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EFFECTS OF MATERNAL DEPRESSION AND PANIC DISORDER ON MOTHER–INFANT INTERACTIVE BEHAVIOR IN THE FACE- TO-FACE STILL-FACE PARADIGM

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Abstract

The present study evaluated the interactive behavior of three groups of mothers and their 3-month-old infants in the Face-to-Face Still-Face paradigm. The mothers had either a clinical diagnosis of major depressive disorder (MDD, $n = 33$) with no comorbidity, a clinical diagnosis of panic disorder (PD, $n = 13$) with no comorbidity, or no clinical diagnosis ($n = 48$). The sample was selected to be at otherwise low social and medical risk, and all mothers with PD or MDD were in treatment. The findings indicated that (a) infants of mothers with PD or MDD displayed the traditional still-face and reunion effects described in previous research with nonclinical samples; (b) the 3-month-old infants in this study showed similar, but not identical, gender effects to those described for older infants; and (c) there were no patterns of maternal or infant interactive behavior that were unique to the PD, MDD, or control groups. These results are discussed in light of mothers' risk status, receipt of treatment, severity of illness, and comorbidity of PD and MDD.

Depression is a common psychological condition among women with young children, with a prevalence rate between 8 to 20% depending on how it is measured (American Psychiatric Association, 1994; Beeghly et al., 2003; Beeghly et al., 2002; Coiro, 2001; Horwitz, Briggs-Gowan, Storfer-Isser, & Carter, 2007; O'Hara, Zekoski, Phillips, & Wright, 1990). Panic disorder, which has received much less attention in the developmental psychology literature, affects between 2 to 5% of the general population (Sheehan, 1982) and has a lifetime prevalence of between 1.5 and 3.5% (American Psychiatric Association, 1994). Consequently, a large number of children are exposed to parental depression or panic disorder, which may place a significant number of these children at risk for interactive and psychological difficulties.

Several studies have documented that maternal depression has a detrimental effect on maternal and infant socioemotional behavior (Downey & Coyne, 1990; Field, 1995; NICHD Early Child Care Research Network, 1999; Paulson, Dauber, & Leiferman, 2006; Tronick & Weinberg, 1997). Maternal depression compromises mothers' ability to respond to infant

signals and to facilitate interactions with their young infants (Bettes, 1988; Cohn & Tronick, 1989; Kaplan, Bachorowski, & Zarlengo-Strouse, 1999; Malphurs et al., 1996; Murray & Cooper, 1997; Murray, Kempton, Woolgar, & Hooper, 1993). In turn, infants of depressed mothers have difficulties engaging in sustained social and object engagement and show less ability to regulate affective states than do infants of nondepressed mothers (Campbell, Cohn, & Meyers, 1995; Cohn & Tronick, 1989; Hart, Field, Del Valle, & Pelaez-Nogueras, 1998; Murray & Cooper, 1997; Pickens & Field, 1993). As a dyad, depressed mothers and their infants share negative behavior states more often and positive behavior states less often than nondepressed mothers and their infants (Field, Healy, Goldstein, & Guthertz, 1990). These effects of depression appear most pronounced if the mothers' illness is severe and chronic (Teti, Gelfand, Messinger, & Isabella, 1995), if the infant is male (Murray et al., 1993; Tronick & Weinberg, 2000) or biologically at risk (Feldman & Eidelman, 2007), or if the mother is from an economically disadvantaged background (Beeghly et al., 2003; Lovejoy, Graczyk, O'Hare, & Neuman, 2000; Siefert, Bowman, Heflin, Danzinger, & Williams, 2000). When few risk factors are present, the compromising effects of maternal depression are minimized or absent altogether (Campbell & Cohn, 1997; Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001; Lovejoy et al., 2000).

Compared to the literature on maternal depression, descriptions of the interactive behavior of mothers with panic disorder and their infants are sparse. Most of the research on maternal panic disorder has focused on the positive association between parental panic disorder and child behavioral inhibition (Biederman et al., 1990; Rosenbaum et al., 1988). Only one study, to our knowledge, has observed mothers with panic disorder and their young infants in social interaction. Warren et al. (2003) found that maternal panic disorder was not related to infant behavior at 4 and 8 months, but reported that mothers with panic disorder displayed less sensitivity to their infants than did control mothers during videotaped home observations. This finding is consistent with the observation of Whaley, Pinto, and Sigman (1999) that clinically anxious mothers are less warm and positive and less granting of autonomy during interaction with their school-aged children than are mothers who are not anxious.

The Face-to-Face Still-Face paradigm (FFSF) offers an opportunity to observe the interactions of mothers who are depressed or suffer from panic disorder and their infants. The FFSF has been used extensively to evaluate the interactive behavior of mothers and young infants and the infants' ability to cope with an interactive perturbation (Adamson & Frick, 2003). The FFSF confronts the young infant with three interactive contexts: (a) a face-to-face social interaction with a caregiver (typically the mother) during which the caregiver is asked to play with the infant; followed by (b) a still-face during which the caregiver is instructed to keep an unresponsive poker face and not smile, touch, or talk to the baby; followed by (c) a reunion episode during which the caregiver and infant resume face-to-face social interaction. Infants typically respond to the still-face with what has come to be called the "still-face effect" (Adamson & Frick, 2003). In study after study, infants respond with a signature decrease in positive affect and an increase in gaze aversion and negative affect (Stack & Muir, 1990; Toda & Fogel, 1993; Weinberg & Tronick, 1996). Infants also demonstrate a "reunion effect" when the mothers resume normal behavior in the play episode following the still-face (Kogan & Carter, 1996; Rosenblum, Mc-Donough, Muzik, Miller, & Sameroff, 2002; Weinberg & Tronick, 1996). During this reunion episode, infants typically remain affectively negative, continue to avert their gaze, and to focus on objects while positive affect returns close to baseline levels (at least in infants 6 months or older).

No study to date has evaluated mothers with panic disorder and their infants in the FFSF, and it is therefore unclear whether these infants respond to the FFSF in the same manner as infants in nonclinical samples; however, some information is available on depressed mothers

and their infants in the FFSF. This research has indicated that infants of depressed mothers demonstrate both the still-face and reunion effects that have been documented in infants of nondepressed mothers (Pelaez-Nogueras, Field, Hossain, & Pickens, 1996; Rosenblum et al., 2002; Weinberg, Olson, Beeghly, & Tronick, 2006). These studies looked at mothers with high levels of depressive symptoms as opposed to mothers with a clinical diagnosis of depression. At this point, it remains unclear whether subclinical levels of depression and a clinical diagnosis of depression have the same effects on maternal and infant interactive behavior (Campbell & Cohn, 1997; Weinberg et al., 2001).

Gender differences have been found in young infants' reactions both to the still-face and the reunion episode, although results are somewhat inconsistent. Weinberg, Tronick, Cohn, and Olson (1999) observed that 6-month-old male infants had more difficulty than did female infants in maintaining affective regulation in the FFSF. Boys also were more socially oriented than girls and more likely than girls to look at the mother, smile, and vocalize. Girls, on the other hand, spent substantially more time exploring objects and showing facial expressions of interest. Weinberg et al. (1999) hypothesized that boys and girls use different types of self-regulatory strategies. Whereas female infants use object exploration as a form of regulation, male infants need more regulatory support from a caregiver. In a sample of mothers with a clinical diagnosis of depression, Tronick and Weinberg (2000) further found greater mother-son than mother-daughter interactive compromises. Depressed mothers showed significantly more anger to their 6-month-old sons than daughters, and their male infants expressed less positive affect and self-comforting behavior than did their female infants. This greater compromise in the male infants of depressed mothers also was observed by Carter et al. (2001) and Murray et al. (1993). Since infants with mothers who have panic disorder have not been observed in the FFSF, it is unclear whether the male infants of these mothers will display similar interactive compromises as the male infants of depressed mothers. Also unclear is whether infants as young as 3 months will show the same gender differences in the FFSF as do older infants.

Although depression and panic disorder are highly comorbid (Andrade, Eaton, & Chilcoat, 1994; Matthey, Barnett, Howie, & Kavanagh, 2003), there is some evidence that these disorders may have different effects on young children. Some data have suggested specificity of transmission for panic disorder in family studies (Crowe, Noyes, Pauls, & Slymen, 1983). Biederman et al. (2001) further found that parental major depression was associated with an increased risk for major depression in the offspring regardless of parental panic disorder, suggesting that there may be separate familial vulnerabilities for panic disorder and major depression. Rosenbaum et al. (1988) also reported differential rates of behavioral inhibition in four groups of children. Behavioral inhibition occurred in 85% of the children of parents with panic disorder with or without agoraphobia, 70% of the children with comorbid depression and panic disorder with or without agoraphobia, 50% of the children of parents with depression, and 15% of the children whose parents had neither panic disorder nor depression. In a later study, however, Rosenbaum et al. (2000) found that the comorbidity of panic disorder and major depression accounted for most of the association between parental panic disorder and child behavioral inhibition.

No study to date has evaluated specificity in socioemotional and interactive behavior of mothers with depression or panic disorder and their infants. It is unclear whether specificity would even occur since panic disorder and depression may share a common underlying diathesis (Breier, Charney, & Heninger, 1985; Rosenbaum et al., 1988; Rosenbaum et al., 2000). It also is possible that the mother's diagnostic status is not as important as what the mother actually does with the infant. Whaley et al. (1999) found that maternal interactive behavior rather than diagnostic status was the stronger predictor of child anxiety. Cohn and Tronick (1989) identified different infant interactive profiles depending on the mother's

behavior with the infant even though the mothers had similar levels of depressive symptomatology. Neither the Whaley et al. study nor the Cohn and Tronick study, however, evaluated issues of specificity of disorder or included different psychiatric contrast groups.

The present study evaluated the interactive behavior of three groups of mothers and their 3-month-old infants in the FFSF. The mothers had either a pregravid clinical diagnosis of major depressive disorder (MDD) with no comorbidity, a pregravid clinical diagnosis of panic disorder (PD) with no comorbidity, or no clinical diagnosis (control group). The study addressed three questions: (a) Do infants in the MDD and PD groups show the traditional still-face and reunion effects in the FFSF described in previous research with nonclinical samples? (b) Do the 3-month-old infants in this study show similar gender effects to those that have been described for older infants in the FFSF? (c) Are there differences in maternal and infant interactive behavior among the MDD, PD, and control groups? Does diagnostic specificity vary as a function of gender or FFSF episode? Because the number of mothers and infants in the panic group was small, findings regarding specificity must be considered preliminary.

METHODS

Participants

The 94 mother–infant dyads who participated in this study were divided into three groups. Thirty-three (14 boys, 19 girls) mothers had a pregravid clinical diagnosis of major depressive disorder (MDD group) and no comorbidity, 13 (6 boys, 7 girls) mothers had a pregravid clinical diagnosis of panic disorder (PD group) and no comorbidity, and 48 (24 boys, 24 girls) mothers had no clinical diagnosis (control group). Mothers in the MDD and PD groups were referred to the study from the Perinatal Psychiatry Clinical Research Program at Massachusetts General Hospital, where they were receiving treatment. They were diagnosed using the Structured Clinical Interview for DSM-III-R Axis I Disorders (SCID; Spitzer, Williams, & Gibbon, 1988; Spitzer, Williams, Gibbon, & First, 1992) by the clinical staff of the hospital. The majority of these mothers were treated with psychotropic medications, the most common of which were clonazepam, tricyclic antidepressants (i.e., nortriptyline, desipramine, and imipramine), and fluoxetine. Sixty-eight percent of the mothers were maintained on medication during some part of their pregnancy. During the postpartum period, 48% of the mothers were treated with psychotropic medication, and an additional 40% with both psychotropic medication and therapy. Mothers were told about the study by the clinic staff and gave written permission to be contacted by the research staff working on this study.

The control group consisted of a community sample of mothers. These mothers were recruited from the maternity wards of two metropolitan Boston-area hospitals. The mothers in the control group had no clinical diagnosis on the Diagnostic Interview Schedule-Version-III-R (DIS-III-R; Robins, Cotter, & Keating, 1991). A complete description of the recruitment procedures is provided in Weinberg et al. (2001).

Mothers and infants in the three groups met a set of low-risk social and medical criteria to control for confounding variables (e.g., teen parenting, premature birth) known to affect maternal and infant behavior. Mothers were 21 to 40 years of age ($M = 34$ years, $SD = 3$ years), healthy with no serious medical conditions, married or living with the infant's father, and had at least a high-school-level education ($M = 16$ years of education, $SD = 2$ years). Families ranged in socioeconomic status from working class to upper middle class (mean Hollingshead Four Factor Index of Socioeconomic Status = 56.85, $SD = 7.70$; Hollingshead, 1979). Although mother–infant dyads were recruited regardless of race or ethnic background, the majority were Caucasian. The infants also met low-risk inclusion criteria.

All infants were full term, healthy, and clinically normal at delivery as determined by pediatric examination (mean birth weight = 7.7 lb, $SD = .94$; M gestational weeks = 39.43, $SD = 1.47$). Analyses comparing the three groups revealed no significant differences on any maternal or infant sociodemographic or medical variables.

Laboratory Procedures

Mothers and infants were videotaped in the FFSF when the infants were 3 months of age (Tronick, 2007; Tronick, Als, Adamson, Wise, & Brazelton, 1978). The FFSF consisted of three successive episodes: a 2-min face-to-face normal interaction during which the mother was instructed to play with the infant, followed by a 2-min still-face interaction during which the mother was instructed to look at the infant while keeping a still (i.e., “poker”) face and not to smile, talk, or touch the infant, and a second 2-min normal reunion interaction during which the mother was again free to play, talk, and touch the infant. Each episode was separated by 15-s intervals during which the mother turned her back to the infant. The Institutional Review Board at Children’s Hospital, Boston, approved all study procedures, and all mothers provided written informed consent prior to participating.

The observational room was equipped with an infant seat mounted on a table, an adjustable swivel stool for the mother, two cameras (one focused on the infant, the other on the mother), a microphone, and an intercom via which mothers were given procedural instructions. The signals from the two cameras (one focused on the adult, the other on the infant) were transmitted through a digital timer and split-screen generator into a video recorder to produce a single image with a simultaneous frontal view of the adult’s face, hands, and torso and the infant’s entire body. To facilitate later coding, the videotapes were initialized with computer-readable time code (SEMPTE).

Coding of Data

All coders were masked to maternal-group status and the hypotheses of the study. The infants’ direction of gaze and vocalizations were coded microanalytically second-by-second from video-tapes using the Infant Regulatory Scoring System (IRSS; Tronick & Weinberg, 1990a; Weinberg et al., 1999). The gaze codes were mutually exclusive and included looks at mother’s face, looks at objects, and avert/scans. Looking at objects was coded if the infant looked at an object for 2 s or more. This coding criterion was used to distinguish between sustained object engagement and scanning of the environment, which was defined as looking at an object for less than 2 s. Because mothers were instructed not to use toys or pacifying objects during the FFSF, the code of “look at objects” referred to the infant looking at things inherent to the face-to-face setting (e.g., infant chair or strap, or infant’s or mother’s clothing). The vocalization codes, also mutually exclusive, included neutral/positive, fussy, and crying vocalizations.

The mothers’ direction of gaze and eliciting behavior (e.g., repositioning self in infant’s line of vision, waving, clapping or snapping fingers, and blowing on infant) were coded microanalytically second-by-second with the Maternal Regulatory Scoring System (MRSS; Tronick & Weinberg, 1990b; Weinberg et al., 1999). The gaze codes were mutually exclusive and included looks at the infant, looks at objects, and avert/scans. Look at infant was coded when the mother looked at the baby’s face. Look at object was coded when the mother looked at the same object the infant was looking at. Avert was coded when the mother did not look at the infant or at the same object the infant was looking at.

Infants’ and mothers’ facial expressions were coded second-by-second from videotapes using Izard and Dougherty’s (1980) AFFEX system, which identifies 10 facial expressions (i.e., joy, interest, sadness, anger, surprise, contempt, fear, shame/shyness/guilt, distress, and

disgust) as well as blends of facial expressions. Coders were trained with Izard and Dougherty's training tapes and manuals, and coded the infants' and mothers' AFFEX facial expressions independently of the IRSS and MRSS codes.

A digital time display was used to track time intervals. This produced an absolute frequency count of the behaviors and facial expressions, and maintained their temporal sequence to within a 1-s interval. Each coder used the same onset time for starting the coding of each episode of the FFSF. Tapes were run at normal speed although they were frequently stopped or run in slow motion to accurately determine the beginning and end of shifts in infant and maternal behavior or facial expressions.

To assess interobserver reliability, 20% of the first play, still-face, and reunion play episodes were selected randomly and recoded independently by different coders. Mean kappas (Cicchetti & Feinstein, 1990; Cohen, 1960) for infant AFFEX facial expressions, IRSS gaze, and IRSS vocalizations were .76, .83, and .79, respectively. Mean kappas for MRSS gaze and the adult AFFEX codes were .78 and .82, respectively. These kappas are similar to those reported in previous studies using microanalytic scoring methods (Toda & Fogel, 1993; Weinberg et al., 1999). For maternal elicits, which were not mutually exclusive or continuously coded, percent agreement was calculated. Percent agreement was 93% for clapping and snapping fingers, 87% for waving, 85% for repositioning self in infant's line of vision, and 77% for blowing on infant.

Data Reduction and Creation of Composite Variables

Infant and Maternal Affective-Behavioral Regulation Variables—Following Tronick and Cohn (1989) and Weinberg et al. (1999), the AFFEX, IRSS, and MRSS data were converted into monadic phases using the same set of rules and procedures described in detail in Weinberg et al. (1999). For both the mother and the infant, AFFEX codes were first combined to form three larger categories: positive affect (facial expressions of joy, surprise, and blends involving joy or surprise), interest (facial expressions of interest), and negative affect (facial expressions of sadness, anger, shame, fear, disgust, distress, contempt, and blends involving these affect expressions). Note that for both the infant and the mother, the facial expressions of surprise, fear, disgust, distress, and contempt either did not occur or occurred less than 1% of the time. If they did occur, they were included in the larger categories, as described earlier, because they were needed in the time-series analysis evaluating synchrony.

The IRSS, MRSS, and larger AFFEX categories were then combined to form five phases. For the infant, the phases included: *avert* (looks away from mother + any affect), *object attend* (looks at object + interest), *object play* (looks at object + positive affect), *social attend* (looks at mother + interest), and *social play* (looks at mother + positive affect). For the mother, the same five phases were created using the MRSS gaze and AFFEX codes. Thus, *avert* consisted of the mother looking away from the infant with any affect, *object attend* consisted of the mother looking at an object with expressions of interest, *object play* consisted of the mother looking at an object with positive affect, *social attend* consisted of the mother looking at the infant with expressions of interest, and *social play* consisted of the mother looking at the infant with positive affect.

Mother-Infant Mutual Regulation Variables—Following Tronick and Cohn (1989) and Weinberg et al. (1999), two measures of mutual regulation were assessed in this study: *matching* and *synchrony*.

Matching was defined as the extent to which mothers and infants shared joint states at the same moment in time. An *overall match* required that both infant and mother be in the same

one of the five phases at the same point in time. An *avert match* required both mother and infant to simultaneously be in the avert phase. *Object match* required that both mother and baby simultaneously be in either object attend or object play, and *social match* required that both be in either social attend or social play at the same point in time. Affect matching also was evaluated. Thus, a *positive affect match* involved both partners showing positive affect at the same time; an *interest affect match* involved both simultaneously showing interest, and a *negative affect match* indicated that both mother and infant displayed negative affect at the same time. The percentage of time in matched states for each match variable was used in the analyses to account for missing data and differences in the base rates of the different types of matches.

Synchrony was defined as the extent to which mothers and infants changed their affective behavior in temporal coordination with respect to the other. In preparation for the synchrony analyses, maternal AFFEX and MRSS (gaze and eliciting codes) data and infant AFFEX and IRSS data combinations were scaled from 1 to 8 on the same engagement dimension used by Weinberg et al. (1999), with a score of 1 representing maximum negative engagement and a score of 8 representing maximum positive engagement. To deal with missing data, a replacement strategy was used which involved joining the data points before and after the missing data point and rounding the value at the missing data point to the nearest integer. Synchrony was defined as the proportion of shared variance at Lag 0, as indexed by the cross-correlation between each mother's and infant's time series.

Analytic Plan

An analysis of variance (ANOVA) model was used to assess the three questions of the study. The infant data were analyzed using a 3 (episode: play 1, still-face, and reunion play) $\times$ 2 (gender) $\times$ 3 (group: control, MDD, and PD) repeated measures ANOVA, with episodes as the repeated measure. The maternal and dyadic (matching and synchrony) variables were analyzed using a 2 (play 1 and reunion play) $\times$ 2 (gender) $\times$ 3 (group: control, MDD, and PD) repeated measures ANOVA, with episode as the repeated measure. The still-face episode was excluded from the maternal and dyadic analyses since all mothers in that episode had been instructed to act in the same manner. The dependent variables were the adjusted proportion of time the infants and the mothers were in each engagement phase, affect, or matching state during the videotaped interaction. Proportions were calculated by dividing the total time each phase, affect, or matching state occurred by the number of seconds during the episode for which there was valid, nonmissing data. For the synchrony data, the cross-correlation between each mother's and infant's time series was analyzed. Simple effect tests were used to interpret significant two-way interactions. Significant three-way interactions were evaluated using Tukey Kramer post hoc tests. Effect size was calculated using ω^2 or Cohen's *d*.

RESULTS

Do Infants and Mothers in the MDD and PD Groups Show the Traditional Still-Face and Reunion Effects?

Regardless of group membership and gender, the infants displayed the traditional still-face effect. As can be seen in Table 1, main effects for episode indicated that the infants had a significant decrease in positive affect and significant increases in negative affect and interest in response to the still-face. The infants also averted more from the mother, paid more attention to objects, and decreased in social and object play during the still-face as compared to the first episode (see Table 2).

The infants also displayed the traditional reunion effect observed in previous studies (see Tables 1 and 2). The negative affect generated by the still-face did not abate in the reunion play. In addition, the infants' positive affect was significantly lower in the reunion play than in the first play. Furthermore, the infants continued to avert from the mother significantly more in the reunion play and engage in proportionately less social play with the mother in the reunion play as compared to the first play. The levels of object attend and object play returned to the levels observed during the first play episode.

Regardless of group membership and the gender of their infant, mothers also displayed a "reunion effect." The mothers showed a significant decrease in positive affect and significant increases in negative affect and interest relative from the first play to the reunion play (see Table 1). They also were significantly more likely to avert from their infant, more likely to socially monitor or attend to the infant, and less likely to engage in social play during the reunion play than during the first play (see Table 2).

The matching data reflected the effects of the still-face. As can be seen in Table 3, overall behavioral matching was more frequent during the first play than during the more stressful reunion play. During the reunion play, dyads were more likely to engage in avert matches and less likely to engage in social matches than during the first play. Furthermore, they were significantly more likely to match negative affective states and significantly less likely to match positive affective states in the reunion play as compared to the first play.

Do the 3-Month-Old Infants in This Study Show Similar Gender Effects to Those That Have Been Observed in Older Infants?

Main effects for gender indicated that boys were significantly more likely than girls to show positive affect, boys: $M = 23.76$, $SD = 21.65$; girls: $M = 18.60$, $SD = 19.43$; $F(df = 1, 88) = 4.22$, $p < .05$; $d = .25$, and to engage in social play with the mother, boys: $M = 24.30$, $SD = 21.83$; girls: $M = 18.32$, $SD = 19.16$; $F(df = 1, 88) = 6.00$, $p < .05$; $d = .29$, during the episodes of the FFSF. Mother-son dyads also were significantly more likely to engage in overall matching than were mother-daughter dyads, boys: $M = 30.69$, $SD = 19.57$; girls: $M = 25.98$, $SD = 17.69$; $F(df = 1, 88) = 7.92$, $p < .01$; $d = .25$, and to match positive affective states, boys: $M = 20.23$, $SD = 17.39$; girls: $M = 15.30$, $SD = 13.72$; $F(df = 1, 88) = 4.05$, $p < .05$; $d = .28$. There were no significant differences by gender for negative affect or negative affect matching.

Mothers of girls were significantly more likely than were mothers of boys to attend to objects, boys: $M = 0.55$, $SD = 1.15$; girls: $M = 1.71$, $SD = 3.17$; $F(df = 1, 88) = 7.13$, $p < .01$; $d = .48$, and to play with objects, boys: $M = 1.06$, $SD = 1.97$; girls: $M = 2.27$, $SD = 3.24$; $F(df = 1, 88) = 6.59$, $p < .05$; $d = .57$, with their infants during the episodes of the FFSF. Furthermore, mother-daughter dyads were significantly more likely to engage in object matches than were mother-son dyads, boys: $M = 1.26$, $SD = 2.35$; girls: $M = 3.16$, $SD = 4.27$; $F(df = 1, 88) = 7.51$, $p < .01$; $d = .35$.

There were no significant Gender $\times$ Episode interaction effects.

Are There Differences in Interactive Behavior by Diagnostic Group? Does Specificity of Diagnosis Vary by Gender or Episode?

There were no significant main effects for diagnostic group or Group $\times$ Episode interaction effects. However, there were several significant Diagnostic Group $\times$ Gender interactions and one significant three-way interaction. These interactions indicated that control mothers of girls ($M = 29.60$, $SD = 17.82$) showed more interest during the FFSF than did MDD or PD mothers of girls, MDD: $M = 15.80$, $SD = 11.27$; PD: $M = 18.67$, $SD = 12.87$, whereas there was no difference on this variable for mothers of boys, $F(df = 2, 88) = 4.87$, $p < .01$, $\omega^2 = .$

08. Control dyads with female infants, $M = 17.68$, $SD = 14.11$, also matched more interest expressions than did control dyads with male infants, $M = 9.70$, $SD = 7.91$; $F(df = 2, 88) = 3.15$, $p < .05$, $\omega^2 = .05$, but this finding was qualified by a significant three-way interaction, $F(df = 2, 88) = 4.39$, $p < .05$, $\omega^2 = .07$. Examination of the means indicated that in the PD group, matching of interest expressions was most common in mother–son dyads in the first play and least frequent in mother–daughter dyads in the first play.

DISCUSSION

The first question of this study evaluated whether infants in the MDD and PD groups would show the traditional still-face and reunion effects observed in numerous studies with nonclinical samples. No study to date has evaluated the reactions of mothers with panic disorder and their infants to the still-face. There is more information on depressed mothers and their infants in the FFSF (Pelaez-Nogueras et al., 1996; Rosenblum et al., 2002), but these studies focused on mothers with depressive symptoms as opposed to mothers with a clinical diagnosis of major depression.

The data indicate that the infants in both the PD and MDD groups showed the “still-face effect.” The infants in the study, regardless of diagnostic group membership or gender, responded in much the same way to the still-face as have infants in numerous studies with nonclinical samples (Adamson & Frick, 2003). The infants reacted to the still-face with the signature decrease in positive affect and increase in gaze aversion and negative affect. In addition, they engaged in less social and object play during the still-face.

The infants in the PD, MDD, and control groups also showed the “reunion effect.” The negative affect generated by the still-face did not abate in the reunion play, and the infants continued to show high levels of avert. Although positive affect and social play rebounded from the still-face to the reunion, the levels of positive affect and social play were significantly lower in the reunion than those in the first play. Furthermore, mothers and babies in all three groups were more likely to match negative affective states and to engage in avert matching, and were less likely to match positive affective states and engage in social matching during the reunion play than they were in the first play. These findings replicate the previously observed carryover effect of negative affect from the still-face into the reunion episode (Adamson & Frick, 2003; Kogan & Carter, 1996; Stoller & Field, 1982; Weinberg & Tronick, 1996) and are consistent with our interpretation that infants are stressed by the reunion play and that this stress interferes with their ability to engage in positive social interactions (Weinberg & Tronick, 1996). The reunion play findings indicate that this episode provides a unique opportunity to observe infants’ attempts to renegotiate their typical interaction and to cope with negative intra- and interpersonal states in the aftermath of the still-face.

The data indicate that the still-face and reunion effects were robust in both clinical groups and in the control group. This suggests that the infants’ capacity to detect, process, and respond to variations in maternal interactive behavior was not compromised by having a mother with MDD or PD, at least at 3 months of age. It also suggests that the still-face and reunion effects may be general characteristics of infants’ reactions to the still-face paradigm that are not disrupted by conditions such as MDD or PD. In addition, the data indicate that the infants in this study whose mothers had a clinical diagnosis of MDD responded to the still-face similarly to the infants whose mothers had high levels of depressive symptoms, but no clinical diagnosis. Both Rosenblum et al. (2002) and Weinberg et al. (2006) found practically identical reactions to the still-face in their studies of infants of mothers with high levels of depressive symptoms. This is consistent with the findings from a recent meta-analysis of depression studies, which found that studies using either diagnostic interviews or

self-report measures yield similar effects (Lovejoy et al., 2000). Taken together, this study's findings and data from other samples (e.g., cocaine-exposed infants, premature infants) suggest that the still-face effect is a robust phenomenon that occurs regardless of maternal psychiatric status, symptom level, or other risk condition. This ubiquitous effect suggests that the still-face is tapping into a very basic interactive, intersubjective phenomenon.

Although the assumption in the FFSF literature is that mothers resume their usual behavior during the reunion play, mothers in this study, regardless of their diagnostic status and the gender of their infant, demonstrated a "reunion effect." Mothers showed a significant decrease in positive affect and significant increases in negative affect and interest from the first play to the reunion play. They also were more likely to avert from the infant and to simply monitor the infant's activities during the reunion play than during the first play.

The data do not indicate why this maternal reunion effect occurred. Research is needed to understand how mothers with different diagnostic histories perceive and experience the still-face. A qualitative study designed to elicit mothers' subjective experience of the still-face may provide a fascinating glimpse into mothers' representations of the meaning of this interactive perturbation and their ability to cope with stress in the mother-child relationship. Mayes, Carter, Egger, and Pajer (1991) found that mothers who felt uncomfortable during the still-face returned to the interaction with more soothing comments; however, it is unclear if the mothers' reactions were based on their infant's behavior (e.g., mothers responded to their infant's increased negativity and decreased positivity), on the mothers' representations of parenting (e.g., the mother felt she was a bad mother because she did not respond to the baby during the still-face), or on the mother's past or psychiatric history (e.g., posing the still-face made the mother feel depressed or elicited feelings of abandonment by her own mother).

The gender differences observed in the FFSF in this study of 3-month-old infants were similar, but not identical, to those observed in a normal sample of 6-month-old infants (Weinberg et al., 1999). Contrary to what had been expected, boys did not show more negative affect than girls in the FFSF, which may have been a developmental effect or reflect something particular to this cohort of infants. However, the other gender findings were consistent with prior work. Regardless of group membership, infant boys were more likely than were girls to show positive affect and to engage in social play with the mother. In addition, mother-son dyads were more likely than were mother-daughter dyads to match positive affective states and to engage in more overall matching. Mothers and daughters, on the other hand, were more focused on interactions involving some kind of object engagement and were more likely than were mothers and sons to match object focused states. These data replicate the findings reported in previous research by Malatesta and Haviland (1982), Tronick and Cohn (1989), and Weinberg et al. (1999) and add to a growing literature suggesting that mothers and sons and mothers and daughters establish different forms of mutual responsiveness. The data also may indicate that there are general features of gender organization in the FFSF that are not disrupted or obscured by maternal psychopathology.

There were no significant diagnostic group effects. Prior research has found compromises in depressed mothers' and infants' interactive behavior (Kaplan et al., 1999; Malphurs et al., 1996; Pickens & Field, 1993). There also is some indication that mothers with PD are less sensitive towards their infants (Warren et al., 2003). Many of the depression studies, however, focused on high-risk samples. Recent work has suggested that the effects of maternal depression are minimized in samples at low social and medical risk. Carter et al. (2001) found no effects of maternal depression on mothers' and infants' interactive behavior in a low-risk sample similar in nature to this sample. Campbell and Cohn (1997) reported no

differences in infants of depressed and nondepressed mothers when depression was the only risk factor present. In a recent meta-analysis of 46 studies on maternal depression, Lovejoy et al. (2000) found no effects of depression on positive parenting behavior (e.g., praise or affection) unless the women also were economically disadvantaged. Thus, cumulative risk is a crucial factor to consider in the research on mothers with affective disorders (Sameroff, Seifer, Baldwin, & Baldwin, 1993). When maternal depression is the sole risk factor, the children may be protected from harm by a host of compensatory factors such as an intact home, financial security, or a nondepressed father; however, when maternal depression is combined with other risk factors, the risk to the mother–child dyad is amplified.

The mothers in this study also were in treatment, which might have significantly mitigated the effects of the mother's illness on the mother's and baby's functioning, blunted differences between the MDD and PD groups, and resulted in the MDD and PD mothers looking similar to controls. Thus, despite a diagnosis of MDD or PD, these mothers in treatment and their infants did not differ from controls. This finding points to treatment as a potential protective factor and suggests future studies which compare treated and untreated groups.

Treatment effects may explain the inconsistency in findings between this study and a previous study by Tronick and Weinberg (2000), who found compromises in mother–infant interactions in a low-risk sample of clinically depressed mothers, particularly in dyads involving a male infant. The mothers in Tronick and Weinberg's 2000 study were drawn from the community and were generally not in treatment. Data on the effects of treatment of postpartum depression on the mother–infant relationship, however, are inconclusive and complex. For example, Weinberg and Tronick (1998) studied a small mixed sample of mothers with a diagnosis of MDD, PD, or obsessive compulsive disorder who were in treatment and found that although the mothers reported feeling well, their interactions with their infants remained compromised. Weinberg and Tronick concluded that in this sample, the infant was the forgotten patient and that a mother–baby focus may have been needed to effect change in the mother–child relationship (also see Forman, O'Hara, & Stuart, 2007; Nysten, Moran, & Franklin, 2006). However, in a study contrasting several treatment approaches of postpartum depression, Cooper and Murray (1997) found that even treatment approaches that included a focus on the mother–child dyad failed to have an effect on the quality of the mother–child relationship. The reasons for this were unclear since postpartum depression is an illness that affects everyone in the family. Recently, several interventions that hold much promise have begun to address the needs of not only the depressed parent but also the needs of the children and the family as a whole as part of the therapeutic process (Beardslee et al., 1997; Clark, Keller, Fedderly, & Paulson, 1993). Family treatment may promote more optimal child development than would treatment approaches that focus solely on improving the mother's symptomatology.

The data on the specificity of disorder were unclear. Due to the small sample size of the PD group, these results must be considered preliminary and are in need of replication with larger samples. Contrary to our expectations, there were no main effects of diagnostic status; however, significant interactions with gender and group were found that revealed some differences primarily in the domains of interest expression with female infants. These interactions indicated that control mothers of girls showed more interest during the FFSF than did MDD or PD mothers of girls whereas there was no difference on this variable for mothers of boys. Control dyads with female infants also matched more interest expressions than did the control dyads with male infants. These data appear consistent with the gender findings reported in previous studies indicating a greater frequency of interest expressions in mother–daughter than in mother–son dyads and a greater social focus in mother–son than in mother–daughter dyads (Malatesta & Haviland, 1982; Weinberg et al., 1999). However, a

three-way interaction also indicated that in the PD group, matching of interest expressions were most common in mother–son dyads in the first play and least frequent in mother–daughter dyads in the first play. An explanation for this gender reversal in the frequency of interest is unclear.

While it is likely that the small sample size of mothers with PD precluded finding significant differences, it also may be that it is not the mother's diagnosis, per se, that matters but what the mother actually does with the infant that is important. Whaley et al. (1999) found that maternal interactive behavior rather than diagnostic status was the most salient predictor of child anxiety. Cohn and Tronick (1989) found specificity in the interactive behavior of mothers with equivalent levels of depressive symptoms and their infants. From this perspective, differences in the infants' behavior in this study should perhaps not have been expected since there were no significant differences in the MDD, PD, and control mothers' affect and behavior.

It also is possible that MDD and PD are disorders that fall on the same spectrum (Andrade et al., 1994) and share etiological factors (Rosenbaum et al., 2000), making it unlikely that researchers will identify differential effects unique to each disorder. This perspective is supported by the fact that MDD and PD are highly comorbid and that the pattern of symptoms in the comorbid versus pure conditions are remarkably similar (Andrade et al., 1994). Comorbidity also has implications for the severity of the mothers' illness. For example, Carter et al. (2001) found no differences in the interactive behavior of a purely depressed group, but found differences when depression was coupled with another diagnosis such as anxiety or an eating disorder. Rosenbaum et al. (2000) also found that behavioral inhibition in children was most frequent when maternal MDD and PD were comorbid. Thus, comorbid MDD and PD may represent a similar, but more severe, psychopathological condition than may pure MDD or PD (Andrade et al., 1994). To address this issue, future research should ideally include mothers with pure MDD, mothers with pure PD, and mothers with comorbid MDD and PD as well as a control group of mothers with no psychiatric illness (Rosenbaum et al., 2000).

There were several limitations to this study. Our ability to detect differences among the diagnostic groups was limited by the small sample size in the PD group, and it is plausible that the lack of differences between diagnostic groups was the result of low power rather than a true null finding. Thus, the specificity findings reported here must be interpreted with caution until replicated. There also was no comorbid contrast group in this study, which made it impossible to evaluate whether mothers with both MDD and PD have a more severe psychopathological condition with concomitant effects on the quality of the mother–infant relationship than have mothers with pure MDD or PD. In addition, the participants in this study were primarily Caucasian, at low medical and social risk, and in treatment. Because only about 10% of mothers with postpartum depression in community samples seek treatment (O'Hara et al., 1990), the generalizability of our data to other groups may be limited.

Clinical Implications

This initial study is the first to evaluate the behavior of mothers with PD and their infants in the FFSF paradigm and one of the few studies to include a psychiatric contrast group to mothers with MDD and their infants. The study raises clinically relevant questions regarding specificity, severity, maternal risk status, comorbidity, and treatment and offers some interesting directions for future studies. The study also sounds an encouraging note for women struggling with PD or MDD and who are concerned about their functioning as a mother and their infant's welfare. Our findings add to an emerging viewpoint that suggests that when such mothers seek treatment and live in a relatively low-risk environment, they

may have enough compensatory factors in place to buffer their infants from the compromises observed in higher risk samples.

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TABLE 1

Mean Percent Time (M) and SDs of Positive, Interest, and Negative Affect for Infants and Mothers During Episodes of the Face-to-Face Still-Face Across Groups and Gender

Affect	Play 1		Still-Face		Reunion Play		F for Episode	ω^2
	M	SD	M	SD	M	SD		
INFANTS								
Positive	29.59 ^a	23.02	9.58 ^b	10.99	23.69 ^c	20.39	27.66***	.37
Interest	61.16 ^a	25.06	71.01 ^b	26.26	53.80 ^a	25.94	14.32***	.23
Negative	9.25 ^a	18.71	19.41 ^b	27.15	22.51 ^b	27.87	11.55***	.19
MOTHERS								
Positive	75.63	18.64			67.09	21.26	16.18***	.14
Interest	20.08	15.59			24.66	15.64	6.42*	.06
Negative	4.29	8.30			8.26	12.69	12.22***	.11

Note. Means with differing superscripts are significantly different at $p < .05$.

* $p < .05$.

** $p < .01$.

*** $p < .000$.

TABLE 2

Mean Percent Time (M) and SDs of Infant and Maternal Phases During the Episodes of the Face-to-Face Still-Face Across Groups and Gender

Phases	Play 1		Still-Face		Reunion Play		F for Episode	ω^2
	M	SD	M	SD	M	SD		
INFANTS								
Avert	14.78 ^a	16.22	27.32 ^b	25.28	29.57 ^b	27.48	$F(df = 2, 87)$ 14.05***	.22
Object attend	29.78 ^a	26.54	40.05 ^b	30.00	24.54 ^a	21.97	11.12***	.18
Object Play	2.88 ^a	4.06	1.55 ^b	2.69	2.54 ^{ab}	3.78	4.41*	.07
Social Attend	23.63	17.51	19.84	20.56	20.17	15.28	1.71	.02
Social Play	28.93 ^a	22.81	11.24 ^b	12.81	23.18 ^c	20.88	24.60***	.34
MOTHERS								
Avert	1.76	2.98			2.47	3.14	$F(df = 1, 88)$ 4.21*	.03
Object Attend	1.06	2.51			1.27	2.51	0.17	.00
Object Play	1.93	3.00			1.45	2.52	2.11	.01
Social Attend	22.07	14.84			29.10	18.79	19.83***	.17
Social Play	73.18	16.72			65.70	20.39	20.20***	.18

Note. Means with differing superscripts are significantly different at $p < .05$.

* $p < .05$.

** $p < .01$.

*** $p < .000$.

TABLE 3

Mean Percent Time (M) and SDs of Matching and Synchrony During the Episodes of the Face-to-Face Still-Face Across Groups and Gender

Variable	Play 1		Reunion Play		F(df = 1, 88) For Episode	ω^2
	M	SD	M	SD		
MATCHING OF BEHAVIOR						
Overall Behavior Match	30.81	19.83	25.44	17.09	11.60***	.11
Avert Match	0.58	1.72	1.32	2.83	5.77*	.05
Object Match	2.53	3.86	1.98	3.34	1.58	.01
Social Match	49.91	29.92	41.34	28.45	10.59**	.10
MATCHING OF AFFECT						
Overall Affect Match	35.36	16.60	33.24	15.24	3.73	.03
Positive Affect Match	21.48	17.96	16.99	15.28	11.38**	.10
Interest Affect Match	12.01	11.15	11.39	9.98	0.18	.00
Negative Affect Match	1.87	6.34	4.85	9.77	12.44***	.11
SYNCHRONY	0.14	0.17	0.17	0.18	0.80	.00

* $p < .05$.

** $p < .01$.

*** $p < .000$.