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Maternal Depressive Symptoms and Responsiveness to Infant Distress: Contingency Analyses of Home Mother-Infant Interactions at 3 Months

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MATERNAL DEPRESSIVE SYMPTOMS AND RESPONSIVENESS TO INFANT DISTRESS: CONTINGENCY ANALYSES OF HOME MOTHER-INFANT INTERACTIONS AT 3 MONTHS

A Thesis Presented

by

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ABSTRACT

MATERNAL DEPRESSIVE SYMPTOMS AND RESPONSIVENESS TO INFANT DISTRESS: CONTINGENCY ANALYSES OF HOME MOTHER-INFANT INTERACTIONS AT 3 MONTHS

August 2012

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Maternal depressive symptoms during the postnatal period have been shown to be detrimental to the socio-emotional, cognitive, and motor development of infants. Studies indicate that one of the mediators of these detrimental effects is decreased maternal responsiveness, a maternal characteristic that may hinder infant emotion-regulation development and infant secure attachment. Although previous research has shown the impact of infant cries on the behavior and physiology of mothers with elevated depressive symptoms in laboratory-based contexts, little is known about the quality and timing of maternal responsive behaviors to infant negative affect in mothers with elevated or non-elevated depressive symptoms in the naturalistic environment. The general aim of this study was to evaluate the contingencies between infant distress displays and maternal responsive behaviors during home observations of mothers with elevated and non-elevated depressive symptoms and their 3-month-old infants. Specifically, the goal was to analyze differences in the quality and timing of maternal response to infant distress among mothers with high depressive symptoms compared to mothers with low depressive symptoms during observations of mothers and their infants at home. To evaluate maternal responsiveness, a variety of maternal behaviors were coded from 30-minute videotapes of home interactions in 83 low-risk Caucasian mother-infant dyads. Maternal behavioral responses, non-responsiveness, latency of response, and number of responses per episode of infant distress did not differ significantly between the no or low depression symptom groups and the high symptom group. After controlling for maternal and infant individual differences, CESD scores did not predict maternal responsive behaviors. Maternal responsiveness rates and infant affectivity levels were congruent with those found in previous studies of mothers with non-elevated depressive symptoms. The small differences found between CESD groups in this sample may suggest that maternal depressive symptoms, without other comorbid or environmental risk factors, may not impact the way in which mothers respond to infant distress at 3-months.

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1. CES-D – Center for Epidemiologic Studies – Depression Scale

CHAPTER 1

INTRODUCTION

Maternal depressive symptoms during the postnatal period have been shown to be detrimental to the socio-emotional, cognitive, and motor development of infants (Murray, 1992; Sharp et al., 1995; Maughan, Cicchetti, Toth, & Rogosch, 2007; Abrams, Field, Scafidi, & Prodromidis, 1995). Studies indicate that one of the mediators of these detrimental effects is decreased maternal responsiveness (Drake, Humenick, Amankwaa, Younger, & Roux, 2007; Gondoli & Silverberg, 1997); a maternal characteristic that may hinder infant emotion-regulation development and infant secure attachment (Gianino & Tronick, 1988; Moehler, Brunner, Wiebel, Reck, & Resch, 2006). Although previous research has shown the impact of infant cries on the behavior and physiology of mothers with elevated depressive symptoms in laboratory-based contexts, little is known about the quality and timing of maternal responsive behaviors to infant negative affect in mothers with elevated or non-elevated depressive symptoms in the naturalistic environment home. The general aim of this study is to evaluate contingencies between infant distress displays and maternal responsive behaviors during home observations of mothers with elevated and non-elevated depressive symptoms and their 3-month-old infants. Specifically, the goal is to analyze differences in the quality and timing of maternal response to infant distress among mothers with high depressive symptoms compared to mothers with low depressive symptoms during observations of mothers and their infants at home.

To accomplish this goal, maternal responsive behaviors and their latency of response immediately following infant distress were coded from 30-minute videotaped mother-child home interactions. A detailed coding system (see appendix) was used to capture the behaviors observed during the home interactions of low-risk mostly Caucasian (N=83) mothers and their 3-month-old infants. Maternal depressive symptoms were measured with self-reported symptoms with the Center for Epidemiologic Studies-Depression Scales during the home visit (CES-D; Radloff, 1977). To assess how the intensity of infant distress would affect maternal responsiveness in mothers with elevated and non-elevated depressive symptoms, intensity of infant distress was differentiated between fussiness and cry (see appendix for code descriptions). The data were drawn from a larger longitudinal study of maternal depression, called the HOME study. Dyads were recruited at the time of child's birth from two major Massachusetts hospitals. Home interactions from the 3-month visit from the HOME study were coded.

Maternal Depression and Child Development

The postpartum is a crucial time for the development of the mother-child relationship. During this period, infants are dependent on their caregivers to meet their needs, and mothers' responsiveness is necessary for them to achieve different forms of engagement with people and the inanimate world (Tronick, Als, & Adamson, 1979). However, when proximal risk factors such as maternal psychopathology are present, the development of this relationship may be at risk.

Maternal postnatal depression afflicts about 10-15% of all women in the first 6 months after birth (Beck, 2001; O'Hara & Swain, 1996). Recent studies show, however, that these rates may be even higher in different ethnic cultures (reaching up to 60%; Halbreich & Karkun, 2006). These rates highlight the relevance of this problem to women and children throughout the world.

Women of child-bearing ages show the highest levels of depression rates (Eaton & Kessler, 1981). More recent epidemiological studies have shown a significant age difference in women, where women of 18-34 years had a 13.6% incidence of depression; 35-49 years had a 11.3% incidence of depression; 50-65 years had a 9.1% incidence of depression, and 65 and over had an incidence of only 3.7% (Kessler, Birnbaum, Bromet, Hwang, Sampson, et al., 2009). Increased rates of depression are observed in women when there are increased child-rearing burdens, such as three or more of children under 6 years in the home, or the presence of an ill child (Klerman & Weissman, 1989; Brown & Harris, 1978).

Infants demand relatively constant care and attention from their caretakers, especially in the first months of life. When mothers have elevated depressive symptoms, it may be harder for them to be attentive to their infants' cues and needs. Studies show that mothers with elevated depressive symptoms are less contingent and affectionately attuned to their infants (Charles, Murray, & Stein, 2004). This quality affects the early mother-infant interaction, which in turn may result in the impairment of the mother-child relationship (Moehler et al., 2006). And relational impairment has long been associated with long-lasting effects on the development of the infant. For example, maternal postpartum depression has been linked to negative effects on cognitive, socio-emotional, and motor development (e.g. Murray, 1992; Sharp et al., 1995; Maughan, Cicchetti, Toth & Rogosch, 2007; Abrams, Field, Scafidi, & Prodromidis, 1995).

The socio-emotional development of children of mothers with elevated depressive symptoms in the postpartum period, compared to children of mothers with non-elevated depressive symptoms in the puerperium, has been shown to have increased negative affectivity and self-regulatory difficulties. Children who were exposed to maternal depression in the first months of life have been shown to have maladaptive emotion regulation patterns at age 4 and lower perceived competence ratings at age 5 (Maughan, et al., 2007). Furthermore, higher rates of insecure attachment have been shown in children of mothers who had elevated depressive symptoms in the postpartum period compared to children of mothers who did not have elevated symptomatology. For example, children of women who had chronic symptoms in the postpartum period up to 36 months after birth were more likely to have preschoolers who were classified as insecure D; and intermittent symptomatology in the first 36 months was associated with insecure C or D in preschoolers (Campbell, Brownell, Hungerford, Spieker, Mohan, et al., 2004). Furthermore, mothers with comorbid symptomatology (e.g. depression and at least one other psychopathological condition) have also been shown to have infants with higher risk of developing insecure attachment with their mothers at 14 months (Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001).

Motor issues can also be observed in children whose mothers had elevated depressive symptoms in the first months postnatally. For example, Abrams et al. (1995)

showed that newborns of mothers with elevated depressive symptoms had decreased motor tone, lower activity levels and less robustness on the Brazelton Neonatal Behavioral Assessment Scale, compared to those born to mothers with non-elevated depressive symptoms. Similarly, activity levels were shown to be lower in early childhood in children whose mothers had elevated depressive symptoms during the first year postnatally. A recent study has shown that children whose mothers had high depressive symptomatology at 15 months had lower activity levels at ages 4 through 6 years when compared to their peers whose mothers did not show elevated depressive symptoms at 15 months (Fernald, Jones-Smith, Ozer, Neufeld, & DiGirolamo, 2008).

Although the evidence focuses on the influence of maternal depression on the child, there are infant factors that might affect maternal behavior and symptomatology. Murray, Stanley, Hooper, King, et al. (1996) have shown that high infant irritability is predictive of onset of maternal depression in the first 8 weeks postpartum. Infant irritability has also been shown to predict parenting, sensitivity, and mother-infant attachment. For example, irritable infants receive less sensitive care and have less secure relationships than non-irritable infants (Crockenberg, 1994; van den Boom, 1994; Thompson, 1997; van den Boom, 1997). Furthermore, studies have shown that infant genetic factors may influence parenting, and maternal sensitivity (Mills-Koonce, Propper, Gariepy, Blair, Garrett-Peters, et al., 2007; O'Connor, Deater-Deckard, Fulker, Rutter, & Plomin, 1998).

Maternal Depression and Responsiveness

Postpartum depression may impact parenting in significant ways. Responsiveness to infants' needs may be particularly impaired due to depression. Feelings of hopelessness, low self-esteem, and self-efficacy, which are associated with depression and emotional distress, may also cause mothers to be less responsive to their infants (e.g. Drake et al., 2007; Gondoli & Silverberg, 1997). Another facet of depression is psychomotor retardation, which might prevent mothers from responding in a consistent and timely fashion to their infants' needs. Alternatively, Stein, Lehtonen, Harvey, Nicol-Harper, & Craske (2009) propose that it is maternal preoccupation, or the cognitive distortions of psychopathology, in particular thought rumination and attention, that might impact maternal responsiveness in postpartum depression.

Another way that maternal depression may affect responsiveness is on the type of soothing responses that mothers with elevated depressive symptoms are more likely to have. Studies done with American samples have shown that mothers with elevated depressive symptoms may act withdrawn or understimulating, or intrusive and overstimulating (Cohn & Tronick, 1983; Cohn, Matias, Tronick, Lyons-Ruth, & Connell, 1986; Field, Healy Goldstein, & Guthertz, 1990; Malphurs, Larrain, Field, Pickens, Pelaez-Nogueras, et al. 1996; Beebe, Jaffee, Buck, Chen, Cohen, et al., 2008). As Cohn et al. (1986) point out, withdrawn mothers are more likely to be disengaged from their infants and only respond to infant negative affectivity, while intrusive mothers interact with their infants in a rough manner, especially when infant is distressed.

On the other hand, it is important to keep in mind that not all mothers suffering from post-natal depression are inadequately responding to their infants. Most studies presented above emphasize mean differences, without highlighting the fact that some women suffering from depression in the puerperium do not show decreased responsiveness towards their infants. There seems to be some sort of parallel, but independent, process between depressive symptoms and maternal responsiveness, where depression may be present but responsiveness (or parenting quality) may or may not be impaired. For example, intervention studies targeting infant development or parent-infant mental health with women who had elevated depressive symptoms in the postpartum period and their infants have shown that, while maternal responsiveness to infant's cues, and mother-infant interactions and child outcomes improve, depressive symptomatology may remain unchanged (Lyons-Ruth, Connell, Grunebaum, & Botein, 1990; Heinicke, Fineman, Ruth, Recchia, Guthrie, et al. 1999; Cicchetti, Rogosh, & Toth, 2000). The reverse has also been observed, where mothers with elevated depressive symptoms already receiving pharmaceutical or other standard form of mental health care to treat depressive symptoms still presented less than optimal parenting practices (Weissman, Prusoff, Gammon, Merikangas, Leckman, et al., 1984; Gordon, Burge, Hammen, Adrian, Jaenicke, et al., 1989; Weinberg & Tronick, 1998).

Additionally, infant factors may also play an important role in modulating maternal responsiveness and parenting quality. Infants who are more difficult to soothe may impose greater challenges for the parents, which may, in turn, impact maternal self-esteem, self-efficacy and mood symptomatology. A child's difficult temperament and diminished ability to self-regulate may increase parental stress and diminish maternal sense of competence (Cutrona & Troutman, 1986). Studies have shown that increased stress and depression is associated with decreased self-efficacy (Coleman & Karraker, 1998; Jackson & Huang, 2000; Scheel & Rieckmann, 1998; Teti, O'Connell, & Reiner, 1996). Hence, maternal responsiveness and parenting quality may be negatively impacted by mother's perceived efficacy as a parent and sense of agency, especially in the first year of the infant (Teti & Gelfand, 1991).

Responsiveness and Child Development

Although it is important to consider the effect of infant irritability on maternal responsiveness, researchers have also studied the opposite direction of causality, where maternal depression may negatively impact infant and child development through reduced maternal responsiveness. According to this view, maternal depression may disrupt communication feedback loops in the early mother-child relationship. The potential lack of maternal responsiveness in mothers with elevated depressive symptoms may prevent these mothers from providing proper emotion regulation for their infant (Moehler, et al., 2006). Over time, the lack or delay of maternal responsiveness during infant distress may have repercussions for the child's development of self-regulatory skills (Tronick & Gianino, 1988).

According to Bornstein and Tamis-LeMonda (1989), maternal responsiveness, especially around the middle of the infant's first year, may be essential for cognitive development. They show that maternal responsiveness at 4 months is highly correlated with faster non-verbal discrimination-learning and with higher IQ scores on the Wechsler Preschool and Primary Scale of Intelligence (WIPPSI) at four years of age. In terms of generalizability of this phenomenon, similar trends have been observed in Japanese mother-infant dyads, where mothers who were more responsive at 4-5 months postnatally had toddlers who were more likely to obtain higher scores on the Catell Infant test (MCC), and young children who scored higher on the Peabody Picture Vocabulary Test (PPVT; Bornstein, Miyake, Azuma, Tamis-LeMonda, et al., 1990). However, it should be noted that long-term consistent maternal responsive patterns may play a role in the child cognitive outcomes found in these studies.

In addition, Milgrom, Westley, and Gemmill (2004) have shown that lower cognitive performance on the WIPPSI at 42 months of infants of mothers with elevated depressive symptoms was explained by the mediation of lower maternal responsiveness (based on frequency of response to cues) at 6 months—although, as mentioned earlier, long-term maternal responsive patterns may also have contributed to these outcomes. Furthermore, though the measurement of temperament is still questioned by some authors (e.g. Kagan, 1994), this study also showed that temperamental difficulties observed in the children of mothers with elevated depressive symptoms —through the STSI and STST parent-report questionnaires on approach, cooperation-manageability, persistence, rythmicity, distractibility, irritability and reactivity—was not associated with maternal responsiveness.

However, some researchers argue that individual differences in infants may impact the extent to which maternal responsiveness will be detrimental to child development. For example, irritable infants may be more sensitive to parental behaviors because they might be more dependent on it to self-regulate emotions and behaviors (Ziv & Cassidy, 2002). Hence, their well-being seems to be more dependent on parental responsiveness than in their peers. Such regulatory issues may be especially true for boys (Weinberg, Olson, Beeghly, & Tronick, 2006).

Furthermore, Belsky, Rovine, and Taylor (1984) explored the importance of maternal parenting patterns on infant affectivity and mother-infant interaction, while accounting for infant individual differences. According to their findings, they suggest that fussiness is caused by mothering, instead of predicting mothering behaviors. The authors found that mothers' behaviors had a greater influence in determining individual differences in attachment. For example, they propose that fussy infants, who are more difficult to care for, elicit over- and understimulating maternal interaction patterns, which may lead to insecure relationships. They assert that, "while the infant most certainly makes a contribution to the care it receives, …, it is the care provided by the mother that plays a relatively greater role in determining individual differences in the quality of infant-mother attachment."

Responsiveness to Infant Distress

Many studies have observed how mothers respond to their crying infants. Some focus on response quality (e.g. types of behaviors used), while others focus on the latency of time of maternal response to infant distress. To date, most studies of descriptive maternal responsive behaviors to infant distress have been done with low-risk mothers, and have focused on general types of maternal responsive behaviors (e.g. looking, holding, feeding, etc). However, to our knowledge, no studies have focused on the number of strategies or responses mothers use to respond to each infant distress bout, or the use of multiple behaviors in each response (e.g. vocalizing + holding + looking at the same time vs. solely vocalizing) to soothe their distressed infant.

Bornstein and Tamis-LeMonda (1989) found that low-risk mothers in the laboratory setting respond to distress by vocalizing 58% of the time, by picking up, patting or feeding 22% of the time, and by orienting infants to the environment about 10% of the time (in the attempt to comfort or distract infant).

In cross-cultural comparisons, Richman, Miller, and LeVine (1992), found that Gusii mothers were more likely to respond to their 4-month-old infant's cry by holding (40% of the time) or touching (20% of the time), then by vocalizing, feeding, or looking at the infant (10%, 9%, and 3% of the time, respectively). On the other hand, the Bostonian counterparts in this study responded to cry in their 4-month-olds more prevalently by holding (30% of the time), looking (22%), and vocalizing (21%), and less often, by touching and feeding (8% and 2%, respectively).

Latency of time to respond to infant distress has also been studied across cultures. For example, it has been observed in the Efe Pygmy caretakers that the latency time for responding to fuss or cry was about 10 seconds after onset of negative affect, 85% of the time in the first 7 weeks of the infant, and 75% of time at 18 weeks (Tronick, Morelli, & Winn, 1987). Studies have shown that European caregivers have similar latency rates of response to infant distress; where the latency time span for low-risk mothers to respond to infant behavior is between 200 to 800 milliseconds (Papousek & Papousek, 1987, 1989, 1991).

These findings indicate that there may be some variability in the ways mothers respond to their infants' distress according to culture. However, low-risk white middle-class U.S. mothers seem to primarily use holding and vocalizing to soothe their infants. In contrast, latency of time to respond to infant distress seems to be similar among caregivers across different cultural backgrounds.

Maternal Depression and Responsiveness to Infant Distress

Even though studies have focused on responsiveness to infant positive affect in mothers with elevated or non-elevated depressive symptoms (Dix, Cheng, & Day, 2008; Feng, Shaw, Skuban, & Lane, 2007), or more generally, the responsiveness to infant cues in mothers with elevated or non-elevated depressive symptoms (Milgrom, et al., 2004), to our knowledge, no study has analyzed maternal responsiveness to infant distress in mothers with elevated or non-elevated depressive symptoms.

Infant cry is a signal that infants rely on to get their needs met and intentions scaffolded by their caregivers. Although some parents may take solace in their infant's cry (i.e. indication of infant's liveliness and robustness), crying and fussing more often arouses displeasure and elicits a response from the parents that is motivated by a desire to terminate it. Yet, the infant's negative state is crucial in promoting proximity between mothers and infants. Studies have shown that there might be psychophysiological mechanisms that are related to the triggering of parental responses to infant distress and cry. For example, Stallings, Fleming, Corter, Worthman, et al. (2001) showed that first-time mothers, who felt more sympathy for infant distress, especially in response to hunger cries, had higher baseline salivary cortisol levels and higher heart rate than non-postpartum women, or multiparous mothers, who showed lower sympathy for infant distress. These findings may suggest some underlying bio-chemical mechanism to parental responsiveness to infant distress signals. However, it should be noted that elevated stress and anxiety levels of primiparous mothers may affect psychophysiological factors, thus leading to the observed results in Stallings, et al.'s study.

According to some authors, parents who consistently ignore distress signals may threaten the well-being of their infants (Bell & Ainsworth, 1972; Lester¸ Boukydis, Garcia-Coll, & Hole; 1990). Parental emotional state plays an important role in the way parents make meaning of different cry sounds. As mentioned earlier, some mothers with high depressive symptoms may respond to infants in a withdrawn/avoidant and understimulating manner, while other mothers with elevated depressive symptoms may be intrusive and overstimulating. Studies of maternal perceptions of, and physiological responses to, infant cry have shown both types of behavioral patterns in response to infant cries.

Avoidant Maternal Behaviors

Some researchers argue that mothers with elevated depressive symptoms may use avoidance of their infants in order to decrease their feelings of inadequacy (or their negative perception of efficacy) as mothers (Donovan & Leavitt, 1989; Rotter, Chance, &

Phares, 1972; Seligman, 1975). In addition, others argue that maternal depression causes difficulty responding to or discerning between higher and lower pitched infant cries (Hubbard & van IJzendoorn, 1991). Compared to mothers with low depressive symptoms, mothers with elevated depressive symptoms have been shown to perceive high-pitch cries (i.e., recordings of newborn infant's hunger cry digitally altered to increase in fundamental frequency in 100 Hz increments) as less arousing and less necessary of urgent response (Schuetze & Zeskind, 2001).

Avoidant behaviors in response to infant distress may be observed in terms of physical distance. For example, proximity between mother and infant has been inversely associated with onset of crying (Bell & Ainsworth, 1972; Keller, Chasiotis, Risau-Peters, Volkner, Zach, et al., 1996). These findings indicate that mothers who have elevated depressive symptoms might present more distal behaviors in response to infant distress (e.g. just looking at the infant from a distance and/or vocalizing); whereas mothers with low depressive symptoms will respond to infant distress with more proximal behaviors (e.g. approaching infant's visual field, and using physical contact to respond to distress--touching, patting, or picking up the infant).

Intrusive Maternal Behaviors

On the other hand, mothers with elevated depressive symptoms may also respond to infant cry with heightened attunement and physiological arousal. While low-risk caregivers, who are attentive to infant hyperphonated cries (indicative of the infant sounding sick), have heart rate decelerations, caregivers who are inattentive, or who show defensive responses to aversive sounds show increased heart rate to infant hyperphonated cries (Zeskind, 1983). Although these studies do not measure depressive symptomatology, they highlight the association of parenting styles and psychophysiology.

Mothers with elevated depressive symptoms who are more intrusive may perceive cries as more intolerable, than mothers with low depressive symptoms, resulting in increased attunement to negative affectivity. For instance, it has been shown that mothers with elevated depressive symptoms and their infants spend more time in negative states, and match negative states more often than positive states (Cohn, Campbell, Matias, & Hopkins, 1990; Cohn et al., 1986; Field, 1984). Increased negative expressivity from the mother may indicate a more attuned responsiveness contingent upon infant negative affective display. This finding suggests that mothers with elevated depressive symptoms may be more reactive or responsive to infants' negative as opposed to positive or neutral behaviors. This would make sense given cognitive processing studies among individuals with elevated depressive symptoms, in which there may be selective attention to negative versus positive inputs.

The literature reviewed in this section indicates that withdrawn mothers use more distal behaviors or respond less often to infant distress than intrusive or low risk mothers. In contrast, intrusive mothers may use physically proximal behaviors more promptly and more often than withdrawn mothers, however, the responsive behaviors they use may not be effective in soothing the crying baby.

Although the evidence suggests that there are at least two distinct patterns of responsive behaviors in mothers with elevated depressive symptoms (withdrawn vs. intrusive), as well as an inconsistent pattern, the dearth of research on this topic limits our understanding of why and how these distinct patterns of behaviors develop and coexist in depressed mothers.

Individual Differences

Individual differences may impact the observed rates of infant behavior in a study. They are especially important to be considered when infant negative affect is a focal variable because individual differences in affectivity and temperament may mediate or interact with the impact of parenting and maternal psychopathology on infant behavior and developmental outcomes (Maxted, Dickstein, Miller-Loncar, High, Spritz, et al., 2005; Lester, et al., 1995). In addition, rates of individual differences in infant affectivity may affect maternal perception of and responsiveness to infant distress (Rothbart & Derryberry, 1981; Boukydis & Burgess, 1982; Lounsbury & Bates, 1982). Hence, mothers may learn different soothing strategies according to their perceptions of infants' distress and needs and the infant's routine displays of affectivity. Based on the infant temperament "goodness of fit" transactional model put forth by Thomas & Chess (1980), Lester et al. (1995) suggest a "goodness of fit" model in infant cry and maternal behavior, where the combination of maternal ability to interpret infant's signals and clarity of the infant's signals predicts infant cognitive and motor developmental outcomes.

In terms of rates of cry and affectivity, researchers have shown that cry acoustics, including duration of cry and fundamental frequency, remain stable over the first 12 weeks of life (Huffman, Bryan, Pedersen, Lester, Newman, et al., 1994; St. James-Roberts, & Plewis, 1996) and predicted maternal perception of infant temperament at 12 weeks; while rates of fussing have been shown to be stable from 3 months to 9 months (St. James-Roberts et al., 1996). Children's individual characteristics, such as temperament, may allow observers to predict behavior over time (Goldsmith, Buss, Plomin, Rothbart, Thomas, et al., 1987). For instance, infant temperament shows stable individual differences over the course of the child's life (Goldsmith et al., 1987). St. James-Roberts and Plewis (1996) showed that individual differences in low-risk infants accounted for 23% of the overall variance of fussiness, 15% of cry, and 16% of both fussiness and cry combined.

Contingency Analyses

Given the importance of observing maternal responsiveness to infant cues, studies have shown effective ways to capture the frequency and delay of maternal responsiveness to infant behavior (Milgrom, 2004; Field, Healey, Goldstein, & Guthertz, 1990; Dix et al., 2008; Beebe et al., 2008; Jahromi & Stifter, 2007; Manian & Bornstein, 2009, Bakeman & Gottman, 1997). Bakeman and Gottman have played an important role in the field of interaction observation, and, in their book (1997), they describe how to design studies to observe sequences of interactive behaviors and the best ways to statistically measure the probabilities of specific sequence of behaviors of occurring during an interaction. Examples of such approaches for analyzing observational data of mother-infant interactions are sequential analyses, contingency analyses, and or simple frequency analyses and correlations. However, studies that analyze contingent behavior tend to vary between time and frequency domains. This situation creates an inconsistency in evaluating interactive contingent behavior in mothers with elevated depressive symptoms and their infants in the literature.

In order to analyze maternal contingent behaviors following negative affect, contingency analyses may capture the predictability of sequences of behaviors between mothers and infants, more effectively than correlational analyses. A correlational method loses unique information about individual moments of responsiveness to particular infant distress displays. However, sequential analyses also have some limitations when analyzing contingency of behaviors in conditional associations (e.g. probability of A, given B). Sequential analyses have been shown to be useful in predicting behaviors according to dyadic partners' contingent behaviors, or self-contingent behaviors. This type of analysis, allows for a string of events to be analyzed in a sequential form: predictions of the order of behaviors can be made by choosing a time lag between behaviors (or events; see Bakeman & Quera, 1995). For example, it is possible to statistically test how likely it is for a child to go from a happy state (A) to a distressed state (B) during a particular type of interaction or observation. It is also possible to measure the likelihood that a mother's smile (A) happens within close temporal proximity of her child's smile (B) during an interaction. Hence, sequential analyses allow for the analysis of the probability of A→B occurrence within an interaction.

On the other hand, in sequential analyses discernment of order of events or causality of A→B, should not be assumed, since the analyses will only capture the occurrence of the presence of behavior A at a time lag from behavior B, like a snapshot in time, without considering the onset of each behavior. For example, B may be a continuous behavior that had an onset prior to A, however this cannot be observed through set parameters of the calculations, which only consider the probability of occurrence of B after A within a set lag time.

Similarly, in the case of maternal responsiveness to infant cry, it would be difficult to tease apart when a mother, who is holding her infant, was using touch, for example, in order to sooth the infant, or when that behavior was already present before the onset of infant display of negative affect. This type of analysis would just show the probability of behavior A (cry) to be followed by behavior B (touch), within a given time constrain (e.g. 1, 2, or 3 second lag of time) and without considering duration of events. It would also pose limitations on the analysis of responsive behavior when change in intensity of affectivity is observed. Hence, if onset is set on start of fussy behavior (A), as the child's affective state escalates to a cry and is not accounted for in the calculations, the analysis may predict the probability of a maternal responsive behavior that was elicited by the cry and not by the fussy behavior.

Contingency analyses have been shown to be effective in measuring probabilities in conditional associations (Bakeman, 2000). Since conditional probabilities are not good candidates for parametric analyses because the simple probabilities may impact their absolute values by representing the higher probability values and not conditional or sequential factors, strength of association and effect sizes are better for subsequent parametric analyses. According to Wampold (1992), such measures do not impact the number of tallies. These types of measures are well developed for 2 by 2 tables (see figure 1). A common statistic for examining whether the observed values in a 2 by 2 table are different from chance is an odds ratio. While the odds ratio, a widely used measure in epidemiological studies, is found to be less descriptively by some researchers since it varies from 0 to infinity, a transformation of the odds ratio, called Yule's Q, is more useful since it ranges from -1 to +1 and works as an index of the strength of the contingency between two variables. Yule's Q reflects the odds that a given contingency will take place while controlling for the base rate of behaviors (Bakeman, 2000; Bakeman, McArthur, & Quera, 1996). Yule's Q has been successfully used in various studies in order to show patterns of maternal responsiveness to infant behavior (e.g. Van Egeren, Barratt, & Roach, 2001; Jahromi & Stifter, 2007).

Due to the effectiveness of the Yule's Q technique for measuring contingency analyses of interactive behaviors, this technique will be used to analyze the probability of rates of maternal responsive behaviors to onset of infant distress in this study.

Figure 1.

A 2 by 2 odds ratio table.

	Lag 1	
Lag 0	B	~B
A	A	B
~A	C	D

In sum, maternal depressive symptoms during the postnatal period have been shown to be potentially detrimental to the socio-emotional, cognitive, and motor development of infants. Studies also indicate that one of the mediators of these detrimental effects might be decreased maternal responsiveness; which may hinder infant emotion-regulation development and infant secure attachment. Different patterns of maternal responsiveness (i.e., intrusive, withdrawn, or both) in mothers with elevated depressive symptoms have been shown in different studies. Research also suggests, however, that infant individual differences may affect maternal responsiveness. Although previous research has shown the impact of infant cries on the physiology and responsive behaviors of mothers with elevated depressive symptoms in laboratory-based contexts, to date no home naturalistic observations have been done to study this phenomenon.

The Present Study

The overarching goal of this study was to investigate whether maternal depressive symptoms mediate maternal responsiveness to infant distress at 3-months postpartum. The first aim (Aim 1a) was to analyze the quality of maternal responsive behaviors to infant negative displays of emotion in relation to levels of maternal depressive symptoms. Specifically, the proximity of responsive behavior (e.g. at a distance, by looking or talking to the infant, or more proximally, by touching, holding or patting the infant) and the use of combinations of responsive behaviors (e.g. simultaneously vocalizing, holding, and looking) were analyzed. It was hypothesized that mothers with elevated depressive symptoms would be less likely to use proximal behaviors and combinations of behaviors in response to infant distress compared to mothers with non-elevated depressive symptoms. It was hypothesized that mothers with elevated depression symptoms would respond to infant distress in different ways compared to mothers with low depressive symptoms. In particular, it was expected that the differences would be seen in how proximal the maternal responsive behavior was (e.g. looking at child or talking to the child at a distance, versus touching or holding the child, or a combination of those behaviors, such as holding, vocalizing, and patting the baby simultaneously). It was also expected that, while trying to soothe the infant, mothers with elevated depressive symptoms would change the way they responded to each infant bout less often, present a limited range of responses (e.g. use fewer responses), and/or be less likely to respond than mothers with non-depressive symptoms.

Another aspect of the first aim (Aim 1b) was to measure how often mothers change their responsive strategies following each episode of infant distress based on symptom levels. For aim 1b, it was expected that mothers with elevated depressive symptoms would be less likely to use multiple behaviors in one response (e.g. simultaneously hugging, kissing, vocalizing, etc.).

The last aspect of Aim 1 (Aim 1c) was to analyze how the intensity of infant distress would affect maternal responses. It was hypothesized that the intensity of distress displays would modulate maternal response, where low levels of distress (fussiness) would elicit less responsiveness from mothers with high depressive symptoms, while more intense distress displays (cry), would elicit higher levels of responsiveness which would be comparable with mothers who did not have elevated depression symptoms.

The second aim of this study was to explore the temporal latency of maternal responsive behaviors following the onset of an infant distress episode in relation to levels of maternal depressive symptoms. Latency of time of maternal response was coded micro-analytically following the onset time of each infant distress bout. To account for differences in latency according to intensity of distress, negative affect was coded in two levels: 1) fussiness and 2) cry. It was expected that increased maternal depressive symptoms would be associated with higher latency of time to respond to infant distress episode. It was also hypothesized that higher intensity of infant distress would be perceived as more noxious to mothers with higher depressive symptoms and a smaller latency of time that is comparable to, or faster than, that of mothers with non-elevated depressive symptoms. It was hypothesized that Mothers with elevated depressive symptoms would have slower reaction times in response to the onset of infant distress compared to mothers with low levels of depressive symptoms. Depression is characterized by psychomotor retardation, which makes the person suffering from depression lethargic. Another consequence of depression is cognitive impairment, or problems in concentration and decision making, which can impair mothers' ability to respond to infant cues properly (Stein, et al., 2009). These behavioral characteristics may prevent the mother from responding to her infant's distress in a predictable manner. Furthermore, consistent with the hypothesis from aim 1c, it was hypothesized that intensity of affective displays would impact maternal responsive reaction times, such that low levels of distress (fussiness) would elicit slower responses from mothers with elevated depressive symptoms, while more intense distress displays (cry), would elicit faster responses, which would be comparable with mothers who did not have elevated depression symptoms.

The third aim of this study was to evaluate the effect of individual differences in infant affectivity on the quality (Aim 1) and temporal (Aim 2) features of maternal responsiveness in relation to maternal depressive symptoms. Although previous studies have shown a positive relation between amount of infant cry and maternal depressive symptoms, the direction of this interaction is still unclear. Thus, infant affectivity may play an important role in how mothers with varying levels of depressive symptoms respond to infant distress. After controlling for infant individual differences (e.g. duration and frequency of affectivity), this study explored maternal responsiveness to infant distress (e.g. latency and quality of responsive) in relation to maternal depressive symptoms and intensity of infant distress display (e.g. fussiness or cry). Maternal differences in risk for psychopathology were also analyzed to control for comorbidity factors and variability of depressive symptom reporting. It was hypothesized that after controlling for individual differences in the amount of infant distress (the length or frequency of negative affect displays), mothers with elevated depressive symptoms would use fewer responsive strategies (such as fewer responsive behaviors at once, or less proximal responses), slower responses, and greater likelihood of not responding than mothers with low depressive symptoms. It was hypothesized that mothers with elevated depressive symptoms in this sample would respond to infant distress less often than those with non-elevated depressive symptoms.

CHAPTER 2

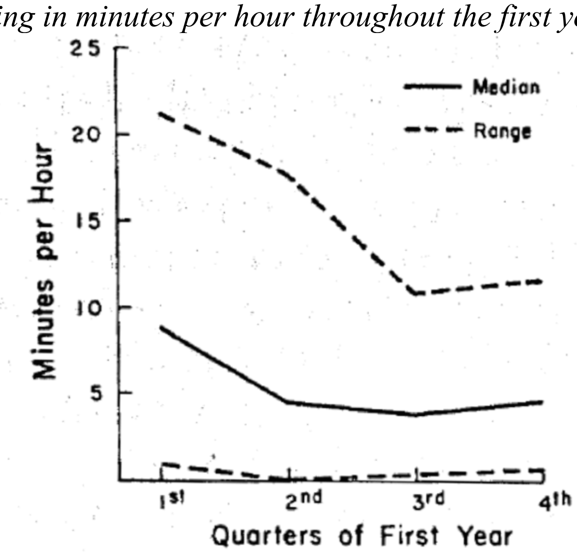
METHODS

Participants

The participants in this study were part of a larger longitudinal study. The group of dyads analyzed in this study included those that had: 1- two hours of videotaped interactions completed; 2-videotapes with optimal image and sound for coding; and 3-mothers who completed symptom ratings when the infant was 3-months of age. The infant age of 3-months was chosen since the peak of normal crying behavior happens within the first 3 months of life (see Figure 2, Bell & Ainsworth, 1972; Barr, 1990).

Figure 2.

Duration of crying in minutes per hour throughout the first year of life.[1]



[1] From "Infant crying and maternal responsiveness." by Bell and Ainsworth, l972. *Child Development, 43*, p. ll77.

The sample included 83 White, well-educated, middle-class mothers and their healthy infants. To minimize the effects of confounding factors known to affect maternal and infant outcome, infants and mothers had to meet a set of selection criteria. Infants had to be full-term, with no gestational or birth complications, or postnatal hospitalizations or serious illnesses. Birth weights had to fall between the 10^{th} and 90^{th} percentiles (mean= 7.6 lbs, SD= 1 lb). The mothers had no serious chronic medical condition. Multiparas and mothers who had returned to work before the baby's 3-month birthday were excluded from the study to control for differing maternal experience.

Participating mothers' mean age was 31.5 years (range 21-40, SD = 3.5 years). They had an average of 16 years of education (SD = 1.8 years), were living with the infant's father (99% married), and their socio-economic status had a mean Hollingshead four factor index of 54 (SD = 8.2). Although there was no race or ethnic selection criteria, the mothers were almost exclusively Caucasian (97%). Fifty-one percent of the infants (N= 42) were male.

Subject Recruitment and Depression Screening

Recruitment took place in the maternity wards of two New England metropolitan teaching hospitals. A research assistant reviewed medical charts to identify eligible mothers and infants. With the mother's physician's and nurse's approval, eligible mothers were approached by a female research assistant during their hospital stay in order to describe the study to the mother. If the mother gave signed written consent, she was asked a short set of socio-demographic questions and her permission to be contacted by phone at 2 months of infant age. Seventy-eight percent of the mothers approached in the newborn period agreed to be contacted by phone two months later.

At 2 months of infant age, a letter was sent to the consenting mothers detailing the study and informing them of an upcoming telephone contact. Mothers were then contacted by phone by a female research assistant. In the phone call, the research assistant described the study in detail and with the mother's permission asked a set of questions regarding her pregnancy and delivery and the infant's eating and sleeping habits. At the end of the phone interview, when the mother and the research assistant had established a comfortable rapport, the Center for Epidemiologic Studies – Depression Scale (CES-D, Radloff, 1977) was administered to assess the mothers' level of depressive symptomatology.

Mothers were assigned to one of three groups based on their 2 months CES-D intake score: 1) HIGH CES-D group: Mothers with an intake CES-D score of 16+ or higher (N=26 or 31% of the sample); 2) LOW CES-D group: Mothers with an intake CES-D score between 2-12 (N=23 or 28% of sample); and, 3) One or No CES-D group: Mothers with an intake CES-D score of 0-1 (N= 34 mothers or 41% of sample). The One or No CES-D group may be associated with the low risk nature of this sample, as similarly observed by Tronick, Beeghly, Weinberg, & Olson (1997), and not denial of symptoms as previously observed in high risk samples (Scafidi, Field, Prodromidis, & Abrams, 1999). Mothers who had a CES-D score of 13-15 were excluded from the larger study after recruitment in order to more clearly delineate the HIGH and LOW CES-D groups. This criterion applied only to the initial recruitment at 2 months. CES-D scores were free to vary at the 3-month visit; the symptom groups used in this study were based on 3-month CES-D scores. Each CES-D group did not differ significantly on the socio-demographic, maternal (e.g. number of years of education, marital status, and age), or infant (e.g. birth weight) variables (see Table 1 for demographic factors).

Table 1.

Demographics

	N	**SES** M (SD)	**Education** M (SD)	**Mat. Age** M (SD)	**Mat. Ethnicity** (%)	**Pat. Ethnicity** (%)	**Infant Gender** (%)
One/No CES-D	34	55.3 (8.7)	16.5 (2)	31.6 (3.2)	97% White/ Euro-American, 3% Asian	97% White/ Euro-Am., 3% Asian	47% male, 53% female
Low CES-D	23	53 (6.6)	16.2 (1)	31 (3.5)	100% White/ Euro-American	100% White/ Euro-Am.	52% male, 48% female
High CES-D	26	53 (8.8)	15.8 (2)	31 (4)	96% White/ Euro-American, 4% African American	92% White/ Euro-Am., 4% African Am. 4% Hispanic	54% male, 46% female
Total	83	54 (8.12)	16 (1.8)	31.2 (3.5) Range: (22-39)	98% White, 1% Asian, 1% African American	97% White, 1% Asian, 1% Hispanic, 1% African American	51% male, 49% female

Note: Maternal age and education and paternal education were measured in years, SES was based on Hollingshead Score. CES-D groups did not differ on any demographic variable.

Procedure

At 3 months of infant age, a female research assistant visited the mother and infant at home. Visits were scheduled at a time when mothers judged their infant to be typically alert and rested. In addition, visits took place on days that were typical for the family, since day-to-day fluctuations may impact infant affectivity (St. James-Roberts & Plewis, 1996). Visits took approximately three hours–two hours to videotape the mother-infant dyad and one hour for the administration of the CES-D.

During the naturalistic observations of the mothers and infants, mothers were told to act freely with their infant and to do the things they would normally do with the infant while at home. Observations were not made if the infant was sick or if exceptional events occurred, such as a visit by family members. In these cases, replacement observations were scheduled. At the end of the visit, the mothers completed the CES-D and answered questions on the Parental Interview.

Several procedures were put in place to ensure that mothers felt as comfortable as possible and to habituate the mothers and infants to the observer in order to reduce subject reactivity. A day or two before the visit, a female observer visited the home in order to establish rapport with the mother and to habituate the mother and infant to her presence, to the video equipment, and to the videotaping procedures. During videotaping, the observer tried to be as unobtrusive as possible by using the zoom feature of the camera and filming from a distance whenever possible.

Measures

Depressive Symptomatology

The Center for Epidemiologic Studies – Depression Scale (CES-D) (Radloff, 1977) was used to assess levels of maternal depressive symptomatology at 3 months of infant age. This 20-item self-report scale was designed to measure depressive symptoms in the general population. Possible scores range from 0 to 60 with a cut-off score of 16 used as indicative of high levels of depressive symptomatology. The CES-D has been shown to have internal, concurrent, and predictive validity in the pre- and post-partum periods (Campbell, Cohn, Meyers, 1995).

Coding of Data

Maternal responses and infant affect were coded from videotapes by coders blind to the study's hypotheses and to the depression status of the mothers. Each coder used the same starting time and coded 30 continuous minutes of baby affect. To further ensure that the mothers were acting as freely and naturally as possible with their infant, the coding started 30 minutes after the onset of the home visit. Infant negative affect and maternal behaviors were coded in real time using the Interact Mangold® video coding program. The tapes were run at normal speed although they were frequently stopped, run in slow motion, or examined frame by frame to accurately determine changes in infant affect or maternal behaviors. Behavioral events were coded based on the beginning and end time of each behavior. Twenty percent of the videotapes was randomly selected and recoded by three independent coders for reliability.

Infant Negative Affect.

Infant negative affect was coded seamlessly based on the infant's facial expressions, vocalizations, posture (e.g. arched back, loss of tonus), and erratic movements (e.g. tensed arms, hands, legs, and feet). Intensity of negative affect was differentiated by two negative affect levels, 1- negative/fussy, and 2- cry (see appendix for code descriptions). These codes were mutually exclusive. Breaks between negative affect displays of less than 3 seconds, were considered as one continuous event, while breaks of 3 seconds or longer were coded as separate events. Coding was done based on previously coded infant affective states (based on 5-code affect system, which included negative affect and cry) using a 5-second interval schedule. All videos were recoded in order to more accurately capture real-time behaviors, and affective state changes. Inter-rater reliability was .9 for infant affect coding.

Maternal Responsive Behaviors

Maternal responsiveness was coded based on 22 maternal response codes, which followed the onset of infant negative affect. Similar to previous studies that have focused on maternal responsiveness to infant behavior (Bell & Ainsworth, 1972; Nicely, Tamis-LeMonda, & Grolnick, 1999; Bornstein & Tamis-LeMonda, 1989), coded responses were based on whether the mother responded to infant negative affect by doing one of 22 mutually exclusive responses that utilized a range of behaviors (e.g., looking, vocalizing, touching, picking up, patting, playing with a toy/object, feeding, or a combination of these behaviors; see table 2 for the list of codes, and appendix for the description of each code). Maternal responses were only coded when a fuss or a cry event was coded for the infant. Inter-rater reliability was .78 for maternal behavior coding.

Table 2.
Coding Scheme

Response Codes	Maternal Behaviors									Proximity		# of Behaviors	
	Feeding	Holding	Looking	Playing	Touching	Vocalizing	Grooming	Patting	Bouncing	Distal	Proximal	Single	Multiple
1			■							■		■	
2						■				■		■	
3					■						■	■	
4		■									■	■	
5				■						■		■	
6	■										■	■	
7							■			■		■	
8	■		■								■		■
9			■		■						■		■
10		■	■								■		■
11			■	■							■		■
12		■	■			■					■		■
13		■						■	■		■		■
14			■			■				■			■
15			■		■	■					■		■
16		■				■					■		■
17		■				■					■		■
18	■					■					■		■
19				■		■					■		■
20			■	■		■					■		■
21	■		■			■					■		■
22		■				■		■	■		■		■

Infant Codes	Infant Behaviors	
	Fuss	Cry
F	■	
C		■

Onset of maternal responses was coded from the second of the onset of infant negative affect display to 10 seconds after the offset of negative affect display. Studies have found that, in low-risk mothers, the latency time span for mothers to respond to infant behavior, based on innate reflexes and rational responses, is between 200 to 800 milliseconds (Papousek & Papousek, 1987, 1989, 1991). Others have used a 5-second window to capture maternal responsiveness following the onset of infant distress (Bornstein, Tamis-LeMonda, Tal, Luderman, Toda, et al., 1992). Due to the naturalistic nature of this study, a 10-second window was used in order to account for mother's distance from infant (e.g. coming from a different room in the house) or inability to attend to the infant (e.g. speaking on the telephone) at the onset of infant distress.

Analytic Plan

A second-by-second output of the coded events was extracted through the Interact Mangold® video coding program. Then data analyses were done with two statistical packages (SPSS and SAS). Before running analyses, distributions of the data were analyzed in order to check for skewed data in this sample. Also, outliers were removed, or rescored to decrease issues of generalizability to population values (Tabachnick & Fidell, 2007).

To address the aims of the study, the following analyses were performed:

For Aim 1a, analyses of variances (ANOVA) were employed to measure differences in maternal responses (dependent variables) among the three CES-D symptom groups (3-goup categorical, independent variable). Post-hoc Tukey statistics were run to evaluate the significance of between-group differences.

For each mother, 2 by 2 tables were constructed for each possible maternal response (see Figure 3). Yule's Q statistics were calculated for each table to provide a measure of the strength of the contingent relation between the infant's distress behavior and the mother's response. The rows of the tables reflected the intensity of infant distress (cry vs. fussiness) and the columns reflected the presence or absence of a specific maternal response (e.g., code 1 vs. no code 1). Thus, the top left cell of each 2 by 2 contingency table consisted of the number of times cry was contingently associated with the specific maternal response. As described earlier, Yule's Q ranges from -1 to +1, when it equals zero, no relation is assumed. A positive relation is assumed as the value approaches +1, indicating a strong tendency for cry to be contingently associated with the maternal response being observed. A value approaching -1, indicates that the absence of cry (or fuss) is contingent and strongly associated with the maternal response being observed.

Figure 3.

Sample 2 by 2 contingency table used for each maternal responsive behavior.

	Mat Beh	~Mat Beh
Cry	a	B
Fussiness	c	D

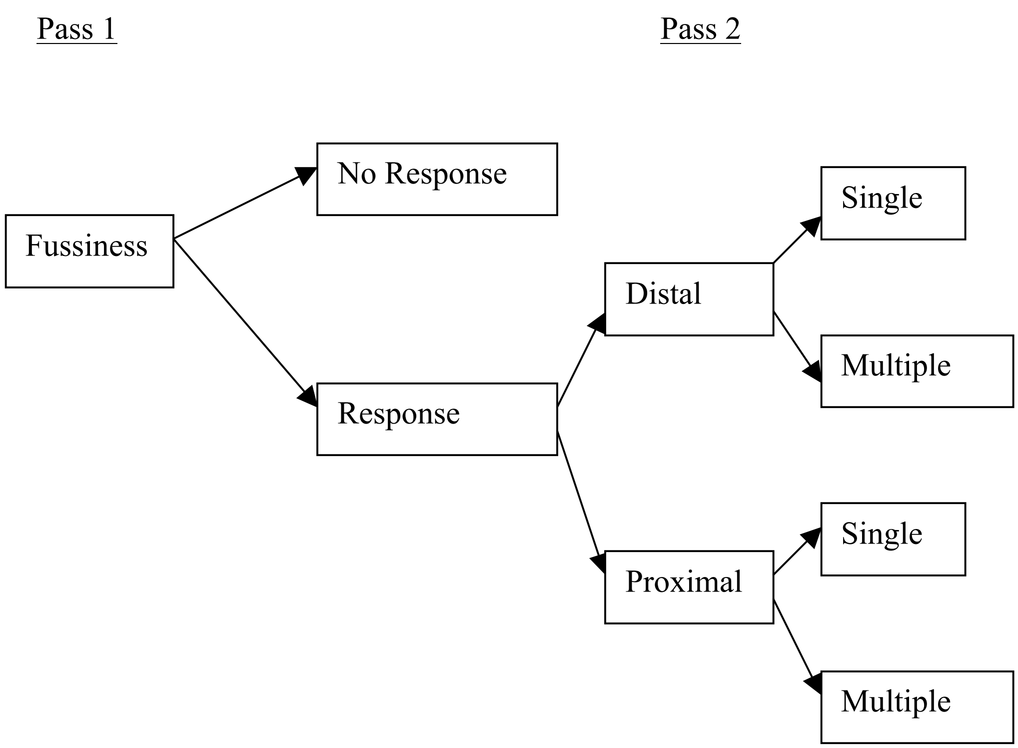
This analysis yielded Yule's Q values for each maternal response and each was used as a dependent variable in an analysis of variance (ANOVA). In addition to the analyses of individual response codes, variables according to proximity and number of behaviors used per response were created based on each code (see table 2).

Yule's Q values were calculated for proximity (Aim 1a) and number of behaviors per response (Aim 1b), and they were used as dependent variables in an ANOVA. *Proximal* responses were based on responses that were physically close to the infant (e.g. codes 3, 4, 9, 10, etc) and *Distal* responses were based on responses that were physically distant from infant (e.g. codes 1, 2, 5, 7, etc). Single-behavior responses were those responses that included only one behavior (e.g. codes 1-7). Multiple-behavior responses were those response codes that included more than one behavior (e.g. Codes 8-22) (see table 2 for examples of response codes, their proximity quality, and the number of behaviors they include. See Figure 4 for the code system diagram).

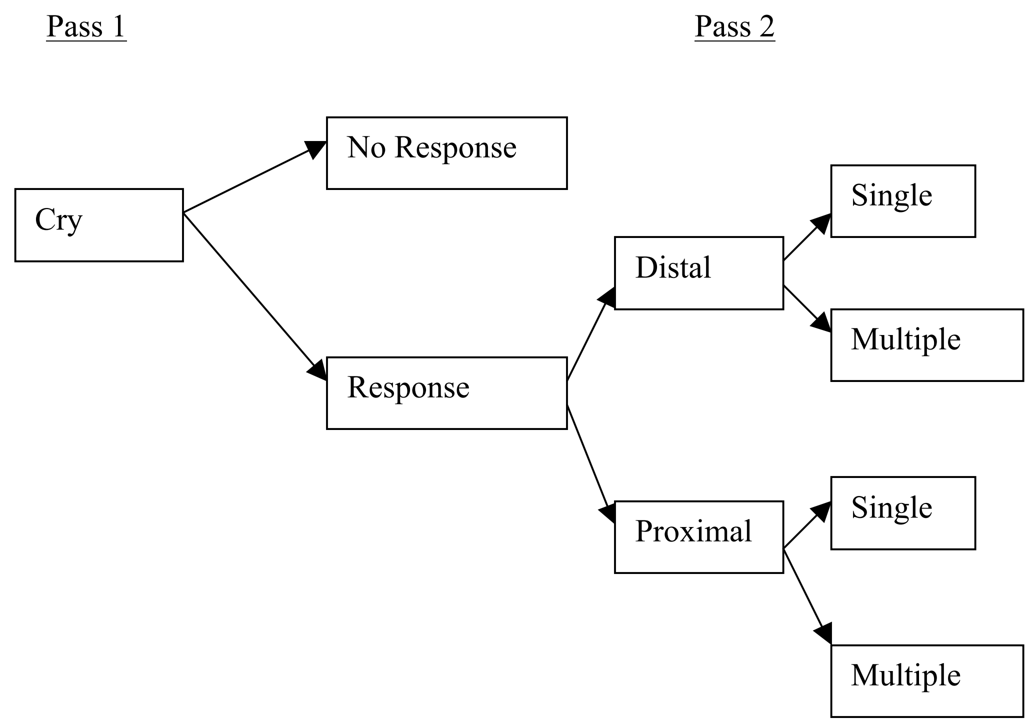
Figure 4.

Coding System Diagram

A. Fuss



B. Cry



To address Aim 1c, the average number of responses that each mother used in response to each infant distress bout was calculated and used as the dependent variable in an ANOVA. The effects of level of distress (1=cry, 0=fussiness), maternal depressive symptom status, infant gender, and the interaction of these variables were also examined in the ANOVA models.

To address Aim 2, the average time in seconds that it took mothers to respond to a sign of infant distress was used as a dependent variable in an ANOVA. The effects of level of distress (1=cry, 0=fussiness), maternal depressive symptom status, infant gender, and the interaction of these variables were also examined in the ANOVA model.

Finally, to address Aim 3, regression analyses were used to examine the effects of maternal depressive symptomatology (3-month CES-D continuous, independent variable) on maternal responses to infant distress while controlling for infant individual differences (duration and intensity of affectivity). Two variables were constructed: 1) the percentage of time the infant fussed and cried, and 2) the number of bouts or episodes of continuous negative affect display per infant. Maternal risk for mental health problems was also assessed in order to control for maternal individual differences for symptomatology. Each of these variables was added to the regression models.

CHAPTER 3

RESULTS

Prior to statistical analysis, variables were inspected in box plots to assess for outliers. Data for one dyad was omitted due to lack of maternal CES-D scores at the 3-month visit. Demographic variables (maternal age, education, or employment, and infant gender and birth weight) were analyzed and did not relate to maternal depressive symptoms, responsive variables, or infant negative affectivity measures used in the analyses. These demographic factors were excluded from further analyses.

The results from this study are presented as follows:

First, descriptive statistics for maternal response codes, proximity, number of behaviors in each response, non-responsiveness, response time-lag, number of changes in responses per bout, and global maternal behaviors are presented. Next, ANOVA results among these variables and CES-D score categories, addressing aims 1-2, are explored. Finally, to address Aim 3, multiple regression analyses designed to measure unique predictive validity of maternal depressive symptoms to maternal response patterns, proximity, number of behaviors used in each response, non-responsiveness, response time-lag, changes in response quality per bout, and global maternal behaviors are described.

Descriptive Statistics

Infant Negative Affect

On average, infants displayed total distress for 202 seconds (range= 3-644, SD= 156.2), fussiness only for 171 seconds (range= 3-619, SD= 131), and cry only for 31 seconds (range= 0-322, SD= 59). Cry was observed in only 37 infant-mother dyads. Mothers responded to infant distress bouts (including the duration of bout plus 10-second interval immediately following the bout), on average, 50% of the time.

Maternal Response

There was a wide range of variability among mothers in terms of sheer responsiveness; mothers' responsiveness (any response) to total negative affect display ranged from 8 to 100% of the time. The distribution of total responsiveness for all groups was skewed to consistent rates of responsiveness, and Kurtosis values of below 0 indicated a flattening of the distribution, where too many dyads fell in the extremes of the distribution. This indicates low variability in this sample.

Table 3 shows the mean and standard deviation of each response code by CES-D-score group. The variables represent the proportion of time that the mother engaged in a specific response (e.g., the total number of seconds in which the specific maternal behavior was observed) divided by the total number of seconds in which the mother could have responded to infant bout—infant bout duration plus 10 seconds from the offset of infant bout (response coding was discontinued after 10 seconds of non-responsiveness from onset of infant bout). In addition, maternal responses were also analyzed according to how proximal the maternal response was to the infant, and whether the response was represented by a single behavior (e.g. code 2; Vocalizing only) or by multiple behaviors (e.g. code 14; Looking + Vocalizing). Finally, rates of maternal non-responsiveness, response time-lag, and number of changes in response behaviors to each bout per CES-D group were also observed. The frequency patterns of composite variables are described below.

Table 3

Descriptives and ANOVA results

		0-1 (No Sxs)			2-15 (Low Sxs)			16+ (High Sxs)			
		N	M	SD	N	M	SD	N	M	SD	ANOVA (*F*)
Response Code											
1 (look only; %)	cry	9	0.4	(1)	20	0.1	(0.6)	9	0.3	(0.7)	*F*(2,35)= .401
	fuss	22	2.2	(4.4)	45	2.4	(3.4)	15	2	(3.2)	*F*(2,79)= .086
	total	22	2.1	(4.1)	45	2	(2.8)	15	2.1	(3.1)	*F*(2,79)= .016
2 (voc only; %)	cry	9	0.7	(0.9)	20	5.7	(7.8)	9	3.1	(4.3)	*F*(2,35)= 2.243
	fuss	22	8.4	(6.8)	45	8.3	(8.5)	15	7.2	(6.1)	*F*(2,79)= .141
	total	22	7.9	(7.1)	45	8.2	(7.6)	15	6.6	(5.9)	*F*(2,79)= .279
3 (touch only; %)	cry	9	0.6	(1.2)	20	0.5	(2.1)	9	0.7	(2.2)	*F*(2,35)= .048
	fuss	22	1.2	(2.2)	45	1	(1.9)	15	0.8	(1.5)	*F*(2,79)= .230
	total	22	1.4	(1.9)	45	1.1	(1.7)	15	0.7	(1.1)	*F*(2,79)= .678
4 (hold only; %)	cry	9	0.2	(0.5)	20	3.2	(12.5)	9	0.4	(1.1)	*F*(2,35)= .463
	fuss	22	1	(2.5)	45	0.6	(2.1)	15	0.6	(1.2)	*F*(2,79)= .347
	total	22	1	(2.4)	45	1.1	(3.6)	15	0.7	(1.2)	*F*(2,79)= .074
5 (play only; %)	cry	9	0.2	(0.7)	20	0.8	(3.4)	9	0	(0)	*F*(2,35)= .332
	fuss	22	0.1	(0.3)	45	0.7	(2)	15	0.8	(2)	*F*(2,79)= 1.203
	total	22	0.1	(0.3)	45	1	(2.2)	15	0.8	(2.1)	*F*(2,79)= 1.850
6 (feed only; %)	cry	9	0	(0)	20	0	(0)	9	0.2	(0.7)	*F*(2,35)= 1.669
	fuss	22	0.2	(0.6)	45	0.3	(1.3)	15	0	(0)	*F*(2,79)= .465
	total	22	0.2	(0.5)	45	0.1	(0.9)	15	0	(0.2)	*F*(2,79)= .155
7 (groom; %)	cry	9	0.3	(1)	20	3.3	(6.1)	9	2.6	(4.5)	*F*(2,35)= 1.111
	fuss	22	2.2	(5.6)	45	3.5	(5.9)	15	0.9	(1.9)	*F*(2,79)= 1.509
	total	22	2.1	(5.6)	45	3.1	(4.8)	15	1.9	(3.2)	*F*(2,79)= .544

Table 3

Descriptives and ANOVA results

		0-1 (No Sxs)			2-15 (Low Sxs)			16+ (High Sxs)			
		N	M	SD	N	M	SD	N	M	SD	ANOVA (*F*)
8 (look + feed; %)	Cry	9	2.6	(7.7)	20	1.6	(4.4)	9	0	(0)	$F(2,35)= .630$
	Fuss	22	0.3	(0.8)	45	0.9	(3.1)	15	0.1	(0.3)	$F(2,79)= 1.091$
	total	22	0.4	(1.1)	45	1	(2.9)	15	0.1	(0.2)	$F(2,79)= 1.279$
9 (look + touch; %)	Cry	9	0.6	(1.8)	20	0.1	(0.3)	9	4.5	(12.4)	$F(2,35)= 1.727$
	Fuss	22	1.1	(2.4)	45	1.7	(4.7)	15	0.3	(1.1)	$F(2,79)= .831$
	total	22	1.2	(2.2)	45	1.7	(4.5)	15	0.6	(1.4)	$F(2,79)= .449$
10 (look + hold; %)	Cry	9	0.5	(1.1)	20	1.2	(5.4)	9	0.2	(0.6)	$F(2,35)= .243$
	Fuss	22	0	(0.2)	45	0.7	(2.3)	15	0.2	(0.7)	$F(2,79)= 1.305$
	total	22	0.1	(0.4)	45	0.8	(2.5)	15	0.2	(0.6)	$F(2,79)= 1.281$
11 (look + play; %)	Cry	9	0	(0)	20	1.5	(4.2)	9	0	(0)	$F(2,35)= 1.147$
	Fuss	22	0.7	(3)	45	0.3	(0.9)	15	0.3	(1.1)	$F(2,79)= .309$
	total	22	0.6	(2.9)	45	0.5	(1.2)	15	0.4	(1.4)	$F(2,79)= .074$
12 (voc + hold + look; %)	Cry	9	0.8	(2.1)	20	7.2	(11.2)	9	1.4	(2.4)	$F(2,35)= 2.470$
	Fuss	22	5.6	(8.3)	45	4.2	(6)	15	2	(2.9)	$F(2,79)= 1.509$
	total	22	5.4	(7.8)	45	4.5	(6.1)	15	1.8	(2.6)	$F(2,79)= 1.598$
13 (hold + pat+ bounce; %)	cry	9	1.2	(2.1)	20	0.2	(0.5)	9	0.8	(2.5)	$F(2,35)= 1.402$
	fuss	22	0.7	(2.4)	45	0.9	(3)	15	2.2	(3.8)	$F(2,79)= 1.298$
	total	22	1.1	(3.5)	45	0.9	(2.8)	15	2	(3.2)	$F(2,79)= .735$
14 (look + voc; %)	Cry	9	4.8	(6)	20	4.7	(6.5)	9	0.8	(1.2)	$F(2,35)= 1.670$
	Fuss	22	10	(8.4)	45	11.7	(13.8)	15	11.6	(13.6)	$F(2,79)= .143$
	total	22	9.5	(8.2)	45	10.6	(13)	15	11	(13.6)	$F(2,79)= .084$
15 (look + voc + touch; %)	Cry	9	6	(12)	20	2.9	(6.5)	9	5.8	(13.1)	$F(2,35)= .465$
	Fuss	22	4.1	(7.8)	45	4.9	(8)	15	6.4	(7.4)	$F(2,79)= .390$
	total	22	5.3	(7.9)	45	4.6	(7.8)	15	5.5	(6.9)	$F(2,79)= .105$
16 (voc + touch; %)	cry	9	2.8	(6.8)	20	0.2	(0.6)	9	5	(13.9)	$F(2,35)= 1.402$
	fuss	22	4.1^{a}	(6.4)	45	1.4^{b}	(2.6)	15	3.5	(4.4)	$F(2,79)= 3.390^{*}$
	total	22	4.5^{a}	(6.5)	45	1.2^{b}	(2.5)	15	3.5	(5)	$F(2,79)= 4.561^{*}$
17 (voc + hold; %)	Cry	9	3.3	(7.9)	20	2.8	(4.9)	9	0.7	(2)	$F(2,35)= .633$
	Fuss	22	1.7	(3)	45	0.7	(1.7)	15	2.3	(3.2)	$F(2,79)= 2.788$
	total	22	2.4	(4.2)	45	1.2	(2.6)	15	2.2	(3)	$F(2,79)= 1.375$
18 (voc + feed; %)	Cry	9	0.9	(2.6)	20	0.9	(4)	9	0.2	(0.7)	$F(2,35)= .135$
	Fuss	22	0.4	(1.7)	45	0	(0.2)	15	0.2	(0.6)	$F(2,79)= 1.188$
	total	22	0.4	(1.6)	45	0.1	(0.6)	15	0.2	(0.5)	$F(2,79)= .948$
19 (voc + play; %)	cry	9	0	(0)	20	1	(2.5)	9	0	(0)	$F(2,35)= 1.411$
	fuss	22	1.5	(2.4)	45	2.2	(4.9)	15	0.6	(1.8)	$F(2,79)= .968$

Table 3

Descriptives and ANOVA results

		0-1 (No Sxs)			2-15 (Low Sxs)			16+ (High Sxs)			
		N	M	SD	N	M	SD	N	M	SD	ANOVA (*F*)
	total	22	1.6	(2.5)	45	2.9	(7.4)	15	1.3	(3.4)	*F*(2,79)= .651
20 (voc + play + look; %)	cry	9	2.3	(6.4)	20	0.8	(2.2)	9	0	(0)	*F*(2,35)= 1.034
	fuss	22	2.2	(3.8)	45	2.4	(4.1)	15	3	(4.3)	*F*(2,79)= .161
	total	22	2.4	(4.3)	45	2	(4)	15	2.9	(4.4)	*F*(2,79)= .225
21 (voc + feed + look; %)	Cry	9	3	(7.6)	20	1.1	(3)	9	1.8	(4)	*F*(2,35)= .500
	Fuss	22	0.8	(2.4)	45	1.9	(4)	15	0.2	(0.8)	*F*(2,79)= 1.868
	total	22	1.7	(3.9)	45	1.7	(3.5)	15	0.4	(1.4)	*F*(2,79)= .907
22 (voc + hold + pat + bounce; %)	Cry	9	4.8	(8.7)	20	1.1	(2.4)	9	6.3	(12.9)	*F*(2,35)= 1.726
	Fuss	22	3	(4.3)	45	2.9	(7.6)	15	0.9	(2.9)	*F*(2,79)= .667
	total	22	3.2	(4.2)	45	2.9	(7.7)	15	1.5	(4)	*F*(2,79)= .353
Proximity											
Proximal (%)	cry	9	29.8	(21)	20	26.8	(22)	9	28.2	(26.1)	*F*(2,35)= .053
	fuss	22	28.8	(18)	45	27.9	(21)	15	24.4	(14)	*F*(2,79)= .263
	total	22	32.9	(19)	45	29.3	(20)	15	24.9	(15.1)	*F*(2,79)= .814
Distal (%)	cry	9	6.2[a]	(7)	20	14[b]	(11)	9	6.9	(4.7)	*F*(2,35)= 3.159*
	fuss	22	22.9	(12)	45	26	(18)	15	21.6	(17.8)	*F*(2,79)= .521
	total	22	21.7	(12)	45	23.9	(15)	15	21.6	(19.9)	*F*(2,79)= .213
# of Behaviors in a Response											
Single (%)	cry	9	2.4	(4.2)	20	13.6	(18)	9	7.4	(5.4)	*F*(2,35)= 2.318
	fuss	22	15.4	(11)	45	16.9	(13)	15	12.2	(6.5)	*F*(2,79)= .960
	total	22	14.8	(11)	45	16.6	(12)	15	12.8	(7.9)	*F*(2,79)= .723
Multiple Behaviors (%)	cry	9	33.5	(22)	20	27.1	(24)	9	27.7	(26.8)	*F*(2,35)= .230
	fuss	22	36.3	(21)	45	37	(22)	15	33.8	(21.7)	*F*(2,79)= .120
	total	22	39.8	(22)	45	36.6	(22)	15	33.7	(21.5)	*F*(2,79)= .360
Mean delay (Secs)	cry	9	8.4	(15)	20	3.24	(1.9)	9	5.14	(4.76)	*F*(2,35)= 1.357
	fuss	22	4.3	(3.1)	45	4.32	(2.8)	15	3.81	(1.85)	*F*(2,79)= .201
	total	22	4.34	(3.1)	45	4.25	(2.7)	15	3.9	(1.91)	*F*(2,79)= .129
Mean number of changes	cry	9	2.93	(1.8)	20	2.74	(1.7)	9	2.31	(1.25)	*F*(2,35)= .355
	fuss	22	2.21	(0.8)	45	2.82	(4.6)	15	2.23	(0.86)	*F*(2,79)= .301
	total	22	2.32	(0.8)	45	2.25	(0.7)	15	2.24	(0.88)	*F*(2,79)= .064

Table 3

Descriptives and ANOVA results

		0-1 (No Sxs)			2-15 (Low Sxs)			16+ (High Sxs)			
		N	M	SD	N	M	SD	N	M	SD	ANOVA (*F*)
Non-response frequency (%)	cry	9	7.2	(15)	20	9.5	(22)	9	7.3	(14)	$F(2,35)= .052$
	fuss	22	18.4	(20)	45	14.7	(16)	15	26.6	(21.4)	$F(2,79)= 2.377$
	total	22	17.6	(20)	45	13.8	(16)	15	24.6	(19.9)	$F(2,79)= 2.131$
Total responsive behaviors	cry	9	35.9	(22)	20	42.9	(25)	9	35.1	(26.3)	$F(2,35)= .422$
	fuss	22	51.7	(22)	45	53.9	(21)	15	46	(24.4)	$F(2,79)= .727$
	total	22	51.5	(22)	45	54	(20)	15	45.3	(24.3)	$F(2,79)= .906$

Note: $*p < .05$, $^{a,\,b}$ significant differences between 0-1 and 2-15 CES-D groups.

Proximity

Proximal Behaviors. Mothers in the 0-1 symptom group responded to infant distress with proximal interactions 33% of the time (29% of the time to fuss, and 30% of time to cry), 2-15 symptom mothers engaged in proximal responses 29% of the time (28% to fuss, and 27% to cry), and 16+ symptom mothers used proximal responses 25% of the time (24% to fuss, and 28% to cry).

Distal Behaviors. Mothers in the 0-1 symptom group responded to infant distress with distal responses 22% of the time (23% of the time to fuss, and 6% of time to cry), 2-15 symptom mothers used distal responses 24% of the time (26% to fuss, and 14% to cry), and 16+ symptom mothers used distal responses 22% of the time (22% to fuss, and 7% to cry).

Number of Behaviors Used per Response

Single Behaviors. Mothers in the 0-1 symptom group responded to infant distress with single-behavior responses 15% of the time (15% of the time to fuss, and 2% of time to cry), 2-15 symptom mothers responded with single-behavior responses 17% of the time (17% to fuss, and 14% to cry), and 16+ symptom mothers used single-behavior responses 13% of the time (12% to fuss, and 7% to cry).

Multiple Behaviors. Mothers in the 0-1 symptom group responded to infant distress with combined behaviors 40% of the time (36% of the time to fuss, and 34% of time to cry), 2-15 symptom mothers responded with combined behaviors 37% of the time (37% to fuss, and 27% to cry), and 16+ symptom mothers used combined responsive behaviors 34% of the time (34% to fuss, and 28% to cry).

Change in Responses per Infant Bout

The mean number of changes in responses to each infant bout was 2 changes for the overall sample to all infant bouts. Mothers in the 0-1 symptom group changed behaviors, on average, 2.3 times (2.2 times while responding to fussiness, and 2.9 times while responding to cry). Mothers in the 2-15 symptom group changed behaviors 2.3 times (2.8 times in response to fuss, and 2.7 times in response to cry), and 16+ mothers changed on average 2.2 times (2.2 in response to fuss and 2.3 in response to cry).

Non-Responsiveness

In terms of non-responsiveness, on average, mothers in the 0-1 symptom group did not respond to17.5% of the total infant distress bouts (18% in response to fuss, and 7% in response to cry), 2-15 symptom mothers did not respond to 14% of infant distress bouts (15% of fuss bouts, and 9.5% of cry bouts), and 16+ mothers did not respond to 25% of infant distress bouts (27% of fuss bouts, and 7% cry bouts). In the overall sample, mothers did not respond to 17% of infant bouts (18% of fuss bouts, and 8% of cry bouts).

Response Time-Lag

Overall, mothers in this sample responded within 4 seconds of onset of infant distress bout (4.14 in response to fuss, and 5.6 seconds in response to cry). Mothers with 0-1 symptom scores responded within 4.3 seconds (4.3 seconds in response to fuss, and 8.4 seconds in response to cry). Mothers with 2-15 symptom scores responded within 4.3 seconds (4.3 seconds in response to fuss, and 3.2 seconds in response to cry), and mothers with 16+ symptom scores responded on average within 3.9 seconds (3.8 seconds in response to fuss, and 5.1 seconds in response to cry).

Maternal Global Behaviors

In addition to the proposed analyses based on the 22 response codes created for this study, the most commonly observed behaviors used by mothers within those 22 responses were also analyzed. The decision to analyze specific behaviors that may occur in multiple response codes was based on the fact that many response codes were observed in only a few mothers; decreasing the sample size for those code variables when sample was divided into three symptom groups. The small N values for some of the response code variables may elicit problems for creating false positive results (increasing likelihood of a type I error), or increasing the chance that important differences would be missed (increasing likelihood of a type II error), which is why the further analysis of maternal global behaviors, used throughout different response codes, was done.

We will call these behaviors maternal "global" behaviors (see Table 2 for list of behaviors in the columns across the table). The maternal global behaviors chosen to be included in the analyses are comparable to maternal responsive behaviors that have been studied in previous research on maternal responsiveness to infant distress in mothers with non-elevated depressive symptoms (Bell & Ainsworth, 1972; Nicely, et al., 1999; Bornstein & Tamis-LeMonda, 1989). These researchers coded the following behaviors individually, as they occurred, even if they were not mutually exclusive. The 22 response codes designed in the current study were mutually exclusive. The most relevant behaviors that are comparable with those analyzed in previous studies were *feeding, holding, looking, playing, touching, and vocalizing.* For example, the frequency of *touching* behavior in our study would be the sum of all maternal responses that involved touching behaviors (e.g. code 3; touching only; code 9; looking + touching; code 15; looking + vocalizing + touching; and code 16; vocalizing + touching).

This can be observed in table 2, where the column labeled "Touch" will have a dark cell on the rows respective to all codes that contains touching behaviors In addition, two global behaviors, Looking and Vocalizing, were observed to occur simultaneously in all symptoms groups for about 20% of the time in response to infant distress; which makes the combination of Looking and Vocalizing global behaviors the third most likely observed global response behavior (see figures 5-7). The occurrence of Looking and Vocalizing simultaneously (sum of response codes 12, 14, 15, 20 and 21), was also analyzed in the models. The rates of each global behavior in response to cry, fuss, and total negative affect are illustrated respectively in figures 5-7.

Figure 5.

Incidence of Global Behavior Responses to Cry

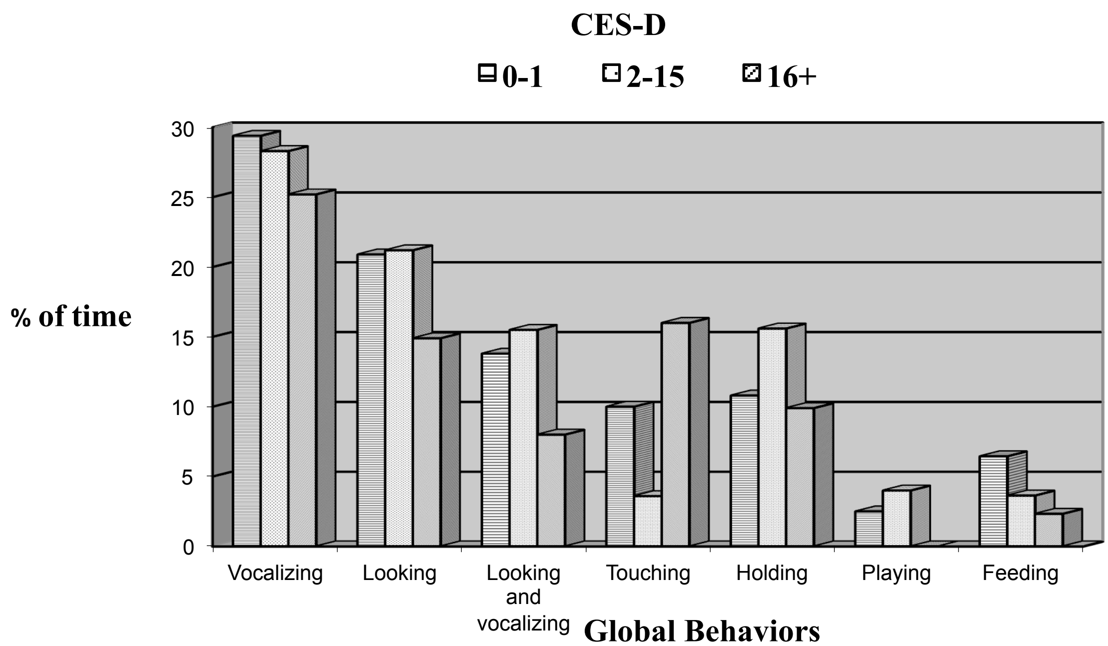


Figure 6.

Incidence of Global Behavior Responses to Fuss

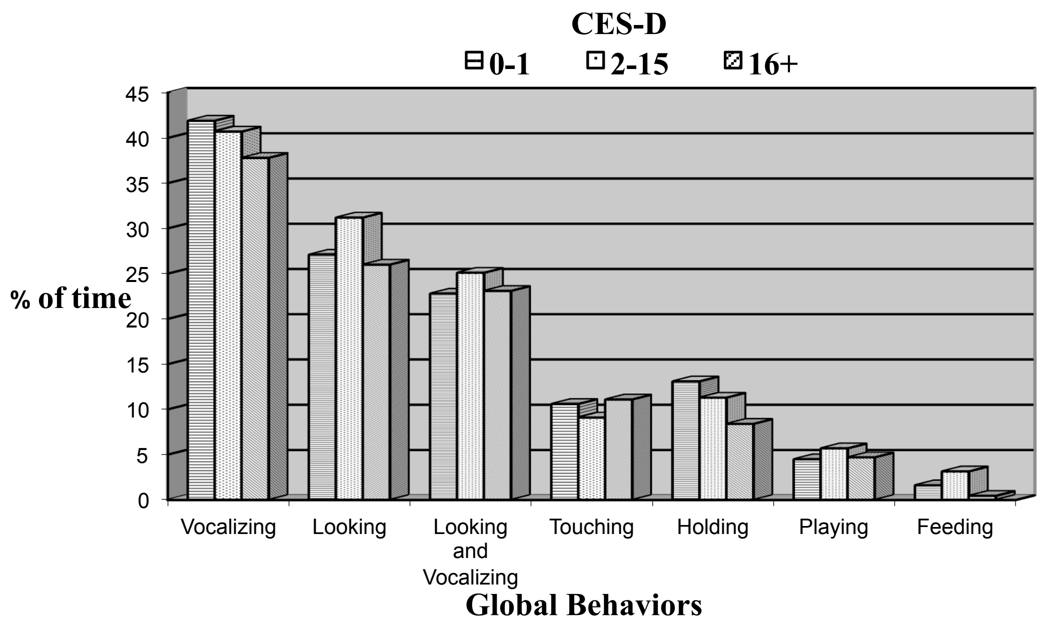
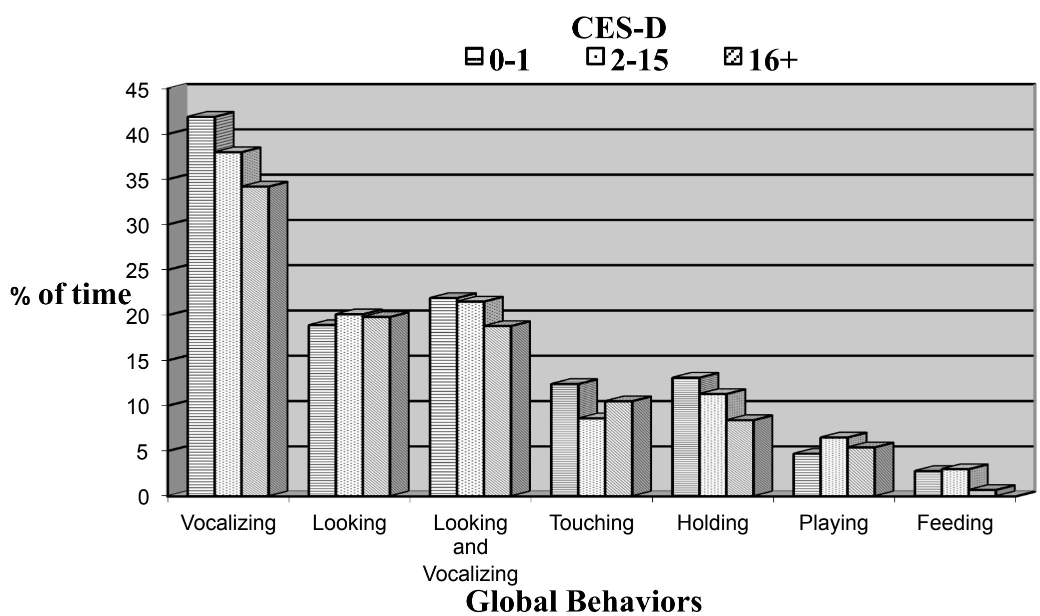


Figure 7.

Incidence of Global Behavior Responses to Total Infant Negative Affect



Feeding. In the overall sample, mothers used *feeding* behaviors 4.3% of the time in response to all distress displays (range= 0-50, SD= 8.7), 3.7% (range= 0-53, SD= 9) in response to fuss only, and 4.5% (range= 0-100%, SD= 15.7) in response to cry only. The use of *feeding* global behaviors did not differ among the three CES-D groups (see table 4 for means and standard deviations).

Holding. In the overall sample, mothers used *holding* behaviors 20% of the time in response to all distress displays (range= 0-68, SD= 16.5), 18% (range= 0-67, SD= 16.4) in response to fuss only, and 15% (range= 0-100, SD= 26) in response to cry only. The use of *holding* global behaviors did not differ among the three CES-D groups (see table 4 for means and standard deviations).

Looking. In the overall sample, mothers used *looking* behaviors in response to infant distress 53% of the time in response to all distress displays (range= 3-100%, SD= 21.8), 54% (range= 4-100%, SD= 22) in response to fuss only, and 20% (range= 0-100%, SD= 29) in response to cry only. The use of *looking* global behaviors did not differ among the three CES-D groups (see table 4 for means and standard deviations).

Playing. In the overall sample, mothers used the global behavior of *playing* with the infant in response to infant distress 11% of the time in response to all distress displays (range= 0-53%, SD= 13), 11.5% (range= 0-65%, SD= 14) in response to fuss only, and 3% (range=0-41%, SD= 8.4) in response to cry only. The use of *playing* global behaviors did not differ among the three CES-D groups (see table 4 for means and standard deviations).

Touching. In the overall sample, mothers used *touching* behavior 18% of the time in response to all distress displays (range= 0-72%, SD= 17), 18% (range= 0-90%, SD=19) in response to fuss, and 7.5% (range= 0-100%, SD= 19) in response to cry. The use of *touching* global behaviors did not differ among the three CES-D groups (see table 4 for means and standard deviations).

Vocalizing. In the overall sample, mothers used the global behavior of *vocalization,* to respond to infant distress, 76% of the time in response to all distress displays (range= 22-100%, SD= 18.5), 77% (range= 22-100%, SD= 19) in response to fuss only, and 32% (range= 0-100%, SD= 41) in response to cry only. The use of *vocalizing* global behaviors did not differ among the three CES-D groups (see table 4 for means and standard deviations).

Looking and Vocalizing. In the overall sample, mothers used *looking and vocalizing* behaviors together 41% of the time in response to all distress displays (range= 0-100, SD= 21.7), 44% (range= 0-100%, SD= 23) in response to fuss, and 14.5% (range= 0-80%, SD= 23.5) in response to cry). The use of *looking and vocalizing* global behaviors did not differ among the three CES-D groups (see table 4 for means and standard deviations).

These maternal global behavior variables were analyzed in ANOVAs to investigate how they differ among the three CES-D groups (see Table 4 for ANOVA results); and in regression models (see Regression Analyses section) to further explore the effect of maternal depressive symptoms on maternal responsive behaviors, while accounting for infant individual differences.

Table 4

Behavior Descriptives and ANOVA results

Global Behaviors		0-1 (No Sx) N	M	SD	2-15 (Low Sx) N	M	SD	16+ (High Sx) N	M	SD	ANOVA (*F*)
Feeding	cry	9	6.45	(15)	20	3.64	(6.7)	9	2.33	(4.2)	*F*(2,35)= .507
	fuss	22	1.62	(4)	45	3.15	(7.2)	15	0.45	(1.3)	*F*(2,79)= 1.42
	total	22	2.8	(4.9)	45	3.0	(6.1)	15	0.7	(1.7)	*F*(2,79)= 1.06
Holding	cry	9	10.8	(9.1)	20	15.6	(18)	9	9.9	(13)	*F*(2,35)= .535
	fuss	22	13.1	(12)	45	11.3	(12)	15	8.4	(7.3)	*F*(2,79)= .756
	total	22	13.1	(12)	45	11.3	(12)	15	8.4	(7.3)	*F*(2,79)= .756
Looking	cry	9	20.9	(19)	20	21.2	(19)	9	14.9	(26)	*F*(2,35)= .312
	fuss	22	27.1	(19)	45	31.2	(20)	15	26.0	(19)	*F*(2,79)= .555
	total	22	18.9	(12)	45	20.1	(16)	15	19.8	(16)	*F*(2,79)= .052
Looking and Vocalizing	cry	9	13.8	(17)	20	15.5	(18)	9	8.0	(13)	*F*(2,35)= .636
	fuss	22	22.8	(16)	45	25.1	(19)	15	23.1	(19)	*F*(2,79)= .151
	total	22	21.9	(17)	45	21.5	(16)	15	18.8	(16)	*F*(2,79)= .186
Playing	cry	9	2.5	(6.4)	20	4.0	(6.6)	9	0.0	(0)	*F*(2,35)= 1.54
	fuss	22	4.5	(5.7)	45	5.7	(7.3)	15	4.7	(5.9)	*F*(2,79)= .294
	total	22	4.7	(5.9)	45	6.5	(9.1)	15	5.4	(7.6)	*F*(2,79)= .410
Touching	cry	9	10.0	(13)	20	3.6	(6.8)	9	16.0	(27)	*F*(2,35)= 2.18
	fuss	22	10.6	(13)	45	9.1	(10)	15	11.1	(10)	*F*(2,79)= .253
	total	22	12.4	(13)	45	8.6	(10)	15	10.5	(9.9)	*F*(2,79)= .960
Vocalizing	cry	9	29.4	(24)	20	28.3	(25)	9	25.2	(18)	*F*(2,35)= .081
	fuss	22	41.9	(22)	45	40.7	(19)	15	37.8	(25)	*F*(2,79)= .176
	total	22	41.9	(22)	45	38.0	(19)	15	34.2	(24)	*F*(2,79)= .629

Yule's Q Scores

As explained earlier, Yule's Q values range from -1 to +1; where zero values indicate that no contingent relation is assumed, plus one (1) values suggest that a positive contingent relation between infant cry onset and maternal behavior is assumed, and a minus one (-1) value indicates that the absence of cry and presence of fuss is contingent and strongly associated with the maternal response being observed (see table 5 for Yule's Q values).

For 0-1 CES-D group, the Yule's Q value for proximal behaviors was contingently associated with onset of cry for 0-1 mothers (Yule's Q= .6, SD= .56, 95% CI, .22 to .941). Yule's Q value for number of behaviors per response (e.g., single vs. multiple-behavior responses) was contingently associated with cry for 0-1 mothers (Yule's Q= .7, SD= .39, 95% CI, .45 to .95). Yule's Q value for Non-responsiveness was also found to be contingently associated with fussiness in the 0-1 CES-D group (Yule's Q= -.73, SD= .6, 95% CI, -.035 to -1.11). For 2-15 CES-D group, the Yule's Q values for *touching* global behavior was contingently associated with onset of fussiness (Yule's Q= -.55, SD= .59, 95% CI, -.27 to -.83). Yule's Q value for Non-responsiveness was also found to be contingently associated with fussiness in the 2-15 CES-D group (Yule's Q= -.7, SD= .6, 95% CI, -.041 to -1.05).

For 16+ CES-D group, the Yule's q value for the *looking* global behavior was contingently associated with fussing (Yule's Q= -.48, SD= .72, 95% CI, .014 to .95) CES-D symptom group. Yule's Q values for *Playing* global behavior were found to be contingently associated with fussing, and not with cry in the high symptom group (16+ CES-D scores; Yule's Q= -1, SD= 0). Yule's Q values for *Looking and vocalizing simultaneously* global behaviors were found to be contingently associated with fussing, and not with cry in the high symptom group (16+ CES-D scores; Yule's Q= -.5, SD= .65, 95% CI, -.08 to -.92). Finally, Yule's Q value for Non-responsiveness was found to be contingently associated with fussiness in the 16+ CES-D group (16+, Yule's Q= -.8, SD= .4, 95% CI, -.54 to -1.06).

Despite these contingent probabilities found, only *multiple-behavior*, *touching*, and *playing* responses differed significantly among the three CES-D groups. The Yule's q values for the maternal global behaviors of *feeding*, *vocalizing*, and *holding* had no contingent association with onset of distress in all three symptom groups.

Table 5

Yule's Q descriptives and ANOVA results

	0-1 (No Sx)			2-15 (Low Sx)			16+ (High Sx)			
Response behaviors	N	M	SD	N	M	SD	N	M	SD	ANOVA (*F*)
YulesQ_proximal	9	**0.58**	(0.56)	19	0.25	(0.57)	9	0.09	(0.86)	$F(2,36)= 1.4$
YulesQ_composed	9	**0.70**	(0.39)	19	0.12	(0.6)	9	0.02	(0.87)	$F(2,36)= 3.3$*
YulesQ_feed	7	-0.19	(1.02)	9	-0.19	(0.86)	4	0.39	(0.95)	$F(2,19)= .062$
YulesQ_look	9	0.03	(0.65)	19	-0.18	(0.49)	9	**-0.48**	(0.72)	$F(2,36)= 1.72$
YulesQ_voc	8	0.18	(0.7)	19	-0.04	(0.81)	9	0.29	(0.71)	$F(2,35)= .62$
YulesQ_touch	8	0.29	(0.68)	17	**-0.55**	(0.59)	8	-0.17	(0.84)	$F(2,32)= 4.2$*
YulesQ_hold	9	0.03	(0.79)	19	0.26	(0.74)	8	-0.08	(0.85)	$F(2,35)= 0.63$
YulesQ_play	5	-0.38	(0.91)	14	-0.18	(0.7)	6	**-1.00**	(0)	$F(2,24)= 3.2$*
Yule's Q_look_voc	9	-0.09	(0.56)	19	-0.31	(.473)	9	**-0.50**	(.65)	$F(2,34)= 1.31$
YulesQ_No_Resp	9	**-0.73**	(0.6)	15	**-0.70**	(0.6)	9	**-0.80**	(.4)	$F(2,32)= .082$

Note: *$p < .05$. Numbers in bold indicate a Yules Q value that is close to 1 or -1.

ANOVA Results

One-way analyses of variance (ANOVAs) were used to test whether there were significant differences in the mean scores of the dependent variables across the three CES-D groups. Analyses of variance were done to measure differences in maternal responses, mean delay of response, rates of non-responsiveness, and average changes in response types per infant distress bout. Percentages of time were used for maternal responsive behaviors in order to decrease likelihood of outliers and to improve normality of data distribution. Proximity and number of behaviors used per response were also analyzed separately. Maternal global behaviors were also analyzed in ANOVA models, since many response codes had a very small representative sample per symptom group.

Aim 1 Results

A one-way between-groups analysis of variance was conducted to explore the effect of levels of depressive symptoms on maternal responses (based on 22 response codes) to infant distress. Subjects were divided into three symptom groups (0-1: No Symptom; 2-15: Low Symptom; and 16+: High symptom). There was a statistically significant difference at the $p < .05$ in code 14 (vocalizing + touching; F (2, 79) = 4.56, p= .013). The effect size, calculated using eta squared, was 0.1, showing a large effect size, according to Cohen (1988). Post-hoc comparisons using the Tukey HSD test indicated that the mean score for 0-1 (No Symptom group; M= 4.5, SD= 6.5) was significantly different from 2-15 (Low Symptom group; M= 1.2, SD= 2.5). The High symptom group of mothers (16+ CES-D score; M= 3.5 SD= 5) did not differ significantly from either No (0-1) or Low (2-15) symptom groups.

No other statistically significant difference was observed among CES-D groups and incidence of use of maternal response codes in response to infant distress (see table 3 for ANOVA results).

A one-way, between-groups, ANOVA was conducted to explore the effect of CES-D symptom levels on use of global behaviors in response to infant distress, according to three symptom groups (0-1; 2-15; 16+). The results of the maternal global behavior analyses resulted in no significant differences among the three CES-D groups in response to all levels of infant negative affect (see table 4).

A one-way, between-groups, ANOVA was conducted to explore CES-D symptom levels' effect on the contingency of responses to onset of infant distress, according to three symptom groups (0-1; 2-15; 16+). Individual Yule's Q values for each response code were not valid variables for this study due to the small frequency of most individual codes used (see table 3 for means). Thus, Yule's Q values were used for only maternal global behaviors.

A one-way, between-groups, ANOVA was conducted to explore CES-D symptom levels' effect on the contingency of proximal responses to onset of infant distress, based on three symptom groups (0-1; 2-15; 16+). Despite the fact that Yule's Q values for proximal responses was contingently associated with fussing in the 16+ CES-D symptom group, and no contingent relation was found in 0-1 and 2-15 CES-D symptom groups, the ANOVA analyses did not result in statistically significant difference in contingency of proximal behavior to infant cry among the three CES-D groups (see table 5 for ANOVA results). Furthermore, the contingency of proximal behaviors also did not differ among the three CES-D groups in response to fuss or total negative affect.

The ANOVA conducted to explore CES-D symptom levels' effect on the contingency of multiple-behavior responses to onset of infant distress, indicated significant differences at the $p < .05$ level, among the three CES-D groups (F (2, 36) = 3.3, p= .05). The Yule's Q value for number of behaviors used per response (single vs. multiple behaviors), was contingently associated with onset of cry for 0-1 mothers, but no association between complexity of behavior and intensity of distress was observed for 2-15 or 16+ mothers). The actual difference in mean scores between the groups was quite large. The effect size, calculated using eta squared, was 0.16, which, according to Cohen (1988), is a large effect size. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for 0-1 (No Symptom group; *M*= .7, SD= .39) was marginally significantly different from 2-15 (Low Symptom group; *M*= .12, SD= .6), and from 16+ group (High symptom group; *M*= .02, SD= .87). The High symptom group did not differ significantly from 2-15-symptom group.

A one-way ANOVA was conducted to explore CES-D symptom levels' effect on the contingency of maternal global *Looking* behaviors to onset of infant distress. Despite the fact that Yule's Q values for the Looking global behavior was contingently associated with fussing in the 16+ CES-D symptom group, and no contingent relation was found in 0-1 and 2-15 CES-D symptom groups, there were no statistically significant differences among the three CES-D groups.

The ANOVA conducted to explore CES-D symptom levels' effect on the contingency of maternal global *Touching* behavior to onset of infant cry, indicated significant differences at the $p < .05$ level, among the three CES-D groups (F (2, 32) = 4.2, p= .024) in response to cry. The global *Touching* behavior was contingently associated with fuss in the Low Symptom group (2-15 CES-D scores), but no contingent relation between touching and intensity of distress was found. The actual difference in mean scores between the groups was quite large. The effect size, calculated using eta squared, was 0.22, which, according to Cohen (1988), is a large effect size. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for 0-1 (No Symptom group; *M*= .29, SD= .68) was significantly different from 2-15 (Low Symptom group; *M*= .55, SD= .59). The High symptom group of mothers (16+; *M*= .17, SD= .84) did not differ significantly from either 0-1 or 2-15 symptom groups. Despite the statistically significant differences among CES-D groups in terms of contingency of *Touching* behavior and onset of cry, the contingency of maternal global *Touching* behavior did not differ among the three CES-D groups in response to fuss or total negative affect.

The ANOVA conducted to explore CES-D symptom levels' effect on the contingency of maternal global *Playing* behavior to onset of infant distress, indicated marginally significant differences among the three CES-D groups (F (2, 24) = 3.2, p= .06), in response to fuss. The *Playing* global behavior was found to be contingently associated with fussing, and not with cry in the high symptom group (16+ CES-D scores), while no contingent relation was found in the No Symptom (0-1), and the Low Symptom (2-15) groups. The actual difference in mean scores between the groups was quite large. The effect size, calculated using eta squared, was 0.23, which, according to Cohen (1988), is a large effect size. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for 2-15 (Low Symptom group; *M*= .18, SD= .91) was significantly different from 16+ (High symptom group; *M*= 1.00, SD= 0). The No Symptom group of mothers (0-1; *M*= .39, SD= .91) did not differ significantly from either 2-15 or 16+ symptom groups. Despite the statistically significant difference among CES-D groups in terms of contingency of *Playing* behavior and onset of fuss, the contingency of maternal global *Playing* behavior did not differ among the three CES-D groups in response to cry or total negative affect.

Notable, the Yule's Q values for all global behavior variables were also not significantly related to demographic variables (e.g. infant gender, maternal education, etc) and were not included in further statistical analyses.

Aim 1a Results

A one-way, between-groups, ANOVA was conducted to explore CES-D symptom levels' effect on proximity of response behaviors, according to three symptom groups (0-1; 2-15; 16+). There was a significant difference at the $p < .05$ level in *Distal* behaviors for the three CES-D groups in response to cry (F (2, 34) = 3.159, p= .05). The actual difference in mean scores between the groups was quite large. The effect size, calculated using eta squared, was 0.15, which according to Cohen (1988) is a large effect size. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for 0-1 (No Symptom group; M= 6.2, SD= 6.9) was significantly different from 2-15 (Low Symptom group; M= 13.9, SD= 11.1). The High symptom group of mothers (16+; M= 6.9 SD= 4.7) did not differ significantly from either 0-1 or 2-15 symptom groups. Despite the statistically significant difference among CES-D groups in terms of proximity of response to infant cry, response proximity did not differ among the three CES-D groups in response to fuss or total negative affect.

Aim 1b Results

A one-way, between-groups, ANOVA was conducted to explore CES-D symptom levels' effect on the number of behaviors used per response by the mothers, according to three symptom groups (0-1, 2-15, and 16+). The use of single-behavior responses in response to total negative affect, fussiness, and cry, did not differ significantly. The use of multiple-behavior responses in response to total negative affect, fussiness, and cry displays, also did not vary significantly among the three CES-D groups (see table 3 for ANOVA results).

Aim 1c Results

Mothers did not differ in the average number of times that they used different response codes per bout in response to all levels of infant distress, and among the three CES-D groups. In addition, among the three CES-D groups, mothers did not significantly differ on frequency of non-responsiveness in response to fuss, cry, or total negative affect display (see table 3).

Aim 2 Results

No significant differences in response latency (or time lag) to all levels of infant distress (cry, fuss, and total distress) were observed in this sample, among all the three CES-D groups.

Regression Analyses

Aim 3 Results

Multiple regressions were used to analyze the predictive validity of depressive symptoms on maternal response to infant distress; number of behaviors used per response; proximity; response delay; number of changes in responses per bout; and non-responsiveness; after controlling for the influence of rates of negative affectivity (duration and intensity) were included in the model to control for infant individual differences.

A standard multiple regression was performed between maternal depressive symptoms (CES-D) as the dependent variable and number of behaviors used per response and proximity as the independent variables. The influence of rates of negative affectivity (duration and intensity) was included in the model to control for individual differences. Analysis was performed using SPSS REGRESSION and SPSS EXPLORE for evaluation of assumptions.

Results of evaluation of assumptions led to transformation of the variables to reduce skewness and the number of outliers, and improve the normality, linearity, and homoscedasticity of residuals, and multicollinearity. Square root transformations were used on the measure of *total single-behavior responses* (Skewness= 1.27; Kurtosis= 1.8), and *total single-behavior responses* to fuss (Skewness= .81; Kurtosis= 1.08), as well as on the continuous *CES-D* dependent variable (Skewness= 1.215), and the control variables of *duration of negative affect* (Skewness= 1.001), *SCL-90 maternal psychopathology risk* (Skewness= 1.79; Kurtosis= 3.89). Logarithmic transformations were used on *intensity of infant distress* Skewness= 4.59; Kurtosis= 26.52). With the use of a $p < .01$ criterion for Mahalanobis distance only one outlier was found among the cases. One dyad had missing data for CES-D at 3 months, and the dyad was removed from analysis, $N = 82$.

Table 6 displays the correlations between the variables, the unstandardized regression coefficients (B) and intercept, the standardized regression coefficients (β), R^2, and adjusted R^2 for all the regression analyses described below. For this analysis, the R for the regression was not significantly different from zero, F (3, 81) = .425, p = .736, with R^2 at .016. The adjusted R^2 value of -.022 indicates that about 2% of the variability in CES-D was predicted by the model. No regression coefficients differed significantly from zero.

Table 6

Regressions: Predicted values by CES-D accounting for independent differences

Variables	**CES-D (log) (DV)**	**Multiple-Behavior**	**Intensity of infant Distress**	**Infant distress (secs)**	***B***	***b***
Multiple-behaviors	-0.071	1	-0.006	0.542	-0.001	-0.139
Intensity of distress	0.049	0.542	0.105	1	0.17	0.125
Infant distress (secs)	-0.041	0.69	0.074	0.441	0	0
					Intercept= 2.519	
						R^2= .016
Means	2.47	135.5	0.76	12.03		Adj R^2= -0.02
SD	1.18	126.77	0.87	4.77		R= .127

Variables	**CES-D (log) (DV)**	**Distal Response**	**Intensity of infant Distress**	**Infant distress (secs)**	***B***	***b***
Distal Response	-0.107	1	0.473	0.689	-0.067	-0.189
Intensity of distress	0.049	0.473	1	0.441	0.168	0.124
Infant distress (secs)	-0.041	0.689	0.441	1	0.009	0.035
					Intercept= 2.795	
						R^2= .025
Means	2.47	8.34	0.76	12.03		Adj R^2= -0.01
SD	1.18	3.35	0.87	4.77		R= .158

Table 6 cont.

Regressions: Predicted values by CES-D accounting for independent differences

Variables	**CES-D (log) (DV)**	**# of Changes/ Bout**	**Intensity of infant Distress**	**Infant distress Durati on**	***B***	***b***
# of changes in Response/bout	0.046	1	-0.481	-0.604	0.02	0.067
Intensity of distress	0.049	-0.481	1	0.441	0.139	0.102
Infant distress (secs)	-0.041	-0.604	0.441	1	-0.011	-0.045
					Intercept= 2.406	
						R^2= .010
Means	2.47	4.89	0.76	12.03		Adj R^2= -0.03
SD	1.18	4.05	0.87	4.77		R= .100

Variables	**CES-D (log) (DV)**	**Maternal Response Delay**	**Intensity of infant Distress**	**Infant distress Durati on**	***B***	***b***
Maternal Response Delay	-0.1	1	0.039	0.189	-0.041	-0.092
Intensity of distress	0.049	0.039	1	0.441	0.107	0.079
Infant distress (secs)	-0.041	0.189	0.441	1	-0.014	-0.059
					Intercept= 2.742	
						R^2= .015
Means	2.47	4.21	0.76	12.03		Adj R^2= -0.02
SD	1.18	2.67	0.87	4.77		R= .124

Table 6 cont.
Regressions: Predicted values by CES-D accounting for independent differences

Variables	CES-D (log) (DV)	Maternal Non-Response	Intensity of infant Distress	Infant distress (secs)	*B*	*b*
Maternal Non-Responsiveness	-0.016	1	0.288	0.398	-0.004	-0.012
Intensity of distress	0.049	0.288	1	0.441	0.116	0.085
Infant distress (secs)	-0.041	0.398	0.441	1	-0.018	-0.074
					Intercept= 2.615	
						R^2= .007
Means	2.47	2.5	0.76	12.03		Adj R^2= -0.03
SD	1.18	3.22	0.87	4.77		R= .086

Global Behaviors

Variables	CES-D (log) (DV)	Feed	Touch	Hold	Play	Intensity of infant Distress	Infant distress (secs)	*B*	*b*
Feeding	-0.03	1	0.1	0.21	-0.089	0.267	0.251	0	-0.004
Touching	-0.068	0.1	1	0.552	0.195	0.181	0.475	-0.001	-0.045
Holding	-0.043	0.21	0.552	1	0.246	0.322	0.571	0	-0.008
Playing	0.074	-0.089	0.195	0.246	1	0.116	0.539	0.007	0.148
Intensity of distress	0.049	0.267	0.181	0.322	0.116	1	0.441	0.144	0.106
Infant distress (secs)	-0.041	0.251	0.475	0.571	0.539	0.441	1	-0.035	-0.141
									Intercept= 2.863
									R^2= .025
Means	2.47	7.46	31.35	34.15	18	0.76	12.03		Adj R^2= -.053
SD	1.18	16.72	45.57	46.9	26.16	0.87	4.77		R= .159

A standard multiple regression was performed between maternal depressive symptoms (CES-D) as the dependent variable and *Distal* behaviors as the independent variable. The influence of rates of negative affectivity (duration and intensity) was included in the model to control for individual differences. Analysis was performed using SPSS REGRESSION and SPSS EXPLORE for evaluation of assumptions (see table 6 for (*B*) and intercept, the standardized regression coefficients (β), R^2, and adjusted R^2). The *R* for this regression was not significantly different from zero, F (3, 81) = .664, p = .577, with R^2 at .025. The adjusted R^2 value of -.013 indicates that about 1% of the variability in CES-D was predicted by the model. No regression coefficients differed significantly from zero. Number of behaviors used per response did not contribute to the regression model.

Another standard multiple regression was performed between maternal depressive symptoms (CES-D) as the dependent variable and maternal response delay (time-lag) as the independent variable. The influence of rates of negative affectivity (duration and intensity) was included in the model to control for individual differences. Analysis was performed using SPSS REGRESSION and SPSS EXPLORE for evaluation of assumptions (see table 6 for (*B*) and intercept, the standardized regression coefficients (β), R^2, and adjusted R^2). The *R* value for this regression model was not significantly different from zero, F (3, 81) = .408, p = .748, with R^2 at .015. The adjusted R^2 value of -.022 indicates that about 2% of the variability in CES-D was predicted by the model. No regression coefficients differed significantly from zero. Number of maternal response delay did not contribute to the regression model.

To analyze changes in response strategy, a standard multiple regression was performed between maternal depressive symptoms (CES-D) as the dependent variable and maternal response changes per bout as the independent variable. The influence of rates of negative affectivity (duration and intensity) was included in the model to control for individual differences. Analysis was performed using SPSS REGRESSION and SPSS EXPLORE for evaluation of assumptions (see table 6 for (*B*) and intercept, the standardized regression coefficients (β), R^2, and adjusted R^2). *R* for this regression analysis was not significantly different from zero, F (3, 81) = .261, p = .853, with R^2 at .010. The adjusted R^2 value of -.028 indicates that about 3% of the variability in CES-D was predicted by maternal response changes per bout, as well as infant distress intensity, and infant distress duration. No regression coefficients differed significantly from zero. Number of maternal response changes per bout did not contribute to the regression model.

For non-responsiveness, a standard multiple regression was performed between maternal depressive symptoms (CES-D) as the dependent variable and maternal non-responsiveness as the independent variable. The influence of rates of negative affectivity (duration and intensity) was included in the model to control for individual differences. Analysis was performed using SPSS REGRESSION and SPSS EXPLORE for evaluation of assumptions (see table 6 for (*B*) and intercept, the standardized regression coefficients (β), R^2, and adjusted R^2). *R* for this regression was not significantly different from zero, F (3, 81) = .196, p = .899, with R^2 at .007. The adjusted R^2 value of -.031 indicates that about 3% of the variability in CES-D was predicted by the model. No regression coefficients differed significantly from zero. Number of maternal non-responsive behaviors did not contribute to the regression model.

Finally, to evaluate the effect of CES-D on use of Global behaviors, a standard multiple regression was performed between maternal depressive symptoms (CES-D) as the dependent variable and *Feeding*, *Touching*, *Holding*, and *Playing* global behaviors as the independent variables. The influence of rates of negative affectivity (duration and intensity) was included in the model to control for individual differences. Analysis was performed using SPSS REGRESSION and SPSS EXPLORE for evaluation of assumptions (see table 6 for (B) and intercept, the standardized regression coefficients (β), R^2, and adjusted R^2). The R for regression was not significantly different from zero, F (6, 81) = .326, p = .922, with R^2 at .025. The adjusted R^2 value of -.053 indicates that about 5% of the variability in CES-D was predicted by the model. No regression coefficients differed significantly from zero.

Regression analyses did not include Yule’s Q values due to the small N values secondary to infrequent infant cry displays in this sample (N=38).

CHAPTER 4

DISCUSSION

This study attempted to measure the effects of maternal depressive symptomatology on maternal responsive behaviors, latency of response, and patterns of response (e.g. proximity, complexity, number of responses per bout, and non-responsiveness) to infant distress at 3-months postpartum. The findings of this study revealed that the rates of response codes and global behaviors, latency of response, number of behaviors used per response, and non-responsiveness were similar across all three depressive symptom groups.

The rates of infant negative affect found in this study (i.e., 202 seconds total, or 11% of the time; 171 seconds, or 9% of the time fussiness only; and 31 seconds, or 2% of the time, cry only) are congruent with those of studies of infant daily crying rates, which showed an average of 2.2-2.7 hours per day, or approximately, 150-202.5 seconds per 30 minutes, within the first three months of the infant (Bell & Ainsworth, 1972; Brazelton, 1962; Hunziker & Barr, 1986; St. James-Roberts & Halil, 1991; and Wolff, 1987). No gender differences were found in rates of infant negative affect displays.

The overall responsiveness to infant distress in this study (i.e., 50% of the time) was similar to those found in studies on mothers with non-elevated depressive symptoms (e.g. 58%; Milgrom et al., 2004). Although these rates are based on response to all infant cues (positive, neutral, or negative), they still seem to be comparable to those found in the current study, in which only responses following negative affect were coded.

Notable, the observed wide range of individual variation in maternal responsiveness (8-100% of the time) in this study has also been reported in studies of maternal responsiveness to infant distress in mothers with non-elevated depressive symptoms by Bell & Ainsworth (at 3-months; 1972), Bornstein & Tamis-LeMonda (at 5-months; 1997), and Nicely, et al. (at 12-months; 1999).

In terms of non-responsiveness, the 7-25% rates of non-responsiveness found in the current study are considerably lower compared to other studies of mothers with non-depressive symptoms, with comparable demographic characteristics, which found 44-46% of unresponsiveness to cry episodes within first 3 months of infant (Bell & Ainsworth, 1992; Hubbard & van IJzendoorn, 1991).

The time lags in response to onset of infant distress found in this study (about 4-second delay in all CES-D groups) seem slower than those found in previous studies of European-American mothers with non-depressive symptoms (e.g., .2-.8 seconds latency, Papousek & Papousek, 1987, 1989, 1991). It is important to note that different studies have measured onset of response, or type of maternal behavior that was considered to be a response to infant distress, in varying ways. These design differences may alter the outcome time-lag rates observed in each study. In addition, laboratory studies are more likely to show faster response rates since the mother does not have the distracters that she might have at home.

ANOVA results showed a significant difference between 0-1 and 2-15 CES-D groups in the use of Code 14- (looking and touching simultaneously), as well as in the use of *Distal* behaviors, but the lower symptom groups did not differ significantly from the16+ CES-D group in both Code 14 and *Distal* behaviors. With the exception of the looking and touching (Code 14), and *Distal* behaviors, the results of this study did not show significant differences among the 22 response codes created to analyze maternal responsive behaviors in response to infant distress, which is why the further analyses of maternal global behaviors, used throughout different response codes, were done. As noted earlier, the decision to analyze specific behaviors that may occur in multiple response codes was based on the fact that many response codes were observed in only a few mothers; decreasing the sample size for those code variables when the sample was divided into three symptom groups.

In the global behavior analyses, mean rates of *vocalization* in response to fuss and overall distress (76-77% occurrence) seem to be comparable but somewhat higher than rates shown by previous studies of low-risk mothers (e.g. 58% occurrence; Bornstein & Tamis-LeMonda, 1989). However, mothers in this study used *vocalizing* in response to cry at a mean rate of 32% of the time, which more congruent with rates found by other studies of low-risk mothers (e.g. 20% occurrence at 3 months; Bell & Ainsworth, 1972; and 21% occurrence in a Boston sample at 4-months; Richman et al., 1992). Mothers in this study responded to infant cry with *Looking* about 20% of the time. A study of Boston, low-risk, non-depressed mothers, found comparable rates of looking in response to distress at 22% of the time, with infants at 4-months of age (Richman et al., 1992). Mothers in this study responded to fuss or overall distress with *Looking* on average 50% of the time. The rates of *touching* in response to infant distress in this sample (e.g. 9-12%) seem to be comparable to those found by previous researchers in studies of mothers with non-depressive symptoms (e.g. 8% occurrence in a Boston sample at 4-months; Richman et al., 1992; and 15% occurrence at 3 months; Bell & Ainsworth, 1972). The mean *feeding* rates in response to cry, fuss, and total distress (~4%) found in this study seem to be comparable to findings from a study with non-depressed Bostonian mothers (e.g. 2% of the time, at 4-months; Richman et al., 1992). However, they seem to be much lower than those observed by other researchers in studies of mothers with non-depressive symptoms (e.g. 15-19% occurrence at 2-3 months; Bell & Ainsworth, 1972; and Jarhomi & Stifter, 2007). The mean rates of 15-18% of *holding* in response to infant cry, fuss, and total distress appear to be lower than those found by previous studies done with non-depressed mothers, which show a 30-40% occurrence rate of holding or picking up the infant in response to cry within the first three months (Richman et al., 1992; Bell & Ainsworth, 1972). The mean rates of *playing* response to fuss and overall distress (11-12%) seem to be comparable to those found by previous researchers in studies of mothers with non-depressive symptoms (e.g. 10%, occurrence, at 3 months; Bell & Ainsworth, 1972). However, mothers in this study were less likely to use *playing* in response to cry (3% of the time). Analyses of variance did not result in any significant differences among the three CES-D groups. No differences were found among the three CES-D groups in use of global behaviors in response to infant cry, fuss, or overall distress.

The low-risk and demographic homogeneity qualities of this sample may have obscured possible influences of higher depressive symptoms on maternal responsive behaviors to infant distress. This is evidenced by the similarity of behavioral rates observed in these samples and previous findings of studies done with non-depressed women—as observed in *vocalizing, looking, touching*, and *feeding* global behaviors.

Contingency analyses carried out with maternal global behaviors, proximity, number of behaviors used per response, and non-responsiveness demonstrated trends of contingent behavior dependent on intensity of negative affectivity display in this sample. For 0-1 CES-D group, the Yule's Q value for proximal behaviors and multiple-behavior responses were contingently associated with onset of cry and non-responsiveness was contingently associated with onset of fussiness. For 2-15 CES-D group, the Yule's Q values for *touching* global behavior and non-responsiveness were contingently associated with onset of fussiness. For 16+ CES-D group, the Yule's Q value for the *looking*, *playing, looking and vocalizing simultaneously* global behaviors, and non-responsiveness were contingently associated with fussing. Despite these contingent probabilities found, only *multiple-behavior*, *touching*, and *playing* responses differed significantly among the three CES-D groups. The Yule's Q values for the maternal global behaviors of *feeding*, *vocalizing*, and *holding* had no contingent association with onset of distress in all three symptom groups.

ANOVA analyses showed significant differences in contingent *multiple-behavior* responses with cry displays between mothers with No/One symptom and higher levels of depressive symptoms. This suggests that mothers with no depressive symptoms may be more likely to readily use multiple-behavior responses to infant cry than mothers with higher rates of depressive symptoms. Low symptom (2-15 CES-D) mothers differed significantly from mothers of other symptom groups on *touching* global behaviors. These mothers contingently responded with touch to low intensity of infant distress. No relation was observed between *touching* global behavior and intensity of distress displays in the other symptom groups. This finding also indicates that mothers with no or one depressive symptom are more likely to touch the infant when the infant is fussy, but not when the intensity of distress increases. Lastly, mothers from different CES-D groups differed significantly in the way they used *playing* global behavior contingent to onset of infant distress displays. High symptom mothers differed from lower symptom mothers (at marginally significant levels) in the way they used *playing* to contingently respond to infant distress displays—high symptom mothers did not use play interactions to respond to high intensity infant distress (cry). This suggests that higher depressive symptoms may decrease mother's likelihood of playing with her infant in response to infant cry. This finding seems to be congruent with the notion that mothers with elevated depressive symptoms may perceive cry as a more noxious stimulus, which elicits more involved and proximal/soothing responsive behaviors from these mothers.

A limitation of the Yule's Q contingency analyses is the diminished sample size for these analyses. Less than half of the total sample size was used for the contingency analyses. This was due to the low rates of crying in this sample. Only 37, out of the 82 infants, displayed cry during the coded videotaped interactions. This means that to compare contingent behaviors according to intensity of affective display (fuss→cry), only those infants who displayed both levels of intensity of distress were included in the analyses. This issue limited the proposed analyses greatly, and may have prevented these findings from providing generalizable and informative data about contingency of maternal responsiveness to infant distress in these symptom groups. Studies with larger samples need to be completed in order further investigate how maternal depressive symptomatology may impact the way in which mothers contingently respond to different levels of negative affect displays.

Multiple regressions were used to analyze the predictive validity of depressive symptoms on maternal response to infant distress according to number of behaviors used per response; proximity; response delay; number of changes in responses per bout; and non-responsiveness; after controlling for the influence of rates of negative affectivity (duration and intensity) were included in the model to control for infant individual differences. Regression models showed no predictive validity of depressive symptoms on any of the maternal variables. This finding suggests that, even after controlling for infant individual factors, CES-D scores did not predict maternal responsive behaviors.

The reader should be mindful of the demographic homogeneity and low-risk quality of this sample, which may contribute to the maternal responsiveness patterns found in this study. In addition, differences in how mothers respond to infant distress and soothe their infants may depend on cultural and societal expectations (Axia & Weisner, 2002), which should be considered prior to generalizing or comparing these findings to populations with other demographic characteristics.

It should also be noted that the home context of this study may not present the stressors needed to observe behavioral differences in mothers with varying levels of depression symptoms in low-risk Caucasian mothers. Previous studies employing laboratory paradigms including stressful situations (e.g. still face paradigm, or Ainsworth attachment paradigm), have reported differences between mothers with elevated and non-elevated depressive symptoms (e.g., Moore, Cohn, & Campbell, 2001).

In conclusion, this study found that mothers with higher levels of depressive symptoms may be less likely to engage in distal behaviors in response to infant distress compared to mothers with lower depressive symptoms. However, further analyses of response soothing quality are needed to provide further evidence for an intrusive profile for higher CES-D mothers in low-risk samples. Maternal total responsiveness rates and infant affectivity levels were congruent with those found in previous studies of mothers with non-elevated depressive symptoms. The small differences found between CES-D groups in this sample may suggest that maternal depressive symptoms, without other comorbid or environmental risk factors (Carter et al., 2001), or the presence of stressful stimuli, such as laboratory experiments, may not allow for the discernment of the way in which mothers with varying levels of depressive symptoms respond to infant distress at 3-months in their own home setting during a naturalistic observation.

APPENDIX

CODE SYSTEM

Maternal Responsive Codes

1. (Looking only)- Use this code if only mother's gaze shifts towards baby's direction following the beginning of the infant negative affect event.

2. (Vocalizing only)- Use this code if mother only uses vocalizations to respond to infant negative affect.

3. (Touching only)- Use this code if mother touches the infant in order to respond to infant negative affect. Repeated back and forth hand motions on baby's stomach or back are included. Holding or picking up actions should be coded as "h" (holding).

4. (Holding only)- Use this code if mother holds baby or picks up the infant in order to respond to infant negative affect.

5. (Playing with Toy/hands or feet only)- This code should be used when mother responds to displays of infant negative affect by engaging the infant in a playful manner with a toy, or with baby's hands or feet. Tickling, clapping baby's hands, and doing hand games (e.g. itsy-bitsy spider, or patty cake) should also be given this code.

6. (Feeding only)- Use this code when mother responds to infant negative affect by feeding the infant (e.g. including getting a bottle, positioning the infant for breastfeeding, etc).

7. (Grooming)- Use this code when mother responds to infant negative affect by repositioning infant to make him/her more comfortable, cleaning or wiping infant's face or hands, moving the infant to a new location, or changing infant's diaper or clothes.

8. (Looking + Feeding)- same as "feeding" (see code #6), however mother is also looking at infant while engaging in feeding.

9. (Looking + Touching)- Use this code when mother responds to infant distress by touching (see code description #3), while also looking at infant.

10. (Looking + Holding)- Use this code when mother responds to infant distress by holding or picking up the infant (see code description #4), while also looking at the infant.

11. (Looking + Playing)- Use this code when mother responds to infant distress by playing with infant (see code #5), while looking at infant simultaneously.

12. (Vocalizing + Holding + Looking)- Use this code when mother responds to infant distress by vocalizing, holding, and looking at the infant simultaneously (see code descriptions # 1, 2, and 4).
13. (Holding + Patting + Bouncing)- Use this code when mother responds to infant distress by holding, patting, and bouncing the infant simultaneously (see code description #4).

14. (Looking + Vocalizing)- Use this code when mother responds to infant distress by shifting gaze towards and vocalizing to the infant.

15. (Looking + vocalizing + Touching)- Use this code when mother responds to infant distress by shifting gaze towards, vocalizing to, and by touching the infant.

16. (Vocalizing + Touching)- Use this code when mother responds to infant distress by vocalizing to and touching the infant.

17. (Vocalizing + Holding)- Use this code when mother responds to infant distress by vocalizing to and holding the infant simultaneously.

18. (Vocalizing + Feeding)- Use this code when mother responds to infant distress by vocalizing to and feeding the infant simultaneously.

19. (Vocalizing + Playing)- Use this code when mother responds to infant distress by vocalizing and playing with the infant simultaneously.

20. (Vocalizing + Playing + Looking)- Use this code when mother responds to infant distress by using vocalizations, play, and gaze towards the infant simultaneously.

21. (Vocalizing + Feeding + Looking)- Use this code when mother responds to infant distress by vocalizing, feeding, and gazing at the infant simultaneously.

22. (Vocalizing + Holding + Patting + Bouncing)- Use this code when mother responds to infant distress by vocalizing, holding/picking up, patting, and bouncing simultaneously.

Infant Negative Affect Codes

F. (Fuss)- Use this code when baby is fussy. When fussy sounds are uttered, paired with erratic arm and leg movements, AND there is no crying, use this code.

C. (Cry)- This code should be used when it is clear that the infant is crying.

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