

Infant Affect During Parent-Infant Interaction
at 3 and 6 Months: Differences Between
Mothers and Fathers and Influence of Parent
History of Depression

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Abstract

Fifty families participated in mother- and father-infant still-face interaction at infant ages 3 and 6 months as part of a study of affect in early parent-infant relationships. Infants' positive and negative affect and parents' positive affect and physical play were coded from videotapes. Consistent with previous research, during the normal condition, mothers displayed more positive affect than did fathers, and fathers were more likely than mothers to display physical play. Infants were more positive with mothers than with fathers. Parents' positive affect but not parent gender predicted infants' positive affect at 6 months. During the still-face condition, infants of parents with a lifetime history of depression were more likely to display negative affect and less likely to display positive affect than infants with no such parent history. Infants' affect was unrelated to parents' current level of depressive symptoms, which indicates the value of considering family history of psychopathology when examining individual differences in infants' affect.

Introduction

Within the past two decades, there has been noteworthy progress in our understanding of parent-infant interaction and its relation to socioemotional development. Parent positive affect has proven to be a key element. Mothers' positive affect affords a frame within which infants cycle between states of positive and neutral affect, with attention directed toward the parent and periods of looking away (Cohn & Tronick, 1987). If mothers become still-faced contingent upon infant smiling, infants rapidly sober and look away (Cohn & Elmore, 1988). In response to prolonged maternal still face or simulated maternal depression, infant smiles

become markedly attenuated, and negative affect and looking away result (Cohn & Tronick, 1983; Tronick, Als, Adamson, Wise, and Brazelton, 1978). Between 3 and 6 months of age, individual differences in infant affect in response to mother still-face or simulated depression afford an early index of the developing attachment relationship, with infants' positive affect, negative affect, and self-regulatory behavior predictive of attachment at 12 months of age (Braungart-Rieker, Garwood, Powers, & Wang, 2001; Cohn, Campbell, & Ross, 1991; Tronick, Ricks, & Cohn, 1982). Infants' smiling and crying in response to the same context also predict internalizing and externalizing behavior problems 12 months in the future (Moore, Cohn, & Campbell, 2001). Attention to infants' positive and negative affect in face-to-face interactions during the first half-year of life allows the examination of the developing mother-infant relationship (Cohn & Campbell, 1992; Malatesta, Culver, Tesman, & Shepard, 1989), a relationship with important consequences for later socioemotional adjustment.

At least two sets of questions about parent-infant interaction are not well understood. One concerns the specificity of infant affect to affective differences between mothers and fathers. Another concerns the influence of parent history of depression on parent and infant affect. These two questions are the focus of the present paper.

While fathers are present in 72 percent of U.S. households (U. S. Department of Commerce, 2001) and are an important source of nonmaternal care for infants, they have been relatively neglected in research on infant-caregiver interaction. An exception is vocal imitative behavior, in which father-infant dyads have been examined longitudinally (Kokkinaki & Kugiumutzakis, 2000). Fathers are potentially important attachment figures (Belsky, 1999), and yet observations of father-infant affect are infrequent (Fitzgerald, Mann, & Barratt, 1999; Phares, 1996). Despite the relative dearth of research on fathers' behavior with infants, the topic of parent affective differences has received a great deal of attention. It is well established that relative to mothers, fathers less often express positive affect and spend a greater

proportion of time in physical play with infants (Belsky, Gilstrap, & Rovine, 1984; Belsky & Volling, 1987; Field, Vega-Lahr, Goldstein, & Scafidi, 1987; Lamb, Frodi, Hwang, Frodi, & Steinberg, 1982; Parke & O'Leary, 1976, cf. Parke, 1990; Parke, O'Leary, & West, 1972, cf. Parke, 1990; Power & Parke, 1982; Yogman, 1981; Roopnarine, Talukder, Jain, Joshi, & Srivastav, 1990; Sun & Roopnarine, 1996). Even in this literature, the perspective of the infant has been neglected: few studies have addressed whether infants differentially respond to these differences between mothers and fathers in positive affect and physical play.

The findings on differences in infants' affect with mothers and fathers have been inconsistent (Braungart-Rieker, Garwood, Powers, & Notaro, 1998; Bridges & Connell, 1991; Bridges, Grolnick, & Connell, 1997; Sun & Roopnarine, 1996), and previous studies have failed either to examine differences in infant affect in relation to differences between mothers and fathers or to measure infants' and parents' affect with similar observation systems. An exception is a study that found that mothers smiled more at infants during face-to-face play than did fathers and that infants smiled more at their mothers than at their fathers (Field et al., 1987). This study did not consider infants' responses to parents in more interpersonally challenging contexts, such as the still-face condition, however.

At least four perspectives can guide hypotheses about parent-related differences in infants' positive affect during parent-infant interaction. One emphasizes the unique role of parent positive affect in promoting infant positive affect (e.g., Tronick, 1989). Infants' positive affect is seen as specific to parents' positive affect, and differences in parents' positive affect during parent-infant interaction would be accompanied by corresponding differences in infants' affect. Mothers are generally more positive, and infants would thus be more positive with mothers than with fathers. Alternatively, from a functionalist perspective (e.g., Campos, Mumme, Kermoian, & Campos, 1994), parents' positive affect and physical play may have a similar function in that they share the goals of promoting engagement and eliciting infant positive affect. If positive affect and physical play are similarly effective in achieving

that goal, then fathers' physical play could compensate for their lower positive affect and infants' positive affect would be predicted to occur at comparable frequencies in father-infant and mother-infant interaction. Third, inherent gender differences between mothers and fathers may contribute to infants' positive affect. These include culturally based gender differences, such as the tendency for American mothers to be infants' primary caregivers and to spend fewer hours employed outside the home than do fathers (Lamb, 1997), and biologically based differences in features such as body size, facial appearance (Bruce & Young, 1998), and vocal fundamental frequency (Titze, 1989). Caregiving experiences, preference for female anatomical characteristics, or both might lead infants to display more positive affect with mothers, for instance, than with fathers. Fourth, infants may be insensitive to the small but significant differences in parents' positive affect and physical play. Parent-infant affect is mutually constructed and subject to bidirectional influence (Beebe, Jaffe, Feldstein, Mays, & Alson, 1985; Cohn & Tronick, 1988; Lester, Hoffman, & Brazelton, 1985), and infants do not simply respond to their parents' affect. As a result, infants might not mirror the differences between parents.

A related issue for father-infant affect is whether infants' response to the still-face paradigm is comparable with mothers and fathers. This issue is crucial because there is evidence that the still face affords an index of the developing attachment relationship and infants' risk for later behavior problems. This might be because the still face, a dyadic task in which the parent briefly becomes unresponsive and expressionless (Tronick et al., 1978), challenges the parent-infant relationship and the infant's emotion regulation skills. Infants typically respond to this change in interaction by displaying increased distress and attempts to regulate that distress (Braungart-Rieker et al., 1998; Cohn & Tronick, 1983; Field, Vega-Lahr, Scafidi, & Goldstein, 1986; Fogel, 1982; Murray & Trevarthen, 1985; Shapiro, Fagen, Prigot, Carroll, & Shalan, 1998; Stoller & Field, 1982; Toda & Fogel, 1993; Tronick et al., 1978; Weinberg & Tronick, 1996). The still face is

accordingly considered a stressful experience for infants (Weinberg & Tronick, 1994).

The second set of questions, on parental depression, has implications for developmental psychopathology. Parental depression is a risk factor for affective psychopathology in children (Beardslee, Bemporad, Keller, & Klerman, 1983; Hammen, Gordon, Burgs, Adrian, Jaenicke, & Hiroto, 1989; Mendlewicz & Barron, 1981; Weissman et al., 1987), and face-to-face interaction is believed to mediate, in part, this risk (Cohn & Tronick, 1989). Depressed mothers in comparison with non-depressed mothers are often less positive and more negative with their infants, with corresponding differences in infant affect (Campbell, Cohn, & Meyers, 1995; Cohn, Campbell, Matias, & Hopkins, 1990; Cohn & Campbell, 1992; Cohn & Tronick, 1987, 1989; Field, 1984). This pattern of behavior is consistent with emotion and motivation models, which conceptualize the balance of positive and negative affect as central to depression (Clark & Watson, 1991; Depue & Iacono, 1989; Fowles, 1994). Children of parents with early-onset depression may be particularly at risk for affective dysregulation because this depressive subtype has high familiarity (Bland, Newman, & Orn, 1986; Klein, Lewinsohn, Seeley, & Rohde, 2001; Kovacs, Devlin, Pollock, Richards, & Mukerji, 1997; Kupfer, Frank, Carpenter, & Neiswanger, 1989; Moldin, Reich, & Rice, 1991; Price, Kidd, & Weissman, 1987; Weissman et al. 1987).

It is not known whether infants of parents with a history of depression exhibit differences in positive and negative affect during parent-infant interaction when parents are no longer depressed. Depression is an episodic disorder, and previous studies either have confounded current symptoms with prior episodes of depression or have not evaluated current and prior depression separately. Cohn and Tronick (1989) have hypothesized that the effects of maternal depression carry over to periods in which mothers are no longer depressed. If risk for depression in children involves affective differences early in life, and if parent depression effects are not limited to periods of active symptomatology, infants with a parent history of early-onset depression may exhibit affective dysregulation during parent-infant interaction.

Affective differences might be particularly evident during stressful situations. In infants of currently depressed mothers, the still-face condition elicits the predicted pattern of positive and negative affect (Field, 1984), and therefore it is a useful context for testing this hypothesis.

The current study examined infants' positive and negative affect by observing behavior during normal and still-face conditions of mother-infant and father-infant interaction at ages 3 and 6 months. A group of parents in the sample had a documented history of depression dating from adolescence or childhood, and thus some of the infants in the sample are at risk for depression and other behavior problems. We selected infant ages 3 and 6 months and employed a longitudinal design because during this period, engagement in social interaction is a central developmental task and positive emotionality and emotion regulation increase substantially (Rothbart, 1989; Rothbart, Posner, & Rosicky, 1994; Rothbart, Ziaie, & O'Boyle, 1992). Our goal was to test the influence of two factors: (1) affective differences between mothers and fathers and (2) parents' history of depression. We addressed differences between mother-infant and father-infant relationships by examining differences in infants' mean proportion of positive and negative affect with mothers and fathers, the association of infants' affect with mothers' and fathers' affect, and the prediction of infants' affect from parents' gender and positive affect during a normal condition. Infants' negative affect was included in the project so that infants' affect could be examined more thoroughly. We addressed the influence of risk for depression by examining group differences in infants' affect during the still-face condition. The still face was the focus of this question because we expected that its stressful, interpersonal nature and its predictive value for later behavior problems would make it particularly likely to elicit differences in infants' affect tendencies.

We expected to replicate the finding that mothers exhibit more positive affect and fathers exhibit more physical play. Based on a theoretical perspective emphasizing the specificity of positive affect, we predicted that although both positive affect and physical play would contribute to parent-infant engagement,

positive affect would exert a greater influence, leading infants to express more positive affect with mothers than with fathers. We predicted further that the proportion of parents' and infants' positive affect would be correlated at each age, with similar correlations in mother- and father-infant dyads and no contributing effect of parent gender. With regard to parents' depression and infants' affect, we predicted that infants with a parent history of depression would be more likely to display negative affect and less likely to display positive affect during the still face than would infants without such a family history.

Method

Participants

Fifty families with healthy, full-term infants (54% female) were assessed longitudinally, at infant ages 3 months and 6 months. Mean parent age at infant age 3 months was 26 years for mothers ($SD = 2.6$) and 27 years for fathers ($SD = 3.9$). At infant age 3 months, 88% of parents were married. The majority of parents (96% of mothers and 84% of fathers) described themselves as European-American, and the other parents described themselves as Asian-American (2% of mothers), Native American (2% of fathers), Latino (10% of fathers), or of mixed ethnicity (2% of mothers and 4% of fathers). Sixty percent of families had an annual household income greater than \$30,000. With few exceptions, all parents had received a high school diploma or GED, and by infant age 6 months, 39% of fathers and 36% of mothers had received a postsecondary degree. The infant assessed in the study was the firstborn biological child for 38% of mothers and 46% of fathers. All parents were living with their infants at the times of assessment, and all reported having daily contact with their infants. At infant age 3 months, 89% of fathers and 44% of mothers were employed for pay for at least 35 hr/week; at 6 months, 86% of fathers and 31% of mothers were employed at this level. Fathers were more likely than mothers to work full-time at both infant ages (Pearson $\chi^2(1, N = 83) = 19.54, p < .001$ at 3 months; Pearson $\chi^2(1, N = 84) = 24.02, p < .001$ at 6 months).

Families were recruited from a sample of adults participating in a longitudinal study of the developmental course of adolescent-onset

depression. Participants were probands and controls from the study, their partners or spouses, and the couples' infants. Parents originally were part of a representative community sample of 1,709 adolescents who were selected from nine high schools in urban and rural districts of Western Oregon and were first assessed at age 14-18 years. At the time of the first assessment, which occurred approximately 8-12 years prior to the current study, 2.9% of participants in that adolescent sample met diagnostic criteria for current depression and 17.4% met criteria for past depression (Lewinsohn, Hops, Roberts, Seeley, & Andrews, 1993). At a 1-year follow-up, 25% of 1,508 participants reported having experienced an episode of depression (Lewinsohn et al., 1994).

The families included in the current study were participants in the original adolescent depression study who now had infants of the appropriate age during the assessment period of the current study. The participation rate for eligible families was 83%. Families included were those in which both parents participated in the parent-infant interaction assessment and completed at least the normal condition at both infant ages. Fifty families met this criterion, but due to infant fussiness, parent lack of compliance with instructions, or time constraints, 44 families completed the still-face condition at both ages and with both parents.

At infant age 3 months, 13 mothers (26%) and 9 fathers (18%) met diagnostic criteria for lifetime incidence of major depressive disorder according to the Structured Clinical Interview for Axis I DSM-IV Disorders (SCID; First, Spitzer, Gibbon, & Williams, 1994). According to clinical interviews using the same instrument, three participants met criteria for current major depressive disorder during the current study: one mother at infant age 3 months, one father at infant age 6 months, and one father at both ages. Parents' mean self-rated depression scores at the time of both assessments were below a clinically significant level as measured by the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977), a standardized, self-report measure of depression severity that is widely used in research. At 3 months, the mean CES-D score was 10.04 for mothers ($SD = 7.67$,

range = 0–35) and 8.04 for fathers ($SD = 8.25$, range = 0–38); at 6 months, the mean score was 9.34 for mothers ($SD = 7.11$, range = 0–27) and 5.62 for fathers ($SD = 6.66$, range = 0–36).

These scores reflect a decrease over time for fathers' depressive symptoms ($t(49) = 2.78$; $p < .01$) but not for mothers' depressive symptoms.

Materials

Parents and infants were videotaped using two synchronized cameras and video recorders that permitted the independent viewing of participants on a common time base. Following the assessment, parent and infant affect and related behaviors were coded from videotape using videocassette recorders equipped with a shuttle to regulate viewing speed.

Procedure

Parents and their infants attended laboratory assessment sessions on two occasions, when infants were ages 3 and 6 months. Face-to-face interaction occurred as part of a larger battery of observational procedures. Parents completed demographic and other questionnaires prior to the assessment. The order of mothers' and fathers' face-to-face interactions with their infants was counterbalanced at each age. Whenever possible, both parents were observed with their infant on the same day. Because infant fussiness sometimes precluded the assessment of the infant with both parents on the same day, parents in 70% of families at infant age 3 months and 38% of families at 6 months were assessed on two different days. The number of families assessed on two days decreased with infant age (Pearson $\chi^2(1, N = 50) = 10.31$, $p < .01$), which is consistent with the hypothesis that infant self-regulation increases over this period. During each parent-infant interaction, the other parent left the room and did not observe his or her partner's behavior.

During face-to-face interaction, the parent was seated and the infant was placed in an infant seat secured to a table so that parent and infant faced each other at eye level. Parent affect, parent physical play, and infant affect were observed during a series of conditions that were a modified version of Tronick's still-face paradigm (Tronick, Als, Adamson, Wise, & Brazelton, 1978). Face-to-face interaction included four conditions designed to elicit a range of infant emotions: a 3-min normal

interaction, 40 s of peek-a-boo, a 2-min still-face interaction, and a 1-min reunion interaction. The normal and still-face conditions are the focus of the current study.

Infant fussiness led to the cessation of face-to-face interaction if experimenters judged crying infants to be temporarily inconsolable (defined as crying bouts exceeding 15 s) or if parents asked that the interaction be stopped. If a dyad ended the session during a face-to-face interaction condition, subsequent conditions were not completed. All available data on parent and infant affect were included in analyses.

The SCID was administered by phone by an interviewer who had no involvement in the play assessment. Thus, the staff conducting the assessment and observers performing the coding were blind to parents' clinical status and history.

Coding and Data Reduction

Parents' and infants' affect and related behaviors during face-to-face interaction were coded categorically on a 1-s time base. Parents' affect and physical play were coded during the normal condition, and infants' affect was coded during the normal and still-face conditions. Parents' facial expressions were classified as one of the following mutually exclusive emotion categories: anger, sadness, neutral, low positive, high positive, surprise, and empathy. Parent physical play was defined as bouncing the infant chair and was coded as present or absent. The infant chair bounced easily, and parent behaviors such as tickling the infant or moving the infant's limbs resulted in bouncing. Therefore, bouncing captured physical play in general. Infants' facial expressions were classified into the mutually exclusive categories of positive, neutral, or negative. Parent and infant affective codes were part of a system developed from Tronick's monadic phases (Cohn & Tronick, 1987; Tronick, Als, & Brazelton, 1980) and Izard's Affex system (Izard, Dougherty, & Hembree, 1983).

Videotapes of parents and infants were coded by observers trained to a minimum reliability of $\kappa = .70$ and 80% agreement. Separate coding teams coded videotapes of parents and infants. To eliminate a potential source of bias in coding, the same coder in a coding team was never assigned to code both parents in a family at the same infant age or the

infant with both parents at the same age. Intercoder agreement for affect coding was computed by assigning 20% of parents and 20% of infants at both ages to more than one coder. Intercoder agreement was $\kappa = .82$ for parents' affect, $\kappa = .84$ for parents' physical play, and ranged from $\kappa = .71-.83$ for infants' affect.

Following Moore, Cohn, and Campbell (1997) and Cohn, Campbell, Matias, and Hopkins (1990), microanalytic data on facial expression were reduced to the proportion of time that each behavior was exhibited. Proportions were computed by dividing the number of seconds in which a behavior was displayed by the total number of seconds in the interaction condition. Parents expressed anger, sadness, and empathy infrequently, and accordingly parent affect data were reduced to the proportion of positive affect, which included the coding categories of high positive, low positive, and surprise (which tended to co-occur with positive expressions). Neutral affect, which tended to occur more than the other affect categories when parents were not expressing positive affect, was not of interest to the current study. Parent physical play was reduced to the proportion of time in which parents displayed physical play. Infant affect data were reduced to two variables representing the proportion of time spent in an affective state: positive affect and negative affect.

Parent positive affect and infant positive affect during the normal condition were subjected to arc sine transformation because of skewness. Parent physical play during the normal condition, infant negative affect during the normal condition, infant positive affect during the still-face condition, and infant negative affect during the still-face condition had highly skewed distributions, with a score of 0 for at least 20% of cases. As a result, these variables were unsuitable as continuous variables and were recoded as dichotomous.

Statistical Analyses

To test hypotheses about differences between mother-infant and father-infant affect with the continuous variables of parents' positive affect and infants' positive affect during the normal condition, a repeated measures multivariate analysis of variance (MANOVA) approach was used. Parent (mother-infant or

father-infant interaction) and infant age (3 or 6 months) were included as within-subjects factors, and sex of infant (male or female) was included as a between-subjects factor. The Pillai's trace statistic was used to evaluate relations among independent and dependent variables. To test these hypotheses with dichotomous variables (e.g., parent physical play), we conducted repeated measures categorical model analyses using PROC CATMOD in SAS (v. 8.2). Parent and infant age were within-subjects factors, and sex of infant was a between-subjects factor. Only cases with data for both parent-infant interactions at both ages could be included, and as a result 50 families were included in the analyses of parent physical play and 44 families were included in the analyses of infant affect during the still-face condition. To test the hypothesis that parents' positive affect but not parent gender predicts infants' positive affect, random regression models were computed (in SPSS v. 11). Because parent was a within-subject variable, data for infants' affect with each parent could not be considered independent. The possible influence of within-family factors on infant behavior was modeled by including family as a random effect in the models. Infants' positive affect was the dependent variable, and parents' positive affect, parent gender (dummy coded), and the interaction of parents' positive affect and parent gender were fixed effects. To test hypotheses about the relation between infants' and parents' affect within families, Pearson correlation analyses were conducted. The relation of parent history of depression to infant positive and negative affect during the still-face condition was examined with repeated measures categorical models that contained parent and infant age as within-subjects factors, lifetime history of depression in one or both parents (present or absent) as a between-subject factor, and infant sex as a between-subjects factor.

Results

Preliminary Analyses

Preliminary analyses examined the potential effects of parents' employment level, of whether assessments were completed in one day or two, and of the order of parents' interaction with the infant. To examine the relation of parents' employment to parents' and infants' affective

Table 1

Mothers' and Fathers' Positive Affect and Physical Play and Infants' Positive and Negative Affect During Dyadic Face-to-Face Interaction

	<u>3 months</u>				<u>6 months</u>				Effect	
	Mother-Infant		Father-Infant		Mother-Infant		Father-Infant			
	<i>N</i>		<i>N</i>		<i>N</i>		<i>N</i>			
Normal Condition										
Parent Positive Affect	50	.62 (.19)	50	.50 (.24)	50	.54 (.21)	50	.48 (.23)		P
Parent Physical Play	50	.68	50	.80	50	.50	50	.72		P, A
Infant Positive Affect	50	.16 (.14)	50	.14 (.12)	50	.28 (.21)	50	.20 (.17)		P, A
Infant Negative Affect	50	.58	50	.70	50	.60	50	.62		None
Still-Face Condition										
Infant Positive Affect	48	.60	49	.55	48	.73	48	.69		None
Infant Negative Affect	48	.79	49	.76	48	.77	48	.73		None

Note: Effects: A = age, P = parent. For dichotomous variables (parents' physical play, infants' negative affect during the normal condition, and infants' positive and negative affect during the still-face condition), the proportion of cases in which behavior was present is reported. For continuous variables (parents' positive affect and infants' positive affect during the normal condition), proportion of time is reported and standard deviations appear in parentheses. Effects for dichotomous variables were examined using repeated measures categorical modeling analyses; effects for continuous variables were examined using repeated measures MANOVAs.

Table 2

Correlations between Infants' Positive and Negative Affect and Mothers' and Fathers' Positive Affect and Physical Play

Infant during Normal Condition	Parent during Normal Condition			
	Mothers' Positive Affect	Mothers' Physical Play	Fathers' Positive Affect	Fathers' Physical Play
	3 months			
Positive Affect	.21	-.09	.18	-.09
Negative Affect	.18	.20	-.16	-.02
	6 months			
Positive Affect	.35*	.28*	.45**	-.05
Negative Affect	-.28*	-.08	-.30*	-.06

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

Table 3

Proportion of Infants Displaying Positive and Negative Affect during Parent-Infant Still Face in Relation to Parent Lifetime History of Depression

	3 months				6 months			
	<u>Depression</u>		<u>No Depression</u>		<u>Depression</u>		<u>No Depression</u>	
	Mother-Infant	Father-Infant	Mother-Infant	Father-Infant	Mother-Infant	Father-Infant	Mother-Infant	Father-Infant
Positive Affect	.42	.52	.72	.57	.76	.72	.71	.67
Negative Affect	.89	.89	.72	.67	.71	.67	.80	.77

behavior, we classified mothers and fathers as working full time (i.e., 35 or more hours per week; $Ns = 16$ mothers and 42 fathers at 3 months, 11 mothers and 41 fathers at 6 months) or less than full time ($Ns = 20$ mothers and 5 fathers at 3 months, 25 mothers and 7 fathers at 6 months). Employment status was not reported by 14 mothers and 3 fathers at infant age 3 months and by 14 mothers and 2 fathers at 6 months. Separate oneway analyses of variance (ANOVAs) for mothers and fathers at each age indicated that mothers' and fathers' employment levels were unrelated to parents' proportion of time spent in positive affect (all $F_s < 1.45$, all $p_s > .10$). Chi square analyses for mothers and fathers at each age indicated that parents' employment level was unrelated to physical play (Pearson χ^2 s ranged from .003-3.37, all $p_s > .30$).

To test whether day of assessment was related to parents' and infants' affect, we conducted oneway ANOVAs for parents' positive affect, infants' positive affect during the normal condition, and infants' negative affect during the normal condition at each infant age, with day of assessment (mother-infant and father-infant interaction on the same day or different days) as the independent variable. Parents' proportion of time spent in positive affect (F_s ranged from .02-3.65, all $p_s > .05$) and infants' proportion of time spent in positive or negative affect during the normal condition (F_s ranged from .02-2.08, all $p_s > .15$) did not differ between families with same-day assessments and families with different-day assessments. Chi square analyses with day of assessment and parents' physical play, infants' positive affect during the still-face condition, or infants' negative affect during the still-face condition (present or absent) were conducted for each age and each parent. These analyses also revealed no difference between same-day and different-day families (Pearson χ^2 s = .01-.68, all $p_s > .40$).

To test the effect of the order of mother-infant and father-infant interactions, analyses were conducted with data from the families in which infants were assessed with both parents on the same day. Oneway ANOVAs conducted with order of parent (mother first or father first) as the independent variable and parents' positive

affect and infants' positive affect during the normal condition as dependent variables indicated that the order in which mothers and fathers interacted with their infants did not influence the proportion of time that parents or infants spent in positive affect during the normal condition at either age (for parents, F_s ranged from .00-2.60, all $p_s > .10$; for infants, F_s ranged from .00-3.90, all $p_s > .05$). To test for parent order effects on parents' physical play and infants' negative affect during the normal condition and infants' positive and negative affect during the still-face condition, chi square analyses were conducted with parent order (mother first or father first) and each dichotomous affect variable (present or absent) at each assessment age. At both ages, parent order was unrelated to the presence of parents' physical play and infants' negative affect during the normal condition and infants' positive and negative affect during the still-face condition (Pearson χ^2 s ranged from .01-3.12, all $p_s > .05$).

Differences Between Mothers and Fathers in Positive Affect and Physical Play

Table 1 contains means and standard deviations for parents' positive affect, parents' physical play, infants' positive affect, and infants' negative affect. A repeated measures MANOVA for parents' positive affect during the normal condition revealed that during parent-infant interaction, mothers spent a greater proportion of time in positive affect than did fathers ($F(1,48) = 7.58, p < .01, \eta^2 = .14$). Mothers' and fathers' proportion of time spent in positive affect did not differ with infant sex or age ($F(1,48) = .48, p > .45$ for sex; $F(1,48) = 3.46, p > .05$ for age), and the infant sex X parent interaction effect ($F(1, 48) = .00, p > .95$) was not significant.

Categorical modeling analyses for parent physical play during the normal condition revealed parent and age effects. Fathers were more likely to exhibit physical play than were mothers ($\chi^2(1, N = 50) = 9.03, p < .01$), and parents were more likely to exhibit physical play with infants at 3 months than at 6 months ($\chi^2(1, N = 50) = 5.21, p < .05$). Parents were no more likely to use physical play with boys than girls ($\chi^2(1, N = 50) = .57, p > .45$), and the infant sex X parent interaction effect was unrelated to

parent physical play ($\chi^2(1, N = 50) = 1.06, p > .30$).

Differences in Infants' Positive and Negative Affect During Mother-Infant and Father-Infant Interaction

Differences between parents were reflected in infants' affect during the normal condition. A repeated measures MANOVA for infants' positive affect during the normal condition indicated that infants spent a greater proportion of time displaying positive affect during mother-infant interaction than during father-infant interaction ($F(1, 48) = 4.78, p < .05, \eta^2 = .09$) and spent a greater proportion of time in positive affect at 6 months than at 3 months ($F(1, 48) = 17.08, p < .01, \eta^2 = .26$). Male and female infants did not differ in their amount of positive affect ($F(1,48) = .18, p > .65$), and the infant sex X parent interaction ($F(1,48) = .34, p > .55$) was unrelated to infants' positive affect.

Categorical modeling analyses were conducted for infants' negative affect during the normal condition and infants' positive affect and negative affect during the still-face condition. The main effects of parent, age, and infant sex and the infant sex X parent interaction were unrelated to infants' negative affect during the normal condition ($\chi^2(1, N = 50)$ ranging from .20–2.92, all $ps > .05$), infants' positive affect during the still-face condition ($\chi^2(1, N = 44)$ ranging from .04–3.39, all $ps > .05$), and infants' negative affect during the still-face condition ($\chi^2(1, N = 44)$ ranging from .14–2.27, all $ps > .10$). Infants were no more likely to express negative affect with one parent or the other during the normal condition, and they were no more likely to express positive affect or negative affect with one parent or the other during the still-face condition. Infants' likelihood of expressing negative emotion during the normal condition or of expressing positive or negative affect during the still-face condition did not vary with age or sex.

Relation of Parent and Infant Affect

To examine the correspondence between infants' and parents' affect, we computed correlations between parents' and infants' behavior during the normal condition, including the variables of parents' positive affect, parents'

physical play, infants' positive affect, and infants' negative affect during the normal condition. Table 2 contains the mother-infant and father-infant correlations during the normal condition for infant ages 3 and 6 months. Generally, the pattern of correlation of infants' and parents' behavior was similar for mother-infant and father-infant dyads. At 3 months, correlations between infants' affect and parents' positive affect were not significant. At 6 months, infants' and mothers' positive affect and infants' and fathers' positive affect were moderately correlated, and infants' negative affect was modestly and inversely correlated with mothers' and fathers' positive affect. Also at 6 months, infants' positive affect was modestly correlated with mothers' physical play.

We also examined correlations that would address questions about the similarity of parents' positive affect and physical play, the stability of infants' affect across age and between parents, and the relation of infants' and parents' affect across age and condition. Because parents' positive affect and physical play can be considered functionally similar, we examined the correlation between them and found that they were weakly and nonsignificantly correlated at both infant ages (r s ranged from .05–.24, all $ps > .05$). The proportion of time that infants spent in positive affect during the mother-infant normal condition was stable from 3 to 6 months ($r = .31, p < .05$), but the proportion of time that infants spent in positive affect during the father-infant normal condition and in negative affect during the normal condition with either parent were not stable (r s ranged from -.08–.15, $ps > .30$). The proportion of time that infants spent in positive or negative affect during the still face condition was uncorrelated with the proportion of time parents spent in positive affect during the normal condition (r s ranged from -.20–.16, all $ps > .15$). The proportion of time that infants spent in positive or negative affect with each parent during the normal condition was uncorrelated with the proportion of time that the other parent spent in positive affect (r s ranged from -.19–.22, all $ps > .10$). Infants' affect at 6 months was uncorrelated with parents' positive affect at 3 months (r s ranged from -.13 to .20, all $ps > .10$).

Parents' Positive Affect and Parent Gender as Predictors of Infants' Affect

The regression analysis testing the prediction of infants' affect from parents' positive affect and parent gender was limited to infants' proportion of time spent in positive affect during the normal condition at 6 months. This was because infants' negative affect did not differ between mother-infant and father-infant interaction, infants' positive affect differed between parents only for the normal condition, and parents' and infants' positive affect were only correlated at age 6 months. We predicted that when parents' positive affect and parent gender were both included in the model, only parents' positive affect would predict infants' positive affect.

Parents' proportion of time spent in positive affect was related to infants' proportion of time spent in positive affect ($F(1, 95.75) = 16.95, p < .001$), but neither parent gender nor the interaction of parents' positive affect X parent gender was a significant predictor of infants' proportion of time spent in positive affect ($F_s < 1.0, p_s > .85$). Thus when parents' positive affect and parent gender were accounted for, infants' positive affect varied only with parents' positive affect.

Parent History of Depression and Infant Affect During the Still-Face Condition

Table 3 presents the proportion of infants who displayed positive affect and negative affect during the still-face condition at each age and with each parent. Separate analyses were conducted for positive affect and negative affect. There was a parent X depression interaction effect for infants' positive affect ($\chi^2(1, N = 44) = 5.07, p < .05$). Separate follow-up categorical models for mother-infant and father-infant interaction indicated a depression X age interaction effect during mother-infant interaction ($\chi^2(1, N = 44) = 5.13, p < .05$) and not during father-infant interaction ($\chi^2(1, N = 44) = .10, p > .75$), and additional follow-up analyses indicated that infants of parents with a history of depression were less likely to display positive affect during mother-infant interaction at 3 months ($\chi^2(1, N = 44) = 4.41, p < .05$). There was an age X depression interaction effect for infants' negative affect ($\chi^2(1, N = 44) = 7.02, p < .01$). Follow-up categorical models for 3 months and 6 months indicated that at 3 months

only, infants with a parent history of depression were more likely to display negative affect during the still-face condition than were infants without a parent history of depression ($\chi^2(1, N = 44) = 8.48, p < .01$). There was no depression group difference for infants' negative affect during the still-face condition at infant age 6 months ($\chi^2(1, N = 44) = .09, p > .30$) and no parent X depression interaction effect ($\chi^2(1, N = 44) = .04, p > .85$) for negative affect overall.

To address the possibility that parent history of depression influenced infants' affect through parents' affect, we then examined the relation between parent history of depression and parent positive affect and physical play. Oneway ANOVAs indicated that lifetime major depressive disorder was unrelated to mothers' and fathers' proportion of time spent in positive affect (F_s ranged from .00-.23, all $p_s > .10$). Categorical modeling analyses for parent physical play, with parent and age as within-subjects factors and infant sex and history of depression in either or both parents as between-subjects factors, indicated that lifetime major depressive disorder was unrelated to the presence of physical play ($\chi^2(1, N = 50) = .19, p > .65$).

Because the number of mothers and fathers with current diagnoses of major depressive disorder was small, the relation between current diagnosis and affective behavior could not be tested. To evaluate the effect of current depressive symptoms as measured by CES-D score, correlations were computed between parents' CES-D score at infant age 3 and 6 months and parents' proportion of time spent in positive affect at each age. There were low, nonsignificant correlations between current depressive symptoms and parents' positive affect (r_s ranged from -.03-.08, all $p_s > .15$). Logistic regressions predicting the presence of parents' physical play from parents' CES-D scores were computed for mothers and fathers at infant ages 3 and 6 months. Current depressive symptoms were unrelated to the presence of parents' physical play at either age (B_s ranged from -.02-.01, all $p_s > .40$).

Discussion

Previous literature has found that mothers and fathers differ in the extent to which they

show positive affect and engage in physical play with their infants, with mothers more positive in affect and fathers using more physical play. A central goal of the present study was to learn whether these differences between parents are reflected in infant affect. In a longitudinal design, we studied 50 families from a population-based sample in western Oregon. We found that differences between mothers and fathers in the proportion of positive affect but not in the use of physical play were indeed reflected in infants' affect. Infants were more positive with their mothers than with their fathers at both 3 and 6 months of infant age. As in two other studies, infants' negative affect did not differ between parents (Braungart-Rieker et al., 1998; Bridges & Connell, 1996). We found no evidence that parents' use of physical play was functionally equivalent to positive affect: infants' positive affect was unrelated to parent differences in the tendency to use physical play. Consequently, parents' positive affect appeared to be the critical factor. These findings are most consistent with the view that parents' positive affect provides a frame within which infants themselves experience positive affect (Cohn & Tronick, 1988).

The specificity of infants' positive affect to variation in parents' positive affect became stronger with development. At 3 months of age, infants' positive affect varied only with mean differences between mothers and fathers. By 6 months of age, individual differences within mother- and father-infant dyads emerged. Infants' positive affect was accounted for by variation in parents' positive affect, with no additional effect of gender or parent gender by affect interaction. Infants had specific and appropriate affective responses to their parents' affect (Cohn & Tronick, 1989). The finding that parents' gender no longer accounted for variation in infants' positive affect suggests that other factors correlated with parents' gender, such as hours employed outside of the home and physical differences on average between men and women, were inconsequential. Indeed, we found no relation between hours employed outside the home and infants' positive affect. Infants' experience was specific to the affect of their parent, whether mother or father.

The finding that infants experience distinctive interactions with each parent is relevant to the development of attachment. A recent meta-analysis of 21 studies concluded that parents' positive attitude, which includes positive affect, contributes to infants' attachment security (DeWolff & van IJzendoorn, 1997). Affective differences between mother-infant and father-infant interaction could also explain the low correlation between infant-mother and infant-father attachment observed within families (van IJzendoorn & DeWolff, 1997). We found strong evidence of differences between parents in infants' positive affect and of the specificity of infants' response by 6 months of age to parents' affect. Six months of age is the time at which attachment representations are beginning to form (Bowlby, 1969). Infants experienced qualitatively different interactions with each parent, which could over time contribute to differential patterns of attachment.

It is unlikely, however, that the quantity of positive affect in parent-infant interaction alone is the critical variable for the development of attachment. First, despite consistent findings that mothers are more positive than fathers, the relative proportion of infants with secure attachment to mothers and fathers is comparable (Belsky, Campbell, Cohn, & Moore, 1996). Second, while several studies have found that infants' response to the still-face interaction at 6 months appears to tap emerging individual differences in attachment (Braungart-Rieker et al., 2001; Cohn et al., 1991; Tronick et al., 1982), we found no differences in still-face behavior with mothers and with fathers. Furthermore, the effects of parent history of depression on infants' still-face affect were no longer evident by age 6 months. We anticipate that more fine-grained measures of parent-infant bidirectional influence (Beebe et al., 1985; Cohn & Tronick, 1988; Lester et al., 1985) during normal interaction will be needed to reveal individual differences in attachment in the making.

The differences we found in infants' affect with mothers and fathers have implications for research on infant temperament. Mother-rated and father-rated temperament factors are only modestly correlated (e.g., Martin & Halverson, 1991), and parents' disagreement could be

interpreted as error or bias. The cumulative effect of consistent affective differences between mother- and father-infant interaction, however, provide a basis for systematic differences in each parent's relationship with the same child. Lack of agreement between parents' reports would then reflect valid differences in infant temperament-related characteristics with each parent.

The longitudinal nature of the study allowed the examination of change with development in positive and negative affect. As reported in other studies of mother-infant interaction (e.g., Malatesta & Haviland, 1982; Messinger, Fogel, & Dickson, 1999), infants' positive affect increased from 3 to 6 months. We also found indirect evidence that negative affect was decreasing. By 6 months, infants were far less likely to require a second day to complete the still-face paradigm with each parent. The principal reason for requiring a second day was infant distress. Thus, infants' ability to experience positive affect and regulate arousal and irritability appeared to increase substantially over this period.

Additionally, the finding that only 30 percent of infants were able to complete the 3-month assessment with both parents in a single day has methodological implications. It may be inappropriate to assume that young infants are able to tolerate two parent-infant sessions in one day. Future examinations of mothers, fathers, and infants should take this issue into account.

The examination of parents' history of major depressive disorder in the current study was, to our knowledge, the first attempt to disentangle the effects of current symptoms and previous symptoms. Emotion-based models of depression in adults emphasize both the increase in negative affect and the decrease in positive affect during episodes (Clark & Watson, 1991; Depue & Iacono, 1989; Fowles, 1994). During the stressful still-face condition at 3 months, we observed that depression was associated with the same pattern of affect predicted by these models. Infants whose parents have experienced major depressive disorder were more likely to exhibit negative affect and less likely to exhibit positive affect than infants with no such parent history. This is especially striking because parent depression was defined not in terms of current

diagnosis but of prior diagnosis. Infants of depressed parents differed from other infants even when their parents were not depressed: current symptoms were not related to infants' affect, and the influence of parental depression thus is not limited to periods of active symptomatology.

The putative effects of depression in infants are usually expressed in terms of exposure to the dysphoric mood, social withdrawal, fatigue, and marital conflict that occur with depression (e.g., Downey & Coyne, 1990). In our study, this claim is less tenable than in others because only one mother and two fathers were experiencing a depressive episode at the time of the assessment. What, then, could account for differences in infants with a parent history of depression?

Before venturing to interpret our findings on infants' exposure to parental depression, it is worth noting that previous studies have focused on depression in mothers rather than on depression in fathers or on depression in parents. Thus, the conceptualization of parental depression effects in research on infant emotion has been more a conceptualization of *maternal* depression effects. We therefore begin by comparing our results to those found in studies of infants whose mothers are experiencing depression.

One possible reason for our findings is that some mothers experienced postpartum depression that remitted by the time families were seen at infant age 3 months but nonetheless influenced infants' affect. We consider this unlikely, however, because a study with a sample demographically similar to ours found that chronic, current depression but not remitted depression was associated with mothers' and infants' affect at 6 months (Campbell, Cohn, & Meyers, 1995). Some mothers in our sample may have experienced depression during pregnancy, and the accompanying changes may have influenced prenatal development. As maternal depression and psychological function have been reported to influence fetal motor activity (Dieter et al., 2001; DiPietro, Hilton, Hawkins, Costigan, & Pressman, 2002) and neonatal neuroendocrine and neurotransmitter levels (Lundy et al., 1994), it is possible that

prenatal exposure to maternal depression could influence infants' affect early in life.

Another possibility, and one that is relevant to maternal or paternal depression, is that there is something different about individuals with a history of childhood or adolescent depression that conveys specific risk for their children. Depression that begins early in life tends to have a chronic and severe course (Harrington, Fudge, Rutter, Pickles, & Hill, 1990; Kovacs et al., 1984; Newman et al., 1996; Weissman et al., 1999), and when parents have had an early age of onset, depression in offspring has an early age of depression onset and high severity (Bland et al., 1986; Kupfer et al., 1989; Moldin et al., 1991; Price et al., 1987; Weissman et al., 1987). The infants of parents with early-onset depression thus could have a fundamental diathesis toward internalizing behavior problems. Parent depression might exert an influence on infant affect through genetic (see Moldin et al., 1991, for a review), behavioral, and neuroendocrine avenues, and future research should address the mechanisms associated with each of these.

A qualification of the depression effect is that infants with a parent history of depression were less likely to display positive affect only during mother-infant interaction. The number of fathers with a history of depression was relatively low in our sample ($n = 9$), and fathers were less positive overall. A larger effect for depression may be required for differences in father-infant interaction to be evident. The depression-by-parent interaction may also be related to the higher prevalence of depression in women than in men. The issue of paternal depression should receive more attention in future studies of infant socioemotional development.

The depression effects we found disappeared by infant age 6 months, which suggests that the influence of parent depression on infant socioemotional development may be limited to early infancy and may not have far-reaching consequences for infants' behavior, barring renewed clinically significant levels of depression later in childhood. Because our finding on depression was limited to age 3 months, we caution against overemphasizing

differences associated with a history of depression in either parent.

Our longitudinal design allowed us to examine the prospective importance of depression prior to parenthood, but a drawback of our sample was that the rates of current depression were too low to allow an evaluation of the importance of current depression in relation to previous depression. Future family studies of depression and affect would be enhanced by including comparisons of three types of families: those in which a parent has a history of depression and is currently *in* a depressive episode; those in which a parent has a history of depression but is currently *out* of episode; and those in which a parent is currently in episode but has *no prior history* of depression.

With a lack of infant sex effects, our findings stand in contrast to findings on parents' affect with boys and girls and on differences between boys' and girls' affect. Mothers are reported to express more positive affect with girls than with boys during early (Malatesta & Haviland, 1982) and late (Malatesta et al., 1989) infancy. Findings on sex differences in infants are more equivocal, with reports of boys expressing more positive and negative affect than girls (Weinberg, Tronick, Cohn, & Olson, 1999), less negative affect than girls (Malatesta, Grigoryev, Lamb, Albin, & Culver, 1986), or positive and negative affect in similar amounts as girls express (Belsky et al., 1984). At least through 6 months of age, differences between male and female infants appear to be unstable.

A limitation of the present study is the ethnic, socioeconomic, and family structure composition of the sample. The study used a population-based sample, and its findings are generalizable to that population but possibly not to the populations of other regions. In the interest of understanding a broad range of families, we emphasize the importance of including diverse samples in future research on infant development within families.

In all, the present study represents a step toward understanding the role of fathers in parent-infant affect and the influence of parent depression on infants' affect. Behavioral differences between mothers and fathers were reflected in infants' affect, and there was a

differential influence of depression in mother-infant and father-infant dyads. Parents' affect and history of depression could thus be a basis for distinctive within-family differences. In keeping with models of fathers' role in infant development (e.g., Fitzgerald et al., 1999) and models of parent depression and developmental psychopathology (e.g., Cummings, Davies, & Campbell, 2000) our findings underscore the importance of including fathers and other caregivers and considering the role of parents' history of psychopathology in research on infant socioemotional development.

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