 4 months, $F = 6.84, p < .01$, and did not significantly vary between 4 and 6 months. ICQ scores at 2 months were inversely related with hours in nonmaternal care at 4 and 6 months ($r = -.38$ and $r = -.35, p < .01$ and $p < .05$, respectively).

Distribution of attachment classifications. Using a forced-choice classification scheme, 25% ($n = 25$) of infants were classified as avoidant (A), 56% ($n = 37$) were classified as secure (B), and 6% ($n = 4$) were classified as resistant (C). Of eight infants with concurrent D classifications, six were classified as avoidant in the forced-choice classification of A.

ent. When the infants were between 12 and 13 months of age they were taken to the university and assessed in the Strange Situation, according to the procedure outlined by Ainsworth, Blehar, and Wall (1978). Prior to coding the Strange Situations, our two coders established criterion reliability on tapes produced by Dr. Jay Belsky (Belsky et al., 1982), Pennsylvania State University. The two coders scored all Strange Situation cases of disagreement on major points, a faculty member who had worked with Dr. Belsky's laboratory scored the Strange Situation. All cases of possible disagreement or other coding dilemmas were discussed with at least two nationally recognized experts. Final classifications were determined by majority agreement.

Analysis. At each age we analyzed attachment classification in a logistic regression (Cohen & Lemeshow, 1989) using positive and negative elicits, 2-month diagnostic status, hours in nonmaternal care, score on the ICQ, and one interaction term (diagnostic status by hours in nonmaternal care), as independent variables. Total score on the ICQ was the sum of all items, with the exception of item 7 ("first bath"), as the only item with missing data. Following Tronick et al. (1982), positive and negative elicits, as noted above, were analyzed as binary rather than as continuous variables (i.e., occur vs. not-

Secondary analyses

Analysis of depression. The percentage of depressed mothers meeting diagnostic criteria for depression decreased from 44% at 4 months, 15% at 6 months, and remained relatively unchanged through 12 months. Depressive symptoms persisted through 12 months in many of the mothers. At 12 months, 48% of mothers who no longer

met diagnostic criteria for depression still had some depressive symptoms; by 12 months, 35% of mothers who no longer met diagnostic criteria still had some depressive symptoms. (Additional information about the diagnostic course of depression may be found in Campbell et al., in press.) In the analyses reported below, depression refers to diagnostic status at 2 months, unless noted otherwise.

Nonmaternal care. The mean number of hours of nonmaternal care per week increased from 10.8 at 2 months to 16.8 at 4 months, $F(1, 60) = 8.24, p < .01$. It then increased to 19.5 hr per week at 6 months, $F(1, 60) = 2.97, p < .10$, and remained at that level through 12 months. (Standard deviations were 16.5–18.3 hr/week; range was 0–55 hr at each age.) From 4 months through 12 months, hours per week of nonmaternal care were highly stable (average $r = .82, p < .01$). (All p values for correlations are two-tailed.)

Infant proneness to distress. The ICQ is a highly (internally) reliable measure of maternal perceptions of infant difficultness or proneness to distress. Alpha coefficients for total score were .85, .88, and .87 at 2, 4, and 6 months, respectively. Stability was moderate from 2 to 4 months: $r = .50, p < .01$. Stability from 4 to 6 months was low, $r = .23, p < .10$.

Mean ICQ scores decreased from 2 to 4 months, $F = 6.84, p < .01$, and did not significantly vary between 4 and 6 months. ICQ scores at 2 months were inversely correlated with hours in nonmaternal care at 4 and 6 months ($r = -.38$ and $r = -.28, p < .01$ and $p < .05$, respectively).

Distribution of attachment classifications. Using a forced-choice classification, 38% ($n = 25$) of infants were classified as avoidant (A), 56% ($n = 37$) were classified as secure (B), and 6% ($n = 4$) were classified as resistant (C). Of eight infants with concurrent D classifications, six had a forced-choice classification of A and one

each had a forced-choice classification of B and C.

Infant response in the still-face interaction

The proportion of babies that positively elicited did not vary with age: 25%, 30%, and 32% at 2, 4, and 6 months, respectively. The proportions of babies that negatively elicited was comparable and also did not vary with age: 29% at 2 months and 30% at 4 and at 6 months. Babies that elicited positively at one age were no more or less likely to elicit at another age. The same was true for negative elicits. Analyzing positive and negative elicits as continuous variables produced similar results.

Because of the small number of infants classified as resistant, the logistic regressions were run first without including their data. Following a significant finding, data from C infants were then combined with that of the A infants to determine whether the observed findings were strengthened or weakened by pooling A and C groups. The small number of C infants did not permit statistical tests of A versus C babies.

No variables at 2 or 4 months were significantly related to attachment. At 6 months, positive elicits and the diagnostic status by nonmaternal care interaction were both significantly related to secure versus avoidant attachment (partial correlations = .30, $p < .01$, and .23, $p < .025$, respectively). These two variables resulted in a 72% correct classification of A versus B attachment (Table 1). Regressing A versus B attachment on positive expressions alone resulted in a 67% correct classification rate.

Three of the four infants classified at 12 months as resistant had 6-month still-face data for analysis (one infant could not be tested). The logistic regression was rerun, pooling the A and C groups. Positive elicits and the diagnostic status by nonmaternal care interaction were again significant. The resulting partial correlation coefficients decreased to .25, $p < .01$, and .19, $p < .05$, respectively. Accuracy of classification decreased to 68%. Table 2, when compared

Table 1. Secure (B) versus avoidant (A) attachment classification regressed on positive expression and diagnostic status by hours in nonmaternal care: Observed and predicted attachment classifications

Predicted classification	Attachment classification at 12 months	
	A	B
Avoidant (A)	11	3
Secure (B)	12	28

Note: Likelihood ratio $\chi^2 = 15.47, p < .001$; odds ratio = 8.55.

Table 2. Secure (B) versus insecure (A + C) attachment classification regressed on positive expression and diagnostic status by hours in nonmaternal care: Observed and predicted attachment classifications

Predicted classification	Attachment classification at 12 months	
	A or C	B
Insecure (A or C)	11	3
Secure (B)	15	28

Note: Likelihood ratio $\chi^2 = 11.82, p < .01$; odds ratio = 6.84.

with Table 1, shows that the three C babies were misclassified as secure.

As an additional analysis, the logistic regressions were rerun, using frequency, instead of occurrence/nonoccurrence, of positive elicits to predict A versus B attachments. We found no difference in the total proportion of correctly classified cases, but sensitivity and specificity (Fleiss, 1981) were altered. Sensitivity for B classifications decreased from 90% to 74%. Specificity increased from 47% to 70%. The odds ratio decreased from 8.55 to 6.57.

Discussion

Consistent with previous research (Tronick et al., 1982), we found that positive elicits in the still-face interaction at 6 months predicted secure attachment, whereas failure to elicit positively predicted avoidant attachment. Resistant attachments were consistently mispredicted as secure. However, the number of resistant attachments was small ($n = 3$), which may have made reli-

able prediction in this group less likely. A significant association between positive elicits and attachment was found regardless of whether positive elicits were analyzed as a dichotomous or continuous variable. Analyzing frequencies instead of occurrence/nonoccurrence of elicits influenced sensitivity and specificity of prediction, but a significant relationship between positive elicits and attachment was found with each data type.

In contrast to the 6-month findings, we found no association between secure attachment at 12 months and still-face results at younger ages. Infants younger than 6 months of age may be less able to learn the social contingencies necessary to form expectations about their partner's behavior (Bretherton, 1987; Brownell, 1986). In this regard, we found no evidence of stable individual differences in positive eliciting between assessments. A cognitive constraint is long-term memory. Not until about 4 months of age do infants begin to develop relatively stable social expectations on the

order of days or weeks (Brownell, 1986). Stable internal working models may be possible prior to this age.

Both the still-face interaction and the Strange Situation involve age-appropriate stressors. Similar affective and representational mechanisms may be involved in infant response to both procedures. Transfer of congruence is suggested by the high degree of concordance between predicted and observed attachment classifications. Including 12-month attachment classifications as positive elicits at 6 months correctly predicted 67% of the 12-month attachment classifications. Adding the diagnostic status by nonmaternal care interaction increased the accuracy rate to 72%. Predictive validities are within about 10% of the interobserver accuracy of attachment coders in most studies. Concordance between two procedures is strong evidence for construct validity.

The predictive relationship between positive elicits and attachment security strongly suggests that positive elicits index representations, or internal working models, related to the attachment system. Whether or not they are specific to attachment or encompass representations related to other motivational systems as well is a matter for further research. Attachment is closely related to other motivational systems, and attachment figures are identified in many of these. A consequence is that internal working models are strongly correlated within the first year and more.

Recent research suggests that secure attachment is related to stability in infant emotionality during mother-infant interactions over the first year (Belsky et al., 1989; Malatesta et al., 1989). When mother-infant relationships are mutually satisfying and pleasurable, secure attachments become more likely. Our data suggest that positive emotionality in mother-infant relationships is an important factor in the first 6 months of age. The relationship between internal working models of the attachment relationship and the regulation of affect is in need of further study.

*Classification regressed
on nonmaternal care:*

Attachment classification at 12 months
B
3
28

*Attachment classification
by hours in nonmaternal
care:*

Attachment classification at 12 months
B
3
28

in this group less likely. A association between positive attachment was found regardless sensitive elicits were analyzed as discrete or continuous variable. Anomalies instead of occurrence/frequency of elicits influenced sensitivity of prediction, but a relationship between positive attachment was found with each

to the 6-month findings, we association between secure attachment at 6 months and still-face results are consistent. Infants younger than 6 months may be less able to learn contingencies necessary to form relationships about their partner's behavior (Bowlby, 1987; Brownell, 1986). In this study, there was no evidence of stable influences in positive eliciting behaviors. A cognitive constraint on memory. Not until about 4 months do infants begin to develop and meet social expectations on the

order of days or weeks (Brownell, 1986). Stable internal working models may not be possible prior to this age.

Both the still-face interaction and the Strange Situation involve age-appropriate stressors. Similar affective and representational mechanisms may be involved in infant response to both procedures. This congruence is suggested by the high degree of concordance between predicted and observed attachment classifications. Regressing 12-month attachment classification on positive elicits at 6 months correctly predicted 67% of the 12-month attachment classifications. Adding the diagnostic status by nonmaternal care interaction increased the accuracy rate to 72%. These predictive validities are within about 15% of the interobserver accuracy of two attachment coders in most studies. Concordance between two procedures is strong evidence for construct validity.

The predictive relationship between positive elicits and attachment security strongly suggests that positive elicits index infant representations, or internal working models, related to the attachment system. Whether or not they are specific to attachment or encompass representations related to other motivational systems as well is a matter for further research. Attachment is closely related to other motivational systems, and attachment figures are involved in many of these. A consequence may be that internal working models are moderately correlated within the first year or more.

Recent research suggests that secure attachment is related to stability in positive emotionality during mother-infant interactions over the first year (Belsky et al., 1991; Malatesta et al., 1989). When mother-infant relationships are mutually satisfying and pleasurable, secure attachment may become more likely. Our data suggest that positive emotionality in mother-infant relationships is an important factor by 6 months of age. The relationship between internal working models of the attachment relationship and the regulation of positive affect is in need of further study.

We emphasize that positive elicits are in no sense causally related to secure attachment. Rather, they present a probe into the process of attachment formation. When the mother-infant relationship is characterized by stability, we expect that the probe will reliably predict attachment. In the subjects we studied, depression remitted in most cases by 6 months (Campbell et al., in press). A significant proportion of postpartum depressed mothers continued to have stable subclinical levels of depression. Were depressive symptoms less stable, or were new cases of depression to occur, we would anticipate increased negative affect and insensitivity and lack of stability in the mother-infant relationship and consequential attenuated prediction of attachment (Belsky et al., 1991; Egeland & Farber, 1984). In the absence of major challenges to the mother-infant relationship, however, attachment formation can be reliably indexed as early as 6 months of age.

In a previous report (Cohn et al., 1990), we found that mothers' work status had a positive effect on mother-infant interaction at 2 months in the depressed group. A similar but more profound effect emerged here. In infants of depressed mothers, hours of nonmaternal care were positively related to secure attachment. Time with alternative caregivers may have provided babies of postpartum depressed mothers with emotionally corrective experiences at a time when their mothers were either depressed or in the process of recovering. Alternatively, it may be that work outside of the home independently contributes to a mother's ability to relate to her baby. The isolation of rearing a young baby, when coupled with depression, may be a particularly difficult stressor for the mother-infant relationship. Opportunities for social support and more varied responsibilities may contribute to a sense of greater effectance than would otherwise be the case in depressed mothers. Teti and Gelfand (1990) found that the effect of depression on mother-infant interaction was mediated through a mother's sense of effectance. Fathers also may be more supportive of the mother and

more involved with their babies when the mother is working outside of the home. Further research on this topic is needed. In particular, it is important that we consider circumstances in which nonmaternal care may lead to increased security. Past research has focused on the relationship between nonmaternal care and avoidance (Belsky, 1988; Clarke-Stewart, 1989) without considering possible beneficial effects of nonmaternal care on attachment security.

Our findings contraindicate a temperament-based interpretation. Past data suggest a very modest contribution of individual differences in proneness to distress or sociability (see Goldsmith & Alansky, 1987). Using two measures of proneness to distress, negative elicits in the still-face interaction and maternal perceptions of infant difficulty as assessed with the ICQ, we found no relationship with attachment. Neither the frequency of negative elicits nor maternal perceptions of infant difficulty were correlated with attachment. Of course, had our subjects included a sufficient number of infants classified as resistant, it is possible that we would have found a correlation for that group. Individual differences in temperament characteristics, as measured with the ICQ, may not be stable from 4 to 6 months, although internal consistencies were high through 6 months. Nonetheless, the ICQ was stable between 2 and 4 months, and still no

predictive association with attachment emerged.

We had no convergent measures of infant sociability. However, we were able to assess the stability of positive expressions in the still-face interaction from 2 through 6 months. In those data we found no evidence of stability, which suggests that individual differences in the probability of positive affective responses did not contribute to the longitudinal correlation with secure attachment. Were positive expressions in the still-face interaction due to individual differences in sociability rather than to the infant's history with her mother, stability would be expected.

In summary, positive expressions in response to the still-face at 6 months predicted secure attachment at 12 months. Absence of positive expressions predicted avoidant attachment. In infants of postpartum depressed mothers, hours of nonmaternal care positively correlated with secure attachment. Variables associated with infant proneness to distress and sociability were unrelated to attachment security. These results suggest that attachment formation is underway by 6 months of age, and that indicators of 12-month attachment security can be detected as early as 6 months when the mother-infant relationship is stable. Similar mechanisms of affect regulation and coping may underlie both the still-face and Strange Situation procedures.

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Disorganized attachment Short-term stability infant correlates, a

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Abstract

This study of 71 low-income mothers and their infants found that attachment classification is best viewed as corresponding to the forced-secure and forced-insecure classification as a whole, and of the two subtypes including 6-month stability, maternal child behavior, maternal behavior toward the infant at home, and severity of associated family risk factors, a home. Across both D subtypes, disorganized maternal behavior at home and with decrease in relation to Main and Hesse's (1990) theoretical model of disorganized infant attachment behavior a of secure readiness to learn.

Understanding the relations between normal and pathological development is an important priority in the field of infant mental psychopathology. In the developmental perspective articulated by Bowlby (1989) and such as Sroufe (1989) and Cicchetti (1990), maladaptation is seen as compromised competencies in basic natural-developmental areas, such as self-regulation or the expressive use of language, that then further interfere with the acquisition of higher order competencies.

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