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EMOTIONAL REACTIVITY AND REGULATION IN INFANTS OF POSTPARTUM  
DEPRESSED MOTHERS

by

Christina Louise Franklin

An Abstract

Of a thesis submitted in partial fulfillment of the requirements for the Doctor of  
Philosophy degree in Psychology in the Graduate College of The University of Iowa

December 2009

Thesis Supervisor: Professor Michael W. O'Hara

## ABSTRACT

A large body of evidence has accumulated which indicates that infants of postpartum depressed mothers are at risk for negative sequelae, including later psychopathology. However, methodological difficulties including discordant definitions of postpartum depression and the use of paradigms that have used the mother-infant relationship to assess infant emotional expression and regulation lead to a lack of consensus regarding the nature and transmission of that risk. This study sought to address those methodological difficulties by employing an established paradigm designed to elicit emotionality in infants, the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith & Rothbart, 1999).

Participants were 30 women who met DSM-IV criteria for Major Depressive Disorder (MDD), 50 women who did not meet MDD criteria, and their 8-13 month old infants. The women were recruited from five counties within Iowa, which contain both rural and urban centers. Consistent with state demographics, the sample was predominantly Caucasian. Mother-infant dyads were assessed approximately five months after the mother had completed a diagnostic interview. At that time six episodes from the Lab-TAB designed to elicit fear, anger, and positive affect were conducted.

Emotional reactivity was coded using the AFFEX (Goldsmith & Rothbart, 1988) and composite scores were generated for each emotion. Infants of depressed mothers exhibited less intense pleasure to stimuli designed to elicit that emotion. There was also a slight, non-significant, trend for infants of depressed mothers to display more intense fear and to remain fearful longer. There was not a difference between the groups in anger expression. Emotional regulation was examined using a set of procedures set forth by

Buss and Goldsmith (1998) to determine effective regulation. These procedures involve calculating the change in affect from the coding epoch in which a “putative regulatory behavior” is displayed in the epoch immediately after the behavior. Change scores that involved no change in affect or a decrease in negative affect were considered effective regulation. Playing with clothing or an object and interacting with the stimulus were effective at regulating both fear and anger. In addition, averting gaze (disengaging with the task) was effective in regulating anger. Follow-up analysis revealed that infants of depressed mothers used gaze aversion more frequently than infants of nondepressed mothers. In addition, they were less likely to engage in social referencing (looking toward the mother) during episodes designed to elicit fear.

The findings of this study are consistent with a growing body of evidence that documents the significance of considering low positive affect in examination of diagnosis and risk for depression and suggests that fear expression may be central to anxiety. Furthermore, results from the emotional regulation paradigms underscore the need for continued examination of the construct of “effective regulation.” In addition, these results highlight disruptions in the mother-infant relationship, which have implications for developing efficient regulatory mechanisms.

Abstract Approved:

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Thesis Supervisor

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Date

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Thesis Supervisor: Professor Michael W. O'Hara

Graduate College  
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CERTIFICATE OF APPROVAL

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PH.D. THESIS

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This is to certify that the PH. D. thesis of  
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has been approved by the Examining Committee for the thesis requirement for the Doctor of Philosophy degree in Psychology at the December 2009 graduation.

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## CHAPTER 1

### INTRODUCTION

Postpartum depression, or clinically significant depressive symptoms that occur shortly after the birth of a child, affects approximately 13% of new mothers (O'Hara, Neunaber, & Zekoski, 1984; O'Hara & Swain, 1996). This disorder represents a significant public health concern, not only due to its deleterious effects on the psychosocial well-being of the mother, but also due to the demonstrated links between a mother's postpartum depression and negative outcomes for the infant and the mother-infant relationship. An impressive body of research convincingly documents the negative effects of being raised by a depressed mother, which are broad and encompass nearly all aspects of child development. For example, research has demonstrated that children of depressed mothers are at an increased risk for developing depression and other psychiatric disorders (Weissman et al., 1987). However, there is no concise theory that explains the mechanisms by which that risk develops into psychopathology. Recent theories that have attempted to explain the intergenerational transmission of psychopathology have focused on the infant's ability to effectively regulate his or her negative emotions (Thompson, 2001).

Emotional regulation refers to both internal and external processes that are responsible for monitoring, evaluating, and modifying emotional reactions, especially intensity and duration, to accomplish one's goals (Thompson, 1994). Since the concept's introduction in 1994, a large research literature has accumulated that examines this construct in a variety of contexts. However, this research literature has evolved without extensive consideration of the merit and validity of the construct. The most recent review

of the state of the literature on emotional regulation identified three areas of deficiencies for research involving the construct (Cole, Martin, & Dennis, 2004). First, a majority of studies that explore emotional regulation fail to define the construct. Second, much of the research that explores the process of regulating emotion does not clearly distinguish emotion from the process of regulating emotion. Finally, several studies that have explored emotional regulation have related emotional expression (usually described in terms of either positive or negative valence of emotion) with a correlate of interest as evidence of emotional regulation without clearly outlining the regulatory process.

Despite the methodological difficulties, the ability to regulate one's emotions well has been empirically related to several important developmental sequelae. Specifically, emotional regulation is thought to serve an important role in the development of behavioral control (Kopp, 1989). Poor regulation has been related to a greater expression of negative emotions, which is regarded as a risk-factor for developing later externalizing or internalizing disorders (Brody, Stoneman, & Burke, 1988; Caspi, Henry, McGee, Moffitt, & Silva, 1995). Given the importance of regulation to the development of behavioral control and childhood psychopathology, it is imperative to thoroughly examine the emotional regulatory abilities of infants of depressed mothers.

Research using a self-report methodology has outlined the association between maternal depression, negative affect, and infant's regulatory capabilities (Bridgett et al., 2009). Bridgett et al. (2009) found that higher Beck Depression Inventory, Second Edition (BDI-II) (Beck, Steer, & Brown, 1996) scores were predictive of higher levels of mother reported negative affect in infants as measured on the Infant Behavior Questionnaire Revised (IBQ-R) (Gartstein & Rothbart, 2003). Furthermore, there was evidence that

suggested that persistently higher levels of negative affect throughout infancy compromises infants' ability to effectively regulate their negative emotional expressions at twelve months of age.

The present study sought to further the state of knowledge related to the emotional regulatory capabilities of infants of depressed mothers by studying infants in a context other than one that entails mother-infant interaction. Another aim of the study was to address many of the criticisms of the construct of emotional regulation by formulating a precise definition of the construct and examining the relation between emotion and emotional regulation.

#### *Postpartum Depression as a Mechanism of Risk*

Several studies have documented the association between maternal depression and childhood psychopathology. Specifically, this relation has been observed for child depression (Weissman et al., 1987; Beardslee, Schultz & Selman, 1987; Hammen, 1991; Lee & Gotlib, 1991; Cummings & Davies, 1994). In addition, research suggests that children reared by a depressed mother also are at an increased risk for developing another internalizing disorder (e.g., anxiety disorders) or an externalizing disorder (Anderson & Hammen, 1993).

Early attempts to develop a theory that explains the observed relation between maternal depression and childhood psychopathology focused on simple models. These models have often invoked some process, such as direct genetic inheritance, which was posited to be responsible for the development of psychopathology. These simple linear explanations failed to adequately explain the relation between parental depression and childhood psychopathology.

The failure of simple models to explain the observed relation between maternal depression and childhood psychopathology led to the search for mediators and moderators. A large number of psychological variables have been alleged to mediate or moderate the relation between maternal depression and childhood psychopathology. Researchers have examined poverty, parental discord, parental behavior (e.g., punishment, supervision, and attitudes), maternal-child relations (across a variety of ages), stress, child characteristics (including temperamental difficulty, expression of negative affect, endocrine abnormalities, and cognitive deficits), and child gender. In addition, researchers have also examined the duration, number, and time of onset (relative to the child's age) of the maternal depressive disorder (Goodman & Huang, 2001).

The lack of a parsimonious model that can explain the association between maternal mood disturbance and childhood psychopathology likely reflects Ludwig von Bertalanffy's concept of equifinality, meaning that one end result can occur via many different paths (von Bertalanffy, 1962). Based on this model, it is likely that the risk factors listed above influence the child and are influenced by the child and then the environment in different ways throughout development.

During the prenatal period and infancy mothers with mood disorders (even when nonsymptomatic) contribute to their infant's developing temperament both directly and via biological contributions. Biological contributions are conceptualized as either genetic inheritance of traits that place the child at an increased risk for the development of psychopathology (Kendler et al., 1992) or as exposure to hormonal abnormalities in utero (Field, 2002). This association is then mediated and moderated by maternal

behavior (such as sensitivity), the family context (such as poverty or familial stress), parenting behavior, and child's gender.

Children are not passive receptacles of genetic information, hormones, social context, and parenting behavior. As early as infancy, children display individual differences in their arousal, orientation, and response to external stimuli (Meares, Penman, Milgrom-Friedman, & Baker, 1982; Hernandez-Reif, Field, Diego, & Ruddock, 2006; Boatella-Costa, Costas-Moragas, Botet-Mussons, Fornieles-Deu, De Caceres-Zurita, 2007). Therefore, research that attempts to understand maternal depression as a risk factor for later childhood psychopathology must also appreciate children as active forces in not only responding to their environment but also in shaping it.

There is research that has demonstrated differential response to parenting behavior based on child temperamental characteristics. Previous research that examined the relation between fearfulness (based on observation of behavior) and maternal behavior found that the same maternal behaviors did not predict internalization of conscience for low and high fear children (Kochanska, 1997). For high fear children maternal gentle discipline was the strongest predictor of internalized conscience. For low fear children maternal responsive orientation (MRO) predicted internalized conscience. MRO describes a mother-child relation that is characterized by positive affect and the child's committed compliance (Kochanska, 2002). Committed compliance describes a wholehearted acceptance of maternal values and requests. This research demonstrates differential pathways for socialization based on children's characteristics.

The present study was designed to address maternal depression as a risk factor for later psychopathology by examining the impact of maternal depression on the expression

of particular emotions (such as fear and joy). In addition, this project sought to examine the impact of early maternal depression on children's ability to use cognition and behavior to modulate their emotional state. Previous research, using the still face paradigm and behavioral observations of the mother-infant dyad, suggested that there is a significant association between maternal depression and infant temperament. However, these studies have not used assessments that have been linked to recognized theories of temperament. Therefore, the purpose of this research was to examine this association in the context of an established theory of temperament. This research was necessary to provide a foundation to understand the intergenerational transmission of psychopathology.

### *Postpartum Depression*

The 4th edition of the Diagnostic and Statistical Manual defines a Major Depressive Episode with postpartum onset as a Depressive Episode that begins within four weeks of delivery (American Psychological Association, 1994). The succinct definition offered by DSM-IV belies the marked heterogeneity in the definition of postpartum depression employed in the research literature. The definitions used in the research literature vary on a number of dimensions including time of onset, duration, and symptoms that are considered to part of the postpartum state. This variation makes definitive conclusions related to the prevalence, causes, and outcomes of postpartum depression difficult.

### *Prevalence and Definition of Postpartum Depression*

Research studies have used a variety of modalities to establish the presence or absence of postpartum depression, including interviews leading to DSM diagnosis and

self-report measures. Two commonly used self-report measures used to assess depressive symptoms in postpartum populations include the Beck Depression Inventory (BDI; (Beck, Ward, Mendelson, Mach, & Erbaugh, 1961) and the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden & Sagovsky, 1987). The BDI is a 21-item self-report measure which yields scores that range from 0 to 63 and is frequently used to ascertain the level of depressive symptoms in samples of postpartum women. Women are considered depressed if they exceed a scale score of 12. The BDI is used to screen for depression in the general population and it has been argued that postpartum women receive higher than average scores because of the number of items that describe the postpartum period generally, rather than postpartum depression specifically (e.g., increased tiredness). This led to the development of the EPDS, a self-report instrument designed to screen women for postpartum depression. In the research literature women have typically been considered depressed if they exceed a scale score greater than 11 or 12 on the EPDS (Segre & O'Hara, 2005).

The lack of a consistent method of establishing depressive symptoms in the postpartum depression literature leads to confusion when trying to interpret the results of studies that have used inconsistent standards for measurement. Specifically, it is unclear how results from studies that have defined “postpartum depression” by a cutoff score on an instrument like the BDI or the EPDS relate to results from studies which have defined “postpartum depression” by application of diagnostic criteria.

The research literature has also considered a broad time-frame for the onset of symptoms ranging from immediately postpartum to two years after delivery. There is some research that suggests that onset of symptoms does vary markedly across women.

For some women symptoms begin during pregnancy and continue beyond and for others symptoms may begin several months after childbirth (Watson, Elliott, Rugg, & Brough, 1984). The findings reported by Watson et al. (1984) suggest that postpartum depression is a heterogeneous disorder. It is possible that differing times of onset are a result of various causes and may lead to different outcomes. However, further research is needed that could evaluate this possibility.

The lack of a consistent definition of postpartum depression contributes to the difficulty the literature has had reaching a consensus on prevalence. The research literature has provided estimates of postpartum depression ranging from 2% to over 50%. The estimates obtained vary markedly depending on the type of population studied, the definition of postpartum depression used, and the time frame that one considers for onset of symptoms. Studies that have examined rates of depression in disadvantaged populations that use self-report instruments (such as the BDI), and that have longer periods of time considered in the onset of depressive symptoms report higher rates of postpartum depression. A recent meta-analysis found a non-significant trend for studies that used more precise criteria to have lower prevalence rates (Gavin et al., 2005).

There have been two attempts to quantitatively aggregate the literature to provide a more precise prevalence rate of postpartum depression. O'Hara and Swain (1996) conducted a meta-analysis of 59 studies which yielded a mean prevalence rate of 13% (95% CI: 12.3% - 13.4%). This figure has been widely cited in the research literature, and is often quoted as a definitive word on the prevalence of postpartum depression.

Gavin et al. (2005) conducted a meta-analysis of 109 studies that examined the point prevalence, period prevalence, and incidence of depression during pregnancy and

the postpartum period. They concluded that estimating the period prevalence and incidence is difficult given the few studies that have addressed that topic. The lack of studies of these types leads to a wide confidence interval surrounding the estimate and thus reduces the certainty of the conclusion that can be drawn from them. Estimates of point prevalence are more plentiful. They concluded that the prevalence of depression begins to rise immediately after birth and peaks in the third month postpartum at 12.9%. In the subsequent four months the prevalence estimates of depression decline slightly and remain stable at approximately 10%. After the seventh month, postpartum rates continue to decline to 6.5%. However, there is still a fairly broad 95% confidence interval surrounding these estimates.

Research reviewed in later sections consistently indicates that postpartum depression is a risk factor for the development of childhood psychopathology. Therefore, it is important to establish the number of children exposed to this potential risk. If one applies the mean postpartum prevalence rates to the number of live births, it can be concluded that hundreds of thousands of infants are exposed to postpartum depression each year. For example, in 2003 there were 4,091,063 live births in the United States (National Center for Health Statistics, 2005), which suggests that at least 275,000 women experienced clinically significant depressive symptoms following delivery if we use the lowest prevalence estimate.

#### *Risk Factors for and Correlates of Postpartum Depression*

The literature has identified several risk factors that are associated with development of a postpartum depressive episode. Research has examined many demographic variables such as mother's age, marital status, length of relationship with

her partner, level of education, and number of children that may impact a women's likelihood of experiencing postpartum depressive symptomatology. Recent research has examined the association between two of these demographic variables, age at time of delivery and number of children in the home, and postpartum depression in a large sample of postpartum women (Segre, Losch, & O'Hara, 2006). Segre et al. (2006) found that women who were younger or had more children at home had an increased likelihood of developing postpartum depression. These results remained significant after controlling for other demographic variables, such as income.

Another demographic variable, financial difficulty has been robustly related to depressive symptoms in the research literature (Stein, Cooper, Campbell, Day, & Altham, 1989; Murray, Sinclair, Cooper, Ducournau, & Turner, 1995; Brown & Moran, 1997; Graham & Blackburn, 1998; Romito, Saurel-Cubizolles, & Lelong, 1999). This relation holds up over a number of different indices of financial adversity, such as low income, money worries, debt, receipt of benefits, and unemployment. Segre et al. (2006) provided compelling evidence that the risk of developing postpartum depression is disproportionate for those who make less than \$20,000 per year. They found that women in their sample who were in the lowest income bracket were four times more likely to develop postpartum depression than those in the highest income bracket.

The previous results suggest a strong relation between financial adversity and depression. However, they do not address whether or not impoverished conditions could be related causally to the development of postpartum depression. This is difficult given the impossibility of randomly assigning women to impoverished versus non impoverished conditions. However, there is evidence that demonstrates that the presence

of financial hardship tends to precede the onset of depressive symptoms (Brown & Moran, 1997; Reading & Reynolds, 2001; Dearing, Beck, Taylor, & McCartney, 2004). This provides some evidence that financial hardship may be a causal factor in the development of postpartum depression for some women.

In the 1970's George Brown began examining the influence of life events on the development of depressive symptoms (Brown & Harris, 1978). Negative life events are described as unplanned events that involve resources (such as time or money) to solve. Research has consistently demonstrated that negative life events during pregnancy serve as a risk factor for the development of postpartum depression (Cutrona, 1983; O'Hara, Rehm, & Campbell, 1983). However, this literature has been riddled with methodological difficulties. For example, it is difficult to determine what constitutes a significant life event. In addition, it is important to consider the temporal nature of life events. In order for them to be considered causal the life event must occur prior to the onset of the depressive symptoms. However, research has repeatedly demonstrated that negative life events are a risk factor for developing a depressive episode despite methodological difficulties with this type of research (Monroe & Roberts, 1990). Meta analysis of findings related to negative life events suggests that they have a medium to large effect size (O'Hara & Swain, 1996).

One type of negative life event that is specific to pregnancy is obstetric complications. In their analysis of causal factors, O'Hara and Swain (1996) concluded that obstetric complications are only weakly related to the diagnosis of postpartum depression. However, obstetric complications are moderately related to self-reported depressive symptoms. This finding may be due to several factors. First, the meta-analysis

contained a relatively small number of studies. Second, the types of complications varied among studies. Third, there were heterogeneous methods of measuring postpartum depression in these studies. Taken together these flaws would suggest that further research is needed to determine the relation between obstetric factors and postpartum depression.

Social support is thought to serve as a protective factor against the development of postpartum depression (Brugha et al., 1998). Traditionally, the literature has defined three different types of social support. Informational support refers to advice and guidance given by members of the social support network. Instrumental support refers to receiving practical help or material objects from someone. Finally, emotional support is defined in terms of receiving expressions of caring or empathy. The research literature has consistently demonstrated a negative relation between emotional support or instrumental support and postpartum depression (Richman, Raskin, & Gaines, 1991; Beck, 1996; O'Hara & Swain, 1996). These results are consistent regardless of whether the social support is delivered by a spouse, friend, or family member.

Past psychiatric history has consistently been identified as a robust predictor of postpartum depression (O'Hara & Swain, 1996; Beck, 2001; Johnstone, Boyce, Hickey, Morris-Yates, & Harris, 2001; Josefsson, 2003). In addition, findings suggest that depressed mood and anxiety during pregnancy are predictive of a postpartum depressive episode (Collins, Dunkel-Schetter, Lobel, & Scrimshaw, 2004). This finding is consistent with research that suggests that depression tends to be a highly recurrent disorder (Belsher & Costello, 1988).

Although not as predictive as a personal history of depression, a family history of depression is also related to the development of postpartum depression (O'Hara et al., 1984; Johnstone et al., 2001). This finding is consistent with the notion of vulnerability-stress. In a vulnerability-stress model individuals inherit the propensity to express a trait (such as depression). However, whether or not the trait is expressed depends on the type and level of stress to which the individual is exposed. O'Hara (1995) tested a vulnerability-stress model of postpartum depression. Vulnerability was conceptualized as the individual's personal and family history of depression. Examples of stress variables included life stress and sociodemographic variables (such as financial difficulty). Two individual variables and two interaction terms were significant. Number of previous depression and depressive symptoms during pregnancy were individual predictors of postpartum depression which accounted for 16% of the variance. The significant interactions included number of previous depressive episodes by childcare related stressors and prepartum depression by peripartum events. These interaction terms accounted for a further 19% of the variance.

These studies reviewed above provide evidence that there is not a single cause of postpartum depression. Rather, the development of postpartum depression is likely the result of a confluence of multiple factors described in this section which manifest in unique combination for each woman. Consideration of each of these factors is important in the context of this project because several of the factors discussed here, such as poverty, have demonstrated a unique risk for later development of externalizing and internalizing disorders (Friedman & Chase-Lansdale, 2002; Costello, Compton, Keller, & Angold, 2003).

### *The Chronic Nature of Depression*

Depression has been thought of, both clinically and in research, as an “episodic” disorder. This term implies that depression has an acute onset, a clear duration, and a complete resolution of symptoms. Several lines of research suggest that this does not reflect the reality of individuals who suffer from depressive disorders. Longitudinal research has demonstrated that depression tends to be a chronic, recurrent disorder, which is not characterized by complete recovery between “episodes.”

One longitudinal study followed 406 patients admitted between 1959 and 1963 to a psychiatric hospital in Switzerland. The results of the 25-year follow-up demonstrated that the individuals who suffered from MDD were affected by clinically significant symptoms approximately 20% of the time (Angst, 1986). This study illustrates that depressive episodes tend to be recurrent. However, this research still lends credibility to the idea that a person who experiences major depression suffers from distinct episodes of depression with symptom free periods in between the episodes.

In contrast, results from a follow-up of the “Iowa 500 study” suggest that for women, depression tends to be more chronic (Winokur & Morrison, 1973; Tsuang, Woolson, & Fleming, 1979; Coryell & Tsuang, 1985). The “Iowa 500” is a sample of 525 patients admitted to the Iowa Psychopathic Hospital between 1934 and 1944, which included two hundred twenty-five patients diagnosed with depression. The longitudinal results suggest that 18% of the individuals diagnosed with depression tended to follow a chronic course. This means that they continually suffered from symptoms of depression without distinct, symptom free periods. In addition, females were more likely to follow a

more chronic course than males. Males, in contrast, tended to have repeated distinct episodes.

One problem with both of the previously described studies is that they did not employ criteria for diagnosing depression that are comparable to those used today. More recent research from the Epidemiologic Catchment Area (ECA) Program, a population-based sample, supports a more chronic view of depression (Regier & Burke, 1987). The ECA program identified 423 individuals from five communities who met the Diagnostic and Statistical Manual Third Edition (DSM-III) criteria (American Psychiatric Association, 1980) for Major Depressive Disorder. Of the subsample of depressed individuals from whom they were able to obtain follow-up information, 24% of them continued to suffer from symptoms of depression at the one-year follow-up. Although the duration of follow-up is much shorter than the previously discussed studies, this study is important because it focused on a sample of community dwelling adults. The previous studies were conducted with individuals who sought inpatient treatment for their psychiatric difficulties. It could be argued that individuals who seek treatment are more severely impaired or suffer from additional comorbidities that further impair their functioning.

A review conducted by Belsher and Costello (1988) concluded that over 80% of individuals who experience one episode of depression would experience another. Furthermore, they concluded that the period where individuals do not meet criteria for depression tends to be relatively short. Research conducted by Shapiro and Keller (1981) found that more than 50% of individuals relapsed within 2 years of recovery. The period between relapses becomes progressively shorter as a person experiences more episodes

of depression, for individuals who had experienced three or more episodes the relapse rate is approximately 40% 12 to 15 weeks after recovery (Keller, Lavori, Mueller, & Endicott, 1992; Mueller et al., 1996).

Taken together, these studies and reviews provide compelling evidence to suggest that many individuals who suffer from major depression tend to be chronically affected throughout their lives. Furthermore, research suggests that these individuals tend to have significant and long lasting functional impairment. The Medical Outcomes Study (MOS) is an impressive study that measured functional outcomes of over 20,000 individuals who sought care at HMO facilities (Klerman, 1989). Patients who met criteria for MDD, Dysthymia, or both were compared to two groups of individuals, those with chronic medical illnesses and those without chronic medical illnesses. Individuals who experienced significant depressive symptoms (even if they did not meet criteria for MDD) were judged to be lower functioning in physical activities, occupational/role responsibilities, and social activities than were individuals without a chronic medical condition. What is even more striking is that individuals who experienced significant depressive symptoms had poorer functioning in these domains than individuals with chronic medical conditions such as cardiovascular disease, arthritis, pulmonary problems, or diabetes.

Research with women in the postpartum period provides a similar conclusion. Studies that have followed women beyond the first year postpartum have demonstrated that there are a significant number who are chronically depressed (Cooper, Murray, Wilson, & Romaniuk, 2003). This research suggests that up to 1/4<sup>th</sup> of women with postpartum depression (particularly untreated depression) will develop a chronic course

lasting beyond the first year of life. Furthermore, Cooper et al. (2003) found that treatment for postpartum depression did not prevent women from experiencing subsequent episodes of depression. Therefore, even if a woman is successfully treated for the initial episode she is still at risk for relapse in the future.

The research reviewed above suggests that impairment and symptoms of depression do not easily conform to a discrete period of time marked by a clear onset and complete recovery. Rather, depressive symptomatology and correlated impairments represent a chronic source of adversity for women who experience postpartum depression. Alternatively stated, postpartum depression does not represent a brief deviation from normal functioning with a complete return to normal functioning after a discrete period of time. In addition, the research reviewed in this section suggests that some women may not return to normal functioning throughout the child's development which means that some children's entire childhood may take place in the context of a depressed mother.

#### *Impact of Depression on Socio-Emotional Development*

The effects of being reared by a depressed caregiver have been studied at all ages from infancy through adulthood. Although the literature related specifically to postpartum depression tends to be limited to infancy and the toddler years, it is important to note that given the recurrent nature of depression many of the findings from the larger literature related to depressed caregivers applies to this group of children. Alternatively stated, postpartum depression does not represent a specific, concrete, and time-limited risk factor for children.

In the forward to *Children of Depressed Parents: Mechanisms of Risk and Implications for Treatment* Goodman and Gotlib (2002) summarize the literature related to the negative effects of being reared by a depressed caregiver and provide multiple reasons that researchers should be concerned about this particular group of children. The first reason they provide is the repeated finding that depression is highly heritable. Although research has demonstrated that unipolar depression has the weakest genetic component of the mood disorders (Kendler et al., 1992), rates of psychiatric disturbance in children reared by a depressed parent exceed 40% (Beardslee et al., 1988; Orvaschel, Walsh-Allis, & Ye, 1988; Goodman, Adamson, Riniti, & Cole, 1994). The other reason articulated by Goodman and Gotlib (2002) acknowledges repeated findings that environmental factors in households with a depressed parent are not optimal.

#### *Observation and Self-Report of Mother-Infant Interaction*

Researchers have taken multiple approaches in describing the outcomes of postpartum depression. Most research has focused on the behavior of the mother, infant, or dyad in the context of the mother-infant relationship. Research examining maternal behavior during the mother-infant interactions has noted that infants of depressed mothers display qualitatively and quantitatively different behaviors than infants of nondepressed mothers (Cohn, Matias, Tronick, Connell, & Lyons-Ruth, 1986; Cohn & Tronick, 1989; Field et al., 1988). This research shows that during interactions with their mothers these infants tend to display more negative emotion, display less positive emotion, vocalize less, and have lower activity levels (Field, 1995; Dawson et al., 1999).

Mothers who have experienced a postpartum depression report more difficulties interacting with their infants than mothers who have not experienced a postpartum

depression. For example, Righetti-Veltema, Conne-Perrèard, Bousquet, and Manzano (2002) found depressed mothers reported that they and their infants engaged in less vocal communication, visual contact, skin to skin contact, and smiling at three months of age than dyads in which the mother had not experienced a postpartum depression.

The use of depressed mothers as informants of their own or their child's behavior has occasioned a tremendous amount of attention in the research literature. Maternal depression has been alleged to distort maternal perception of their child's behavior or their parenting thereby reducing the accuracy of their reports and inflating the number and severity of symptoms their children display (Cundall, 1987; Breslau, Davis, & Prabucki, 1988; Webster-Stratton & Hammond, 1988; Frankel & Harmon, 1996). In contrast, the notion of depressive realism also has been touted in this research literature. This hypothesis suggests that depressed mothers have less of a "rose-colored filter," which leads to more accurate reporting of deficits in their parenting and of symptoms displayed by their children (Billings & Moos, 1985; Weissman et al., 1987; Ivens & Rehm, 1988; Conrad & Hammen, 1989; Richters & Pellegrini, 1989).

Richters (1992) reviewed the literature related to the accuracy of reports made by depressed mothers and concluded that there was limited support for either of these hypotheses. He found that the disagreements between depressed mothers and the criterion could often be attributed to different samples of behavior observed (such as bedtime vs. school day behavior) and that in many instances there was little evidence to support the validity of the criterion rater over the depressed mother. In regard to the depressed mother's increased accuracy of reporting, he only found a high degree of consistency between criterion and depressed mother's reports in two of seventeen studies. However,

in these studies there was not a comparable degree of severity in child behaviors between the depressed and nondepressed maternal raters. Therefore, these studies fail to offer robust support for the accuracy of maternal ratings.

More recent research has re-examined this question while accounting for the variability in depressive symptoms experienced by depressed mothers (Querido, Eyberg, & Boggs, 2001). Querido et al. (2001) found that the ratings of women who experienced milder depressive symptoms were more discordant with observer ratings during a mother-child interaction than were the ratings of women who experienced more severe depressive symptoms. This research suggests that women who experience more severe depressive symptoms, or symptoms which are more likely to be consistent with the full clinical presentation of Major Depressive Disorder, are more accurate in their perceptions of their children's behavior than are women who experience milder symptoms.

The research that explores the accuracy of maternal report in the context of depressive symptoms is important because it addresses concerns that the behaviors reported by mothers may reflect their own symptomatic state rather than being an accurate perception of the infant's behavior. In light of the research reviewed above, the results from self-report studies should be interpreted with a degree of caution. However, the combined weight of the research which has explored the accuracy of reports made by depressed mothers and the convergent research based on observation which has yielded similar information suggests that the differences reported by depressed mothers represents an actual difference in infant behavior rather than a perceived discrepancy.

*The Still-Face Paradigm*

A majority of research that examines the effects of postpartum depression on infant socio-emotional development has involved an examination of infants' reaction to the still-face paradigm (Tronick, Als, Adamson, Wise, & Brazelton, 1978; Cohn & Tronick, 1983). The still-face paradigm is a three-part laboratory manipulation. Initially, the mother-infant dyad engages in playful behavior for five minutes. Immediately following the play period, the mother freezes her face into an emotionless expression and does not respond to the infant's bids for attention for two minutes. This lack of responsiveness presents a frustrating scenario to infants who have come to expect their mother's emotional availability. After the two minutes of expressionless staring, the mother reengages the infant in play behavior.

Interest in the still-face paradigm in relation to maternal depression was generated following a study reported by Cohn and Tronick (1983). They found that infants displayed distressed behavior when the mother is given instructions to "look depressed," as defined by Cohn and Tronick (1983). During the simulation infants more frequently looked cautious, averted their gaze, made sound of protest, and attempted to elicit a response from the mother. The infants continued to exhibit distressed behavior after the mother was given instruction to resume her normal behavior. The latter finding provides evidence that an infant's reaction to maternal depression may carry over into times when she is not symptomatic.

The results reported by Cohn and Tronick (1983) led to an examination of infants of depressed mothers and infants of nondepressed mothers behavior in the still-face paradigm. This research suggests that infants of depressed mothers did not react to the paradigm in the same way as infants whose mothers had been instructed to "look

depressed” (Field, 1984). The infants of depressed mothers did not appear to be distressed by their mother’s lack of emotional expression. Field (1984) concluded that infants of depressed mothers are accustomed to their mother’s depressed affect and therefore are not distressed by displays of depressed affect.

Later research conducted by Cohn, Matias, Tronick, Connell, and Lyons-Ruth, (1986) expanded upon the earlier findings described by Field (1984). They found that although infants of depressed mothers did not display the outward distress characteristic of infants of nondepressed mothers, they did react to maternal displays of depressed affect. Their research suggests that these infants engage in more avoidant behavior, such as closing their eyes or averting their gaze during this emotionally arousing mother-infant interaction.

Research exploring the still-face paradigm in depressed mother-infant dyads also has focused on the behavior of the mother. Initial research suggested that the depressed mothers displayed depressed affect across all sessions of the paradigm (Field, 1994). However, later research has focused on the variability in interactions displayed by depressed mothers. Research has identified two patterns of behavior displayed by depressed women during the still-face paradigm. Some mothers appeared to be withdrawn throughout the task, which means that they displayed sad affect throughout the task or did not engage the infant. Other depressed mothers appeared angry during the paradigm and engaged in intrusive behavior with their infant (Cohn et al., 1986; Field et al., 1988).

Further exploration of the still-face paradigm has moved beyond descriptions of the mother and the infant in the paradigm toward descriptions of the mother-infant dyad.

This focus on the dyad led to the discovery that behavior displayed by the infant during the still-face paradigm is contingent upon the mother's behavior. Infants of mothers who used an intrusive interaction style displayed significantly more gaze aversion than infants whose mothers used another interaction style. Infants of withdrawn mothers engaged in significantly more protest and showed significantly greater levels of distress than infants of mothers who used another interaction style (Cohn et al., 1986).

Research using the still-face paradigm has provided some evidence that infants employ the same manner of interaction with their depressed mothers and nondepressed stranger. One study found that the infants' behavior during the strange situation was consistent regardless of with whom they interacted (either their depressed mother or a nondepressed stranger) (Field et al., 1988). Field et al. (1988) suggested that the behaviors learned through interactions with a depressed mother may generalize and become consistent across situations.

Research involving the still-face paradigm with infants of postpartum depressed mothers has burgeoned. Beck (1995) attempted to synthesize this growing body of literature using meta-analysis. She found a medium effect size when she combined studies that reported on the relation between postpartum depression and the behavior of the mother only or infant only. However, she found a large effect size when she combined studies which examined the relation between postpartum depression and the interactions of the dyad. The results of Beck's (1995) meta-analysis suggest that the still-face paradigm is most sensitive to the interactions of the dyad rather the actions of the two individuals involved in the interaction.

The still-face paradigm is the most widely used methodology in research studying the effects of postpartum depression on infant socio-emotional development. Despite its prominence, it has several shortcomings. First, descriptions of coded behavior on the part of the infant do not fit easily with other coding schemes or emotional development theory. A richer description of infant behavior during this paradigm may help alleviate this confusion. For example, several still-face paradigm studies have coded for “negative affect” (Fogel, 1982). However, the finding that very few infants cry during the still-face manipulation (Tronick et al., 1978) has been consistently obtained (Weinberg, Tronick, Cohn, & Olson, 1999). Therefore, ratings of “negative affect” are based on increased gaze aversion and decreased positive affect. These behaviors do not provide a robust demonstration of negative affect.

Second, the researchers who have used the still-face paradigm have not used a standardized set of procedures. The paradigms used have varied in terms of stimulus, length of time for each episode, and length of time between episodes (Frick & Adamson, 2003). Lack of standardization makes results from the still-face paradigm difficult to compare. Increased rigor in the standardization of procedures will increase the ability to compare results across studies and is necessary to advance this line of research.

A third problem with the still-face paradigm is that it does not easily lend itself to the study of individual differences in infant behavior. Most of the research to date has focused on either the presence or absence of the effect (Tronick et al., 1978) or group differences in the effect (Hossain et al., 1994). However, some research has suggested that there are individual differences in the expression of the still-face effect (Fogel,

1982). Greater exploration of these individual differences may lead to a more coherent understanding of what the still-face paradigm means.

Finally, there has been a great deal of confusion about what the still-face paradigm actually means. This search for meaning began with the initial presentation of the still-face effect. Tronick et al. (1978) suggested that the still-face effect arises because the procedure violates the rules that govern the mutual regulation of social interactions. However, other researchers have proposed alternate explanations that vary in their clarity and complexity (Frick & Adamson, 2003). The still-face paradigm has been in search of a theory that would explain its effect.

Taken together, the research on the still-face paradigm leads to the conclusion that postpartum depression is a risk factor for abnormal socio-emotional development. However, it is unclear what leads to this disturbance or what long-term consequences this disturbance will have.

#### *Effect of Postpartum Depression on Children*

Additional evidence suggests that postpartum depression affects both the child and the mother-child interaction during the toddler years. Stein, Gath, Bucher, Bond, Day, and Cooper (1991) found that toddlers whose mothers had experienced a postpartum depression were less sociable and displayed larger amounts of distress during a brief separation from their mother. These results remained significant even in cases where women had experienced one postpartum depression and the symptoms had remitted.

Several studies have examined the quality of mother-infant attachment in dyads where the mother had experienced a postpartum depression (Lyons-Ruth, Zoll, Connell,

& Grunebaum, 1986; Murray, 1992; Teti, Gelfand, Messigner, & Isabella, 1995; Campbell & Cohn, 1997). In the majority of these studies, maternal postpartum depression was associated with higher levels of attachment insecurity. Campbell and Cohn (1997), however, found no association between depressive symptoms and attachment insecurity in a relatively low-risk sample. This finding has raised the idea that factors other than depression, such as poverty or family conflict, may be a potential moderator in the outcomes of prior studies which have reported higher rates of insecure attachment in their depressed mother-infant dyads. It should be noted that Campbell and Cohn (1997) found a high rate of insecure attachment in both control and case dyads. Therefore, these results may be an artifact of this study. Future research will need to explore this question more fully.

Research conducted with toddlers and preschool-aged children of women who had experienced a postpartum depression suggests that the behavioral disturbance continues beyond infancy. Evidence from maternal reports suggests that women who have experienced a postpartum depression tend to report more behavioral difficulty than women who had not experienced a postpartum depression (Murray, 1992). The problems reported spanned a wide variety of activities and included difficulties with sleep, eating, excessive temper tantrums, and separation problems.

Studies conducted with children during the preschool years have yielded variable results. Ghodsian, Zajicek, and Wolkind (1984) followed a community sample of women until the child reached 42 months of age. They found that women who were depressed at four months postpartum reported significantly higher levels of behavioral problems in their preschool age children than mothers who did not experience postpartum depression.

However, this relation became statistically nonsignificant after accounting for subsequent depressive episodes.

Evidence from a different community sample contradicts the findings reported by Ghodsian et al. (1992). Wrate, Rooney, Thomas, and Cox (1985) found that women with a prolonged postpartum depression did not report increased levels of behavioral problems. However, mothers who had experienced a relatively brief and minor episode (duration of one month or less) did report increased behavioral difficulties.

A third study may shed light on these inconsistent reports. This study found that there was a tendency for mothers to report more behavioral problems if they had experienced postpartum depression (Caplan, Cogill, Alexandra, Robson, & Kumar, 1989). However, these results were overshadowed by other factors that significantly predicted child outcome, such as current maternal depression, the presence of marital conflict, and a history of paternal psychiatric disturbance.

Results reported by Philipps and O'Hara (1991) support the findings found by Caplan et al. (1989). They found no evidence that an episode of postpartum depression directly led to behavioral difficulties. However, they found that a postpartum depressive episode was associated with increased risk for subsequent depressive episodes. It was these later depressive episodes that were associated with higher scores reported on the CBCL. The authors concluded that postpartum depression may confer risk to the children by increasing the likelihood that women will experience subsequent episodes of depression. (Caplan et al., 1989)

One criticism of the previous studies is that they have relied heavily on maternal reports of child behavior. More recent research sought to address that concern (Murray et

al., 1999). Murray et al. (1999) obtained independent assessments of child behavior problems and social functioning provided by the school teachers. They found that teachers rated children of postpartum depressed mothers higher on behavioral disturbance, often at a clinically significant level. There appeared to be a gender effect with boys of postpartum depressed mothers receiving much higher ratings than girls.

Beck (1998) conducted a meta-analysis of nine studies examining the effects of postpartum depression on children over the age of one. She found that postpartum depression had a significant, albeit, small impact on children's socio-emotional development across a broad range of measures. Additional analysis, which included only studies that controlled for current level of maternal depression, produced the same result as the full analysis, which demonstrated a significant association between maternal depression and negative outcomes. However, postpartum depression accounted for much less of the variance in older children. This means that when the literature related to the effects of postpartum depression on children's socio-emotional development is examined as a whole, there appears to be a significant negative impact for maternal postpartum depression on children's socio-emotional development. However, the importance of postpartum depression diminishes over time.

This literature examining the impact of maternal mood on children's socioemotional development clearly indicates that maternal depression negatively impacts children's socio-emotional development. However, the nature of this impact is unclear as are the specific mechanisms of risk. Further research, such as proposed here focusing on existing, empirically supported theories of child socio-emotional

development, will enrich our understanding of the impact of postpartum depression on infant's and children's socio-emotional development.

### *Temperament and Emotional Regulation*

Given the consequences of maternal postpartum depression outlined earlier, a focus on mechanisms of risk is important for these children. Silberg and Rutter (2002) argued that maternal depression is not in itself a direct risk, meaning that depression is not directly inherited from the mother to the child. Rather, the risk may be conferred through both additive genetic liabilities as well as indirectly contributing to other risk factors. For example, a depressed mother may provide inadequate social interaction to her child because of her depressive symptoms. However, it is the deficient interaction not the depressive symptoms per se that constitutes the risk factor.

Expression of negative emotions and difficulty regulating those emotions has been identified as a mechanism of risk in the literature related to children of depressed parents in older children (Goodman & Gotlib, 2002; Shaw, Keenan, Vondra, Delliquardi, & Giovannelli, 1997). This research has not yet been extended to infants. However, there is research that demonstrates that infants of depressed mothers display more negative emotion, display less positive emotion, vocalize less, and have lower activity levels than infants of nondepressed mothers (Dawson et al., 1999; Field, 1995). These results suggest that infants of depressed mothers also express more negative emotions and may have difficulty regulating these emotions and returning to a neutral emotional state.

Rothbart and Derryberry's (1981) theory of temperament may partly explain how individual differences in emotional expression and regulation develop. Their theory involves largely genetic individual differences in both reactivity and self-regulation.

Reactivity refers to individual differences in the level of arousal. This includes both affective and motoric arousal. Affective reactivity can involve either negative or positive displays of affect. This assertion has been supported by evidence which suggests that there are individual differences in the amount of affect displayed (Rothbart & Bates, 1998).

Rothbart and Derryberry (1981) also suggest that there are qualitative differences in negative affect displayed by individuals. They describe two distinct forms of negative affect, anger and fear. Anger involves displays of distress when the infant is faced with limitations. Fear, in contrast, involves displays of distress in relation to novel stimuli. Research conducted by other temperament theorists has lent credibility to this distinction by providing evidence that it is meaningful (Buss & Goldsmith, 1998).

Regulation of negative emotion does not receive a great deal of coverage in the theory articulated by Rothbart and Derryberry (1981). They suggest that emotional regulation involves processes that serve to reduce an individual's reactivity to situations that elicit fear and anger. Emotional regulation has been more completely defined by Thompson (1994). According to his definition, emotional regulation refers to both internal and external processes that are responsible for monitoring, evaluating, and modifying emotional reactions (especially intensity and duration) to accomplish one's goals (Thompson, 1994).

The ability to regulate one's emotions well has been empirically related to several important developmental sequelae. Specifically, emotional regulation is thought to serve an important role in the development of behavioral control (Kopp, 1989). Poor regulation also results in greater expression of negative emotions, which is regarded as a risk-factor

for the development of childhood psychopathology (Brody et al., 1988; Caspi et al., 1995). Emotional regulation also is hypothesized to serve a protective function with respect to the future development of anxiety and depression (Derryberry & Rothbart, 1988; Eisenberg & Fabes, 1992).

The concept of emotional regulation has garnered interest among researchers during recent years and, as a result, has been the focus of frequent and diverse debates. Specifically, this debate has converged on several topics. First, what is emotional regulation from a biological versus a behavioral perspective? Second, how does one distinguish between unsuccessful regulation and high displays of reactivity? Third, what behaviors are considered regulatory and what behaviors are manifestations of the emotional distress?

From a biological perspective, emotional regulation is a response to a stressful situation. Specifically, when a person encounters a stressful situation both the sympathetic and parasympathetic components of the autonomic nervous system are activated (Ashman & Dawson, 2002). The sympathetic nervous system serves to activate behavioral responses to respond to the stress. More important for emotional regulation is the parasympathetic nervous system, which serves to slow down physical responses to stress. Researchers have attempted to measure the activity of the parasympathetic nervous system using vagal tone, a measurement of output produced by the vagus nerve which governs the parasympathetic regulation of heart rate.

Research has produced consistent findings that suggest that individuals with a higher baseline vagal tone are more easily soothed or calmed in the face of stressful situations. For example, research has demonstrated that higher baseline vagal tone was

associated with more facial expressiveness and soothability in infants under six-months of age (Porges, Doussard-Roosevelt, & Maiti, 1994). Further research has demonstrated that infants and children of postpartum depressed mothers have a higher heart rate (suggesting overall greater arousal) and lower vagal tone (suggesting poorer ability to cope with stress) than infants and children of nondepressed mothers (Field et al., 1988; Dawson et al., 2001). Therefore, children of postpartum depressed mothers are demonstrating both higher reactivity and poorer regulatory ability biologically.

Studies in the field of postpartum depression that have explored emotional regulation in infants of depressed mothers have done so primarily through observations of mother-infant interactions. As previously discussed, this approach makes results from these studies difficult to interpret. It is unknown whether infants of depressed mothers will continue to display high levels of reactivity and poor regulation outside of the context of the mother-infant dyad. Research paradigms employed by the broader developmental literature, which use protocols that are designed to elicit a particular emotion (i.e. anger or fear) outside of the context of the mother-infant dyad, would be beneficial in answering this question.

Additional debate in the literature examining emotional regulation in infants centers on what constitutes a regulatory behavior. A large body of research has amassed an impressive list of putative regulatory behaviors that an infant may display. These behaviors fall into several different domains and include attentional processes, self-soothing behavior, motor behavior, and external processes (such as interactions with others).

Kopp (2002) identified several attentional processes that may be related to infants' emotional regulation. First, infants may use their increasing control of attentional processes such as spatial orienting and ability to discriminate objects to disengage from stimuli they find distressing. Johnson, Posner, and Rothbart (1991) found that infants as young as four months of age could disengage their attention from stimuli that elicited distress. Furthermore, maternal reports indicated that infants who were more adept at disengaging were rated as less fearful, less prone to angry arousal, and more easily soothed. Second, infants have a tendency to orient to novel stimuli (both visual and auditory) and attend to those stimuli. Third, four- to six-month old infants have increasingly coordinated visual attention that relates to their ability to reach and grasp for an object, as well as, sustain play with an object. Finally, infants may use gestures to indicate their desire, which represents an awareness that other people can see and respond to their bids.

Self-soothing behaviors and motor acts also are central to emotional regulation. Self-comforting is a salient behavior across studies that examine emotional regulation (Stifter & Spinrad, 2002; Diener, Mangelsdorf, McHale, & Frosch, 2002). These behaviors involved hand-to-mouth activities, such as thumb sucking, approach, and withdrawal. Ten-month-olds demonstrated an instrumental use of highly coordinated fine-motor acts (e.g. hair twisting, and fingering their clothing). However, less is known about the self-soothing behaviors of younger infants. Kopp (2002) suggests that younger infants may comfort themselves with thumb sucking or other hand-to-mouth activities.

Regulatory behaviors can be conceptualized as both internal and external events. Research suggests that throughout the first year of life external factors play a larger role

and that after one year of age the infant shifts to regulating their emotions internally (Sameroff & Fiese, 2000). For example, older infants continue to use visual distraction, however, they show increases in turning to another person (usually a parent). Research conducted by Stifter and Spinrad (2002) suggests that orienting toward another person increases from 8% at 5-6 months to 40% at 10 months. Mangelsdorf, Shapiro, and Marzholz (1995) found that toddlers' emotional regulation strategies differed depending on mothers' availability. They found that toddlers effectively used behavioral strategies to regulate their emotions when their mothers were not available. However, overall maternal involvement led to an increase in positive affect and a decrease in negative affect, regardless of the type of negative affect. The authors noted that one particular strategy, fussing at the mother, was effective even if the mother was not currently involved with the toddler. They indicated that this may be the result of learning over several trials that turning toward the mother will reduce distress. In contrast, previous research has suggested that infants of depressed mothers are not soothed by their interactions with their mothers (Field et al., 1988; Cohn et al., 1986). Therefore, it is less likely that infants of depressed mothers would employ this strategy to reduce their distress.

Although many studies have documented behaviors of children that may be regulatory, it is unclear if those behaviors are actually regulatory behaviors or merely manifestations of distress. According to the definition provided by Thomspon (1994) regulatory behaviors are defined by their ability to reduce distress. Therefore, considering such behaviors without that context does not speak to their functionality. Future research should address whether displays of behavior conducted by infants in the context of a

specific emotion are effective at reducing (or preventing escalation) of negative affect. Buss and Goldsmith (1998) have attempted to address the debate about what constitutes a regulatory behavior by examining the effectiveness of different putative regulatory behaviors. They found that different self-regulatory behaviors were expressed depending on the type of negative affect that was displayed and the intensity of the emotion. For example, for stimuli that elicited low levels of fear the infant would use approach or interaction with the stimuli. However, when fear was high, the infant was likely to withdraw or look toward his or her mother. A markedly different picture emerged when they examined expressions of anger. Infants did not display a coherent regulatory strategy for regulating emotional expressions of anger. Buss and Goldsmith (1998) also provided data that examined the effectiveness of the regulatory behaviors displayed by infants. For fearful emotional displays they found that regulatory behaviors did not reduce the expression of fear in the infants but they were effective at preventing the escalation of fear-related distress. In contrast, each of the five regulatory behaviors they examined (reach for a toy, interaction with the stimulus, distraction, looks to mother, looks to the experimenter) produced a reduction in angry affect. Taken together these findings suggest that the infants in this study possessed more coherent regulatory behaviors for fearful emotions than angry emotions, but that those displays did not soothe them. In contrast, in response to anger infants demonstrated variable behaviors each of which seemed to be effective at reducing displays of anger.

The research conducted by Buss and Goldsmith (1998) has two implications that are important to consider in relation to emotional regulation. First, this research lends support to the distinction between anger and fear proposed by Rothbart and Derryberry

(1981), suggesting that future research should examine fear and anger separately rather than distress more generally. Secondly, future research should examine the effectiveness of regulatory behaviors that are temporally linked to the distressing event to ascertain which behaviors are truly regulatory and which are behavioral byproducts of the distressed state.

### *Research Aims*

The developmental literature related to emotional regulation provides a framework for examining the emotional regulation abilities of depressed infants. This project was designed to move beyond the still-face paradigm and examine the construct of emotional regulation using multiple methods and in different contexts. This research represents a necessary first step to examine emotional regulation outside of an interpersonal context to determine whether infants of depressed mother's exhibit a deficit in emotional regulation. If there is such a deficit, this research places the field in a position to begin to examine what is the nature of that deficit, as well as, how it may be ameliorated to improve outcomes for children of depressed caregivers. It is in this context that the following research aims are discussed.

#### *Aim 1: Examination of infant affect*

The literature above has made a compelling case for examining the impact of maternal Major Depressive Disorder on infant emotional reactivity.

*Hypothesis 1.* It is predicted that infants of depressed mothers will be more reactive to both fear and anger producing stimuli than infants of nondepressed mothers. Specifically, it is expected that infants of depressed mothers will display more intense and longer reactions to both fear and anger eliciting stimuli.

*Hypothesis 2.* It is predicted that infants of depressed mothers (defined by clinically significant symptoms of depression that meet criteria for a Major Depressive Disorder) will display less positive affect to the episodes of the Lab-TAB designed to elicit positive affect.

*Aim 2: Examination of infant emotional regulation*

Given the research that suggests that the amount of time spent displaying negative emotions is a significant predictor of childhood psychopathology it is important to examine the regulatory capabilities of infants of depressed mothers.

*Hypothesis 1.* It is predicted that infants of depressed mothers will use less social referencing when distressed than infants of nondepressed mothers. Specifically, it is expected that infants of depressed mothers will display fewer turns toward the mother and turns toward the experimenter.

*Hypothesis 2.* It is predicted that the emotional regulation strategies employed by infants of depressed mothers will be less effective than the strategies employed by infants of nondepressed mothers. Specifically, it is expected that fewer infants of depressed mothers will have a change score which either represents no change or an improvement in negative mood than infants of non depressed mothers.

## CHAPTER 2

### RESEARCH DESIGN AND METHODS

#### *Participants*

Participants were 80 mother-infant dyads recruited from the following counties: Linn, Johnson, Polk, Muscatine, and Scott. Recruitment for this study occurred in the context of a larger study designed to develop screening measures for use by the Centers for Disease Control and Prevention, “CDC study.” Women who participated in the CDC study were asked to complete several questionnaires commonly used to screen women for depressive symptoms. A subset of those women who endorsed significant depressive symptoms and a subset of women who did not endorse significant depressive symptoms were asked to complete a diagnostic interview (an adapted version of the Structured Clinical Interview for DSM-IV; First, Spitzer, Gibbon, & Williams, 1997; O’Hara, Stuart, Gorman, & Wenzel, 2000). A woman’s participation in the CDC study concluded after the completion of the diagnostic interview.

From the group of women who completed diagnostic interviews, 30 mothers who meet DSM-IV criteria for MDD, based on the Structured Clinical Interview for DSM-IV (SCID), and their approximately 10 month old infants (range 8-13 months) were recruited for participation in this study. Women were excluded if they also met criteria for a substance abuse or substance dependence diagnosis at the time of the interview. In addition, 50 mothers who did not meet criteria for MDD at the time of their participation in the CDC study and their approximately 39 week old infants were recruited to serve as controls. Women participated in this study approximately 5 months after they completed the SCID ( $M = 4.74$ ,  $SD = 2.72$ ). Depressed women had slightly more time between

diagnosis with the SCID and participation ( $M = 4.90$ ,  $SD = 2.13$ ) than did nondepressed women ( $M = 4.65$ ,  $SD = 3.03$ ). However, this difference was not significant ( $t = -.40$ ,  $p = .69$ ).

A portion of the sample (19%) met DSM-IV criteria for Generalized Anxiety Disorder. This included 3 women in the nondepressed group and 12 women in the depressed group. Women who met criteria for GAD did not differ on any demographic variable from women who did not meet criteria for GAD. Approximately one-third of women (33%) reported a previous episode that met criteria for Major Depressive Disorder. This included 7 women who did not meet current criteria for Major Depressive Disorder and 19 women who currently met criteria for Major Depressive Disorder. Women who currently met criteria for Major Depressive Disorder tended to have an earlier onset of their first episode of depression ( $M = 16.58$ ,  $SD = 6.10$ ) than those who did not currently meet criteria ( $M = 21.14$ ,  $SD = 4.74$ ). However, this difference was not significant ( $t = 2.01$ ,  $p = .07$ ). Women who met criteria for Major Depressive Disorder currently had significantly more episodes of depression ( $M = 17.2$ ,  $SD = 30.02$ ) than those who did not meet current criteria ( $M = 2.67$ ,  $SD = 3.615$ )  $t = -2.07$ ,  $p = .05$ . However, this is largely due to an exorbitantly high number of Major Depressive Episodes reported by a small subset ( $N = 3$ ) subjects. Overall, the modal number of prior depressive episodes was one; the median number of depressive episodes reported by women was two. None of the women who did not meet criteria for Major Depressive Disorder reported suicidal ideation. A subset of women who met current criteria for MDD (24%) reported having suicidal ideation or thoughts of their own death. None of

the participants involved in this study reported having a plan to commit suicide or reported making a suicide attempt currently.

Overall, a diverse group of women participated in this study. At entry to the study, mother's average age was 28.4 years ( $SD = 5.1$ ) with an age range of 19 to 41 years of age. Consistent with the demographic profile of the state of Iowa, 76% of the women identified themselves as Caucasian (not of Hispanic origin), 3% identified themselves as Asian or Pacific Islander, 9% identified themselves as African American and 8% identified themselves as Hispanic. A small minority (4%) of women declined identifying their ethnicity. Women who participated in this study had completed between 10 and 20 years of education. On average women had completed 14.8 years of education ( $SD = 2.4$ ). On average women reported a household income between \$40,000 and \$59,999 per year. However, over 45% of the women who participated reported a household income of less than \$39,999 per year. A large majority (92%) of the women involved in this study were in committed relationship that was either marital (76%) or a committed partnership (16%). Approximately one-third of women (29%) were primiparous, and 84% reported three or fewer pregnancies. The maximum number of pregnancies reported was 7. A majority of women (76%) involved in the study had not experienced a fetal demise. A small number (5%) of women reported terminating a pregnancy and 1 woman reported a stillbirth. A majority of women (71%) reported that they were employed outside of the home. Depressed women did not differ from nondepressed women on any of the demographic variables explored, a summary of maternal demographic characteristics listed by maternal depressive status is displayed in table 1.

Table 1

*Maternal Characteristics Displayed by Depressive Status*

	Nondepressed	Depressed
Mean Age (years)	28.46 (5.15)	28.23 (5.14)
Relationship Status		
Single	1 (2%)	3 (10%)
Committed Relationship	49 (98%)	25 (83%)
Refused	0 (0%)	2 (7%)
Ethnicity		
Caucasian	37 (74%)	24 (80%)
Asian/Pacific Islander	2 (4%)	0 (0%)
African American	4 (8%)	3 (10%)
Hispanic	5 (10%)	1 (3%)
Other	2 (4%)	2 (7%)
Mean years of education	15.04 (2.56)	14.31 (2.14)
Employed outside of the home	40 (80%)	17 (56%)
Annual household income		
< 39,999	20 (40%)	28 (60%)
> 40,000	30 (60%)	12 (40%)
History of miscarriage	11 (22%)	6 (20%)
History of termination of pregnancy	3 (6%)	2 (7%)

Overall infants were between 8 and 13 months of age ( $M = 9.92$  months,  $SD = 1.3$  months). There were slightly more male infants (59%) than female infants (41%). Table 2 displays infant characteristics by maternal depressive status. Although infants of depressed mothers were slightly older ( $M = 10.23$ ,  $SD = 1.38$ ) than infants of nondepressed mothers ( $M = 9.74$ ,  $SD = 1.52$ ) the difference was not significant ( $t = -1.45$ ,  $p = .15$ ).

Table 2

*Infant Characteristics Displayed by Maternal Depressive Status*

	Nondepressed	Depressed
Mean Infant Age (months)	9.74 (1.52)	10.23 (1.38)
Number of Females	21 (42%)	12 (40%)
Number of Males	29 (58%)	18 (60%)

The age range of the infants in this study was chosen based on research that suggests that there is a major reorganization of emotion that occurs during the second half of the first year of life (Sroufe, 1996; Campos, Kermoian, & Witherington, 1996). Sroufe (1996) indicated that fear is reliably demonstrated beginning in the 7th month and that anger is reliably demonstrated during the 8th month. Therefore, recruiting infants beginning at approximately 39 weeks ensured that the infants were developmentally capable of displaying both of the emotions of interest. However, the age range was not optimal in that it encompasses a variety of different motoric capabilities. The infants in

the sample displayed a variety of motor capabilities, which represents an additional confound. To ensure that differential motoric capabilities did not confound the data, episodes from both the prelocomotor and locomotor versions of the Lab-TAB that required the infant to be seated and restrained in either a car seat or high chair were administered.

For the purposes of this study infants were excluded if they were born prematurely (birth prior to 36 weeks gestation), had a known impairment to their cognitive ability, or were identified as visually or hearing impaired. With regard to the exclusion of infants born prematurely, research suggests that infants who are born prematurely have a delayed developmental trajectory during the first year of life. Given this delayed trajectory, their emotional development may also be delayed and they may not be able to demonstrate the emotions targeted in this study.

### *Measures*

#### *Sociodemographic Information*

Subjects provided information related to several dimensions of demographic variables (i.e. parents' ages, parents' education levels, parity, marital status, socioeconomic status, and ethnicity).

#### *Structured Clinical Interview for DSM-IV (SCID)*

The SCID (First et al., 1997) is a semi-structured diagnostic interview that corresponds to the diagnoses available in the Diagnostic and Statistical Manual-IV (DSM-IV; American Psychiatric Association, 1994). For this study the SCID was modified and used in conjunction with the schizotypal and antisocial modules from the structured clinical interview used in the diagnosis of DSM-IV personality disorders

(SIDP-IV; Pfohl, Blum, & Zimmerman, 1997). The modified SCID included the following sections: past periods of psychopathological symptoms, psychopathological symptoms during the last month, current social functioning, and the mood episodes module which was used to assess the current major depressive episode, the past depressive episode, dysthymia, time of onset, melancholic features, and atypical features. In addition, screening questions regarding substance use and dependence were asked. This measure has been used consistently by the Iowa Depression and Clinical Research Center (IDCRC) and is administered by master's level clinical interviewers. Previous research has established reliability of diagnosis of MDD across interviewers using this measure (Kappa = 0.83) (O'Hara, Stuart, Gorman, & Wenzel, 2000).

*Laboratory Temperament Assessment Battery (Lab-TAB)*

The Lab-TAB (prelocomotor and locomotor version 3.1; Goldsmith & Rothbart, 1999) was designed to standardize observational measures of temperament. It is a series of 3-5 minute situations that are designed to simulate experiences that infants and children have in every day life. There are three versions of the Lab-TAB, two are designed for infants and one is designed for preschoolers. The infant versions were designed for infants who cannot yet crawl (prelocomotor) and those who can crawl (locomotor). The age range of infants in this sample, while necessary to answer the research questions, presented a possible confound because infants during this period may exhibit varying degrees of locomotion. Therefore episodes from both the prelocomotor and locomotor versions of the Lab-TAB that require the child to be seated and restrained in either a high chair or a car-seat were administered. Specifically, infants participated in six episodes of the Lab-TAB procedure that are designed to elicit fear, anger, pleasure as well as other emotions.

The Lab-TAB was designed for administration in the laboratory. However given the geographic placement of our subjects, it was necessary to conduct this procedure in the home. Previous studies conducted at that IDCRC and other locations have successfully administered this battery in the home setting (Kochanska, Coy, Tjebkes, & Husarek, 1998; Forman et al., 2003; Forman et al., 2006). The results indicated that variables obtained from home administration could be coded reliably (Kappas ranged from .63 to 1.00). The constructs of fear and anger were only minimally correlated ( $r = .14$ ), which suggests that they are measuring independent constructs. In addition, the results reported by Forman et al. (2003) suggest that the construct of negative emotionality measured from home observations (including the Lab-TAB) correlated significantly with maternal reports of negative emotionality as measured by the Infant Behavior Questionnaire (Garstein & Rothbart, 2003).

For the purposes of this study 8 episodes from the prelocomotor and locomotor versions of the Lab-TAB were administered. The order of the episodes was designed so that there were not two episodes designed to elicit negative affect presented next to each other. There also were not two episodes designed to elicit the same emotion next to each other. The order of vignettes presented to the infant was as follows: stranger approach, puppet game, toy retraction, cognitive assimilation game (Pop-up Bunny), masks, task orientation (blocks), restraint in car seat, and basket of toys. Each of the episodes conducted with the infants are described in more detail in the paragraphs below.

Stranger approach was the first episode completed during the assessments. The camera person served as the stranger while the experimenter operated the video camera. The stranger gradually approached the child who was seated in a high chair stopping two

feet in front of the high-chair. The stranger first greeted the infant using a standardized greeting, then approached gradually, then stopped and stared at the child in a standardized fashion. The elements of novelty and intrusiveness were designed to elicit varying degrees of fearful distress.

The second episode conducted with the infants in this sample was entitled puppet game. It was designed to measure enjoyment in response to social stimulation. In this episode the experimenter placed a puppet on each of her hands. The puppets interact with one another following a standardized dialogue. After the dialogue is complete the infant was given an opportunity to examine each of the puppets. The puppets used during this assessment were bath mitts representing the dragon and hippopotamus from the “Baby Einstein” cartoon. Bath mitts were chosen to minimize the spread of virus and bacteria among subjects.

Toy retraction followed the puppet game episode. In this episode the child was allowed to explore an attractive toy. The toy was then removed from the child and placed in view but out of reach. This episode was designed to create a situation that allows for the expression of anger when the exploration of the toy is interrupted. Additionally, it is designed to be interpersonal and is described as a violation of social norms. During this episode infants were seated in a high chair and presented with two rattles. They were allowed to choice between two rattles and allowed to play with the rattle they chose until they became engaged, after which the rattle was held at the edge of the high chair tray slightly out of reach of the infants.

The next episode conducted during the assessment was cognitive assimilation game (hereafter referred to as pop-up toy). Given difficulties locating a classic “jack in

the box,” an attractive toy which caused music to play and bubbles to pop when a button was pressed was used. The experimenter demonstrated the use of a pop-up toy several times. The child was then allowed to play with the toy for two minutes. This episode is designed to measure pleasure that results from playing with an attractive toy.

Masks followed the pop-up toy episode. This task is designed to elicit fear in a non-social context with a mild and non-intrusive stimulus. During this task the experimenter put on four consecutive masks (for 10 seconds each) and looks at the child, who is seated in a high chair, and says the child’s name. After the examiner modeled the mask they removed it and allowed the infant the opportunity to explore it by placing it on the high chair tray.

After masks, the child participated in the task orientation (hereafter referred to as blocks) episode. During this episode the child was granted the opportunity to manipulate a set of blocks for three minutes. This is an activity that all children are capable of doing; therefore the differentiating factors in children’s participation are persistence and attention.

Following the blocks episode the child participated in the restraint in the car seat episode. The infant was physically restrained in a car seat for thirty seconds. Being compelled to do something against ones wishes can elicit mild anger in some children. This task also has a high degree of face validity because children are required by law to be restrained in a car seat while in a motor vehicle.

The final episode was basket of toys. This episode provided a measure of activity level during object-oriented play. The child sat and was provided access to a basket of

toys. The child was allowed to play with and explore the toys in that basket for three minutes.

### *Procedures*

Women were approached for participation when their child reached approximately 32 weeks of age. Researchers contacted women who were eligible for participation through letters and phone calls. The study was described to them and if they were interested in hearing more, a meeting was set up in their home. Initially, one research assistant entered the home, described the study, and obtained informed consent. In addition, she also played with the infant and allowed the infant to become comfortable with her. The first researcher set up the camera in the home (following the standardization procedures described below). During the in-home visit the infant completed the Laboratory Temperament and Assessment Battery (Lab-TAB) beginning with the “Stranger Approach” vignette.

Many of the procedures outlined in previous research conducting the Lab-TAB in the home were utilized in order to standardize the home environment as much as possible. First, all sessions took place during a time of the day when the mother expected the baby to be alert and rested. If the infant became fussy, the session was terminated and resumed on another day. This occurred in four of the eighty subjects who participated in this study. Second, the experimenters brought a large white blanket with them, which was spread on the floor in an effort to simulate a standard laboratory setting. Third, the experimenters provided all of the materials needed to complete the assessment and those materials were the same for all of the subjects. For example, all subjects used the same high chair, the same car seat, the same toys, and all subjects were to be filmed using the

same video camera. However, the camera used during the first seventy-two assessments was damaged and therefore the remaining eight assessments were conducted using a different, though comparable, camera. Fourth, the mother was asked to wear darkened sunglasses during the assessments. The mother also sat to the right of and behind the infant. The experimenter was always on the infant's left. Finally, the episodes were conducted in the same order for all subjects. Between episodes the child was allowed to rest, explore, and interact with the mother and experimenters until the child was calm and alert.

The Lab-TAB procedure used during this research protocol has been further modified from the original version. The vignettes described in the Lab-TAB procedural manual involved the mother in the tasks. Because the focus of this research is on the infant's regulatory abilities independent of the mother it was necessary to alter the vignettes so that the mother had minimal involvement. The mother was present during the administration of the Lab-TAB. However, she sat to the right of and slightly behind the infant. In this position she was physically present should the infant decide to turn toward her. However, she was not directly involved in the administration of the Lab-TAB.

#### *Affect Coding*

All of the Lab-TAB vignettes were coded using the coding procedures described in the Laboratory Temperament Assessment Battery (Lab-TAB) Manual, Version 2.01 (Goldsmith & Rothbart, 1988). With the exception of latencies, all variables were coded using the coding segments ("epochs") specified in the manual. Latencies to respond to the stimuli were compared in terms of seconds. Discrete behaviors were coded for presence or absence during a coding epoch. Continuous assessments of the intensity of a behavior

displayed were coded for positive and negative emotions in each visible epoch. Two individuals, who were blind to maternal depression status, were responsible for coding the Lab-TAB. Coders were trained using a subset (four) of participants which were chosen because of the range of emotion displayed. Coders had to reach 85% agreement on those four tapes prior to beginning coding. Difficulties with coding that arose were discussed with the other coder and if a consensus could not be reached, were discussed with the primary investigator. Reliability was assessed on 15% of coded tapes chosen at random from the entire sample.

#### *Coding of Regulatory Behaviors*

Three functional categories of emotional regulatory behavior based on the literature were coded (Nachmias, Gunnar, Mangelsdorf, Parritz, & Buss, 1996; Rothbart, Ziaie, & O'Boyle, 1992; Buss & Goldsmith, 1998). Specifically, those classes are defined and were coded as follows:

1) Disengagement of attention can be expressed in one of two ways which are not mutually exclusive of one another and reference the duration of time in which the child is disengaged. In addition, disengagement is only considered if the direction the child looks is not another person. If the child looks toward another person, it is considered social referencing.

- (a) Gaze aversion: a brief look away from the stimulus without focusing on another object (which lasts for less than 1 epoch)
- (b) Distraction: looking away from the stimulus and focusing on another object (lasting more than 1 epoch)

2) Social Referencing can be expressed in one of two ways which are mutually exclusive of one another and reference the person located in the direction that the child gazes.

(a) Looks toward mother: a look toward the mother conducted at any time for any duration during the coding epoch

(b) Looks toward the experimenter: a look toward the experimenter conducted at any time for any duration during the coding epoch.

3) Self-stimulation can be expressed in five ways which are mutually exclusive and refer to self-soothing behaviors which are repetitive or systematic gross or fine motor behavior

(a) Manipulating hair: a touch to the hair at any time for any duration during a coding epoch.

(b) Manipulating clothing: a touch to the child's clothing at any time for any duration during a coding epoch.

(c) Oral Stimulation: a child placing an object or a body part in their mouth at any time for any duration during a coding epoch.

(d) Manipulation of an object: a child manually manipulates any object (other than the stimulus) at any time for any duration during a coding epoch.

(e) Manipulation of the stimulus: a child manually manipulates the stimulus at any time for any duration during a coding epoch.

Regulatory behaviors were coded discretely (as present or absent) during each epoch for all eight of the emotion eliciting episodes. Regulatory behaviors were coded by two individuals who were blind to both maternal depressive status and affective codes. Coders were trained on four tapes that were chosen because they displayed a wide variety of the target codes. Difficulties with coding were discussed among the coders. When a

consensus could not be reached, the difficulties were discussed with the primary investigator. Reliability was established on a subset (15%) of tapes, chosen at random.

A change score was computed for each behavior displayed during an episode. Coding procedures to derive change scores were based upon the contingency analysis proposed by Buss and Goldsmith (1988). This procedure involved locating the coding interval during which a regulatory behavior occurred. For each regulatory behavior displayed the change in affect from the coding interval in which the behavior occurred to the next coding interval is measured. The change score measured the degree to which each regulatory behavior is associated with a change in affect. Buss and Goldsmith (1988) found three patterns of change scores: (1) no change in affect across the two coding intervals, (2) an increase in affective expression after the behavior occurs, (3) a decrease in affective expression after the behavior occurs.

### *Reliability*

#### *Reliability of affect codes*

Reliability was assessed established on a subset of cases (15% of the total sample chosen at random). Inter-rater reliability was derived using intraclass correlations (Shrout & Fleiss, 1979). Intraclass correlations were computed for each aggregate variable of interest and are displayed below in Table 3. Overall, there was strong agreement between the two raters, intraclass correlations ranged from moderate (toy retraction; ICC = .71,  $p = .001$ ) to excellent (positive affect; ICC = .92,  $p = .001$ ).

Table 3

*Reliability of LAB-TAB aggregate variables*

Episode/Variable	Intraclass Correlation Coefficient
Fear aggregate	.82**
Toy Retraction aggregate	.71**
Restraint in Car Seat aggregate	.97**
Positive affect aggregate	.92**

\*  $p < .05$ \*\*  $p < .001$ *Reliability of regulatory codes*

Reliability of the regulatory codes was established on a subset of cases (15% of the total sample chosen at random). Inter-rater reliability was derived using an intraclass correlation (Shrout & Fleiss, 1979). Intraclass correlations were computed for each variable coded in each of the episodes of interest and are displayed below in Table 4. Overall, intraclass correlation which measured the agreement between the two raters regarding the presence or absence of the behavior ranged from moderate (ICC = .66,  $p = .001$ ) to excellent (ICC = 1.00,  $p = .001$ ). There was strong agreement between raters with agreement exceeding 96% on each regulatory behavior.

Table 4

*Reliability of Putative Regulatory Variables Assessed with an Intraclass Correlation*

Episode/Variable	Fear Episodes	Restraint in Car	Toy Retraction
	ICC	Seat ICC	ICC
Gaze Aversion	.85**	.66**	1.00**
Distraction	.84**	.88**	.92**
Looks to Mother	.85**	.81**	.95**
Looks to Experimenter	.87**	.81**	.92**
Hair	.94**	1.00**	1.00**
Oral	.94**	.92**	1.00**
Clothing	1.00**	.80**	1.00**
Object	.92**	.81**	.83**
Stimulus	.97**	.87**	.95**

\*  $p < .05$ \*\*  $p < .001$ *Data Reduction*

Data aggregation took place at three different levels; across epochs (and trials), within an episode, and across episodes. Aggregation across trials and epochs will be considered in the section below. The two remaining levels of data aggregation will be addressed in the second section. Before variables were aggregated associations between

the variables was established using a Pearson correlation. Variables which demonstrated statistically significant associations were standardized and combined.

*Deriving a variable score across epochs*

For the episodes that did not have multiple trials (Puppet Game, Pop Up Bunny, and Restraint in Car Seat), data were aggregated across epochs (individual coding segments) to derive an average score for each discrete variable. For the three episodes that have multiple trials (masks, stranger approach, toy retraction), the epochs were averaged within trials (repeated presentation of a behavior within an episode) for each of the discrete coded variables to yield averages for each trial. Next, correlations between trials were computed for each of the discrete coded variables. For each of the variables that correlated significantly across trials, data were aggregated across trials to yield an overall score for that episode.

Within the Stranger Approach episode facial fear demonstrated significant coherence across trials ( $r = .47$ , range = .38 to .58, all  $p < .001$ ). Vocal distress was also coherent across trials ( $r = .54$ , range = .38 to .67, all  $p < .001$ ). Bodily fear was coherent across the three trials as well ( $r = .73$ , range = .62 to .79, all  $p < .001$ ). Startle did not demonstrate coherence across the three trials and therefore is not included in the analysis. The first two trials were consistent with one another ( $r = .47$ ,  $p < .001$ ). However the first trial was not significantly correlated with the third trial ( $r = .10$ ,  $p = .40$ ) and as such was not aggregated across trials. Escape Behavior also did not demonstrate consistency across the three trials. Once again the first and the second trial were significantly correlated with one another ( $r = .34$ ,  $p < .05$ ). However, the first and third trial were practically unrelated ( $r = .003$ ,  $p = .98$ ) and the second and third trial were insignificantly

related in the opposite direction of what would be expected ( $r = -.07$ ,  $p = .53$ ). In the first two trials the experimenter is approaching the infant, in the third trial they are picking up and holding the infant. These behaviors are qualitatively different, which may have led to the lack of association between the trails. The lack of association among trials may also be due, in part, to the lower reliability of Startle and Escape Behavior. Based on these results facial fear, vocal distress, and bodily fear were aggregated across trials.

A similar pattern of correlations was observed within the Masks episode. Facial fear was coherent across all four episodes ( $\bar{r} = .64$ , range = .56 to .83, all  $p < .001$ ). Coherence was also demonstrated for vocal distress ( $\bar{r} = .63$ , range .48 to .80, all  $p < .001$ ). Bodily fear was found to be coherent across all four episodes ( $\bar{r} = .52$ , range = .26 to .77, all  $p < .05$ ). In contrast to the Stranger Approach episode, escape behavior was coherent across all four episodes ( $\bar{r} = .61$ , range = .59 to .83, all  $p < .001$ ). Similar to the Stranger Approach episode, startle was not coherent across episodes; therefore it was not included in the final aggregate. Trials one and two were significantly related ( $r = .97$ ,  $p < .001$ ). However, trials three and four were not associated with each other nor were they significantly associated with trials one or two ( $r = -.01$ , ranges  $\bar{r} = -.06$  to .04). Based on these results facial fear, vocal distress, and escape behavior were aggregated across episodes.

The Toy Retraction episode consisted of three trials. Facial anger was coherent across all three trials ( $\bar{r} = .44$ , range = .38 to .49, all  $p < .001$ ). Bodily anger was also coherent across each of the three trials ( $\bar{r} = .38$ , range = .29 to .48, all  $p < .01$ ). Distress vocalization also demonstrated coherence across the three episodes ( $\bar{r} = .44$ , range .39 to

.54, all  $p < .001$ ). Based on these results facial anger, bodily anger, and distress vocalization were aggregated across trials.

### *Construct Composition*

Variables that demonstrated a significant positive association using a Pearson correlation were aggregated into a single composite score for that episode. Composite scores for episodes, which are thought to be conceptually related, were aggregated to form the overall emotional construct provided they demonstrated a significant association using a Pearson correlation. There are three emotional constructs of interest to this project fear, anger, and positive affect. The formation of each of the constructs is discussed below.

*Composition of fear construct.* Two episodes (Stranger Approach and Masks) are thought to assess fear in infants (Goldsmith & Rothbart, 1988). The association between the aggregates of the variables which had demonstrated coherence in the Stranger Approach episodes (facial fear, vocal distress, and bodily fear) was assessed using a Pearson correlation. Each of the variables were significantly and positively associated with each other ( $r = .63$ , range .52 to .75, all  $p < .001$ ). Similarly, the associations between the variables which had demonstrated coherence in the Mask episode (facial fear, bodily fear, vocal distress, and escape behavior) were assessed using a Pearson correlation. Each of the variables demonstrated a significant Pearson correlation ( $r = .54$ , range .46 to .68, all  $p < .001$ ). The association between the aggregated variables from the Stranger Approach episode and the Masks episode was assessed using a Pearson correlation ( $r = .38$ ,  $p < .01$ ), which demonstrated a significant, positive relationship.

*Composition of anger construct.* Within this project two episodes were conducted which were designed to measure the anger expressions in the research participants (Toy Retraction and Restraint in Car Seat). Within the Toy Retraction episode the association between variables which demonstrated significant coherence (facial anger, bodily anger, and distress vocalization) was assessed using a Pearson correlation. Two of the variables, facial anger and distress vocalizations, demonstrated a significant association with each other ( $r = .35, p < .001$ ). Bodily anger was not significantly associated with either facial anger ( $r = .18, p = .20$ ) or distress vocalizations ( $r = .14, p = .23$ ). Therefore, only facial anger and distress vocalization were included in the composite variable. The three variables related to anger in the Restraint in Car Seat episode were assessed using a Pearson correlation to determine the extent of their relationship. Each of the variables demonstrated a significant positive association to the other variables ( $r = .48$ , range .38 to .66, all  $p < .01$ ). The overall composites from the Toy Retraction and Restraint in Car Seat Episodes were then examined with a Pearson correlation to determine whether an overall anger composite could be formed. Restraint in Car Seat and Toy Retraction were negatively and nonsignificantly associated with one another ( $r = -.11, p = .93$ ) therefore an overall anger construct is not statistically supported and each episode is analyzed separately.

*Composition of positive affect construct.* The Pop-Up Bunny (Cognitive Assimilation) and Puppet Game episodes each contain a measurement of positive affect. The association between the four variables in the Pop-Up Bunny (Cognitive Assimilation) episodes (positive motor movement, intensity of smiling, presence of laughter, and positive vocalizations) were assessed using a Pearson correlation. Three of

the variables (positive vocalization, intensity of smiling, and presence of laughter) demonstrated a positive and significant association ( $r = .37$ , range .25 to .61, all  $p < .05$ ). Positive motor movement was correlated significantly with positively vocalizations ( $r = .32$ ,  $p < .01$ ) but not with presence of laughter ( $r = -.04$ ,  $p = .73$ ) or with intensity of smiling ( $r = .15$ ,  $p = .18$ ). Similarly, the association between the four variables which related to positive affect in the Puppet Game episode (positive motor movement, intensity of smiling, presence of laughter, and positive vocalizations) was assessed using a Pearson correlation. All four variables correlated significantly and positively associated ( $r = .50$ , range .39 to .64, all  $p < .001$ ). The two positive affect composites were significantly and positively associated with one another ( $r = .27$ ,  $p = .02$ ).

## CHAPTER 3

### RESULTS

#### *Examination of Infant Affect*

The literature reviewed in this paper made a compelling case that infants whose mothers experience “significant” symptoms of negative affect during the postpartum period are at risk for a number of sequelae during their development. However, measurement and methodological issues have muddied the issue such that it is difficult to state definitively what outcomes they are at risk for specifically. Without knowing specific outcomes, it is impossible to examine the mechanisms of risk. In this section the first aim of this document, to establish the impact of maternal negative affect (both in terms of clinical diagnosis and self-report symptomatology) on infant’s emotional expressions, will be addressed below. The second aim of this paper, to examine the regulatory capabilities of infants of depressed and nondepressed mothers, will be examined in later sections of this document.

#### *Infant Negative Affect Reactivity*

The relations between diagnostically significant symptoms of depression that is symptoms of depression which meet current DSM-IV (American Psychiatric Association, 1994) criteria for Major Depressive Disorder (MDD) and infant negative affect was explored. Specifically, it was hypothesized that infants of mothers who met criteria for MDD would be more likely to display higher levels of fear and anger to stimuli designed to elicit those emotions compared to infants of nondepressed mothers. Multivariate analysis of variance (MANOVA) was conducted, examining the impact of maternal

MDD on the fear and anger reactions of infants. Due to the lack of coherence in the anger construct the toy retraction and restraint in car seat episodes were examined separately.

A MANOVA which examined the group difference between infants of nondepressed mothers and infants of depressed mothers on three variables; intensity of fear expression, latency to express fear, and the amount of time spent expressing fear was conducted. Overall, there was a slight, though nonsignificant, trend toward a group difference in the examination of infant's fear in response to fear producing stimuli,  $F(3, 77) = 2.04, p = .10$ . In addition, there was a similar, nonsignificant trend in examination of amount of time the infant was afraid,  $F(3, 77) = 2.97, p = .09$ . However, these variables were also highly correlated ( $r = .76, p = .001$ ). There was not a significant difference between the two groups in the amount of time infants were afraid during the episodes designed to elicit fear  $F(3, 77) = 1.81, p = .18$ .

The group differences in anger expression were examined by evaluating each of the anger episodes separately, as they did not correlate significantly and thus were not considered to form a coherent construct. For each of the anger eliciting episodes the difference between infants whose mothers experienced postpartum depression and infants whose mothers did not were examined on three variables; intensity of anger expression, latency to express anger, and amount of time spent expressing anger.

Within the toy retraction episode there was a slight, though nonsignificant trend toward a group difference, when examining the anger composite of infants of depressed mothers  $F(3, 77) = 2.67, p = .11$ . A similar, nonsignificant, trend emerged for the amount of time spent angry  $F(3, 77) = 2.19, p = .14$ . There was not a significant group difference in latency to express anger  $F(3, 77) = .04, p = .83$ .

There was not a significant group difference in infant anger reaction to the restraint in car seat episode across any of the variables examined. Therefore there was not a significant difference for the emotional expression aggregate  $F(3, 77) = .22, p = .64$  or the amount of time infants spent angry  $F(3, 77) = .16, p = .69$ . Likewise there was not a significant difference for latency to become angry  $F(3, 77) = .20, p = .66$ .

#### *Infant Positive Affect Reactivity*

The hypothesis that infants of depressed mothers would display lower levels of positive affect was assessed using a MANOVA which examined the group difference in the composite of infant positive affect, the latency to display positive affect, and the amount of time the infant spent displaying positive affect. Analysis using a MANOVA revealed a main effect in the relationship between maternal depression and the intensity of infant positive affect  $F(3, 77) = 4.03, p = .05$ . Follow-up t-test indicated that infants of depressed mother's ( $M = 12.33, SD = 9.16$ ) demonstrated less intensity of positive affect than infants of nondepressed mothers ( $M = 16.96, SD = 10.43$ )  $t = 2.00, p = .05$ . There was not a significant group difference between maternal depression and the amount of time infants spent displaying positive emotions  $F(3, 77) = 1.88, p = .17$ . In addition, there was not a significant group difference between maternal depressive status and latency to exhibit positive affect  $F(3, 77) = 2.36, p = .13$ .

#### *Examination of Infant Emotional Regulation*

##### *The Relationship Among Regulatory Behaviors*

Given that there is little research that describes the putative regulatory behavior of infants, the associations among different forms of regulatory behaviors in the context of the emotions in which they are displayed are examined prior to addressing the specific

hypothesis of this project. Below are descriptions of the putative regulatory behaviors exhibited during the episodes designed to elicit fear and anger. These analyses are important as different theories have articulated means of emotional regulation, which are distinct for fear and anger. Social referencing, particularly looking toward mother, and interacting with the stimulus are thought to be more common when introduced to fearful stimuli (Buss & Goldsmith, 1998). Although there are not clear theories which describe anger regulation, one could theorize that distraction (by interacting with an object other than the stimulus) would be more prevalent during anger episodes.

*Fear episodes.* Correlations among the observed putative regulatory behaviors were computed to determine the associations among behaviors observed during the fear episodes. These correlations are displayed in Table 5. Overall, the pattern of correlations suggests that the variables are not highly related and therefore may measure independent constructs. Interestingly, infants who employed gaze aversion tended not to look toward the experimenter. However, both gaze aversion and looking toward the experimenter were related to playing with hair, playing with clothes, or engaging in oral behavior. However, the association was in opposite directions. Infants who used gaze aversion tended to play with their clothing, play with their hair, and engage in oral behavior. Infants who tended to look toward the experimenter engaged played with their hair less, played with their clothing less, and engaged in less oral behavior. Infants who played with an object (other than the stimulus) were also more likely to play with their clothing and engage in oral behavior.

Table 5

Associations Among Putative Regulatory Behaviors during the Fear Episodes

Regulatory Behaviors	1	2	3	4	5	6	7	8	9
1. Gaze		.06	.07	-.44**	.49**	.29**	.28**	.12	-.03
Aversion									
2. Distraction			-.11	-.31**	-.03	.27*	-.11	-.05	.03
3. Looks to				.19	-.19	-.11	-.04	-.22	.08
Mother									
4. Looks to					-.43**	-.38**	-.43**	-.23*	.25
Experimenter									
5. Plays with						.08	.34**	.05	-.06
Hair									
6. Plays with							.46**	.49**	-.01
Clothing									
7. Oral								.42**	.14
8. Plays with									-.09
Object									
9. Plays with									
Stimulus									

\*  $p < .05$  level

\*\*  $p < .001$  level

*Anger episodes.* Similarly, correlations were computed for putative regulatory behaviors which were observed during the anger episodes. Given the lack of significant association in affective expressions between the two anger episodes, putative regulatory behaviors are considered separately for each of the episodes. These correlations are displayed below in tables 6 and 7.

Within the Restraint in Car Seat episode (Table 6), gaze aversion was again related to looking toward the experimenter. Similar to the fear episodes, the subset of infants who used gazed aversion tended to look at the examiner less. In addition, those infants who used gaze aversion also looked at their mother's less. Infants who used gaze aversion also tended to play with their hair, play with their clothing, and engage in oral behavior. In addition, infants who used gaze aversion were less likely to interact with the stimulus. Distraction was not related to any of the other behaviors. The two social behaviors, looking toward the mother and experimenter, were related. Infants who looked toward their mother were also less likely to play with their hair or play with their clothing. Looking toward mother was significantly and positively associated with interacting with the stimulus. Similarly, high levels of looking toward the experimenter were associated with less playing with hair, playing with clothing, oral behavior, and play with an object. Infants who looked toward the mother interacted with the stimulus more. Infants who played with their hair tended to play with their clothing. However, infants who played with their hair were less likely to interact with the stimulus.

Table 6

*Associations Among Putative Regulatory Behaviors during Restraint in Car Seat Episode*

Regulatory Behaviors	1	2	3	4	5	6	7	8	9
1. Gaze		-.03	-.24*	-.57**	.36**	.24*	.25*	.08	-.45**
Aversion									
2. Distraction			.07	.01	-.08	.17	.09	.18	.03
3. Looks to Mother				.41**	-.26*	-.23*	-.21	-.15	.35**
4. Looks to Experimenter					-.43**	-.38**	-.43**	-.23*	.25*
5. Plays with Hair						.22*	-.04	-.01	-.27*
6. Plays with Clothing							-.03	.01	-.18
7. Oral								.19	-.08
8. Plays with Object									-.25
9. Plays with Stimulus									

\*  $p < .05$

\*\*  $p < .001$

Within the Toy Retraction episode (Table 7) gaze aversion was again significantly and negatively related to looking toward the experimenter. Infants who used gaze aversion also tended to play with their hair more frequently and interacted with the stimulus less. Distraction and looking toward the mother were not related to the other behaviors. Infants who looked at the examiner more tended to play with their hair less, play with their clothes less, and engage in less oral behavior. Playing with hair was also significantly and positively related to engaging in oral behavior as was playing with clothing.

Table 7

*Associations Among Putative Regulatory Behaviors During the Toy Retraction Episode*

Regulatory Behaviors	1	2	3	4	5	6	7	8	9
1. Gaze		.02	.08	-.40**	.32**	.15	.03	-.08	-.25*
Aversion									
2. Distraction			-.06	.08	-.13	.04	.10	.02	.20
3. Looks to				.09	-.16	.04	.20	-.13	-.08
Mother									
4. Looks to					-.45**	-.35**	-.39**	-.18	.18
Experimenter									
5. Plays with						.09	.27*	-.01	.17
Hair									
6. Plays with							.31**	.24	-.02
Clothing									
7. Oral								.09	.13
Behavior									
8. Plays with									.03
Object									
9. Plays with									
Stimulus									

\*  $p < .05$ \*\*  $p < .001$

### *Regulatory Behaviors and Expressions of Negative Affect*

Within the aggregated fear episodes only one regulatory behavior, interacting with the stimulus, was significantly related to the affective composite. Infants who tended to interact with the stimulus more displayed less fear ( $r = -.24, p = .03$ ). In the Toy Restraint episode there was a positive association between the anger composite and the following regulatory behaviors; distraction ( $r = .40, p = .01$ ), looking toward the mother ( $r = .40, p = .01$ ), playing with clothing ( $r = .31, p = .03$ ), playing with hair ( $r = .44, p = .01$ ), engaging in oral behavior ( $p = .28, p = .01$ ), and interacting with the stimulus ( $r = .54, p = .01$ ). Within the Restraint in Car Seat episodes infants who displayed more anger used gaze aversion less ( $r = -.43, p = .001$ ). In addition, high levels of anger during the Restraint in Car Seat episode were associated with increased looking toward the mother ( $r = .27, p = .02$ ), increased looking toward the experimenter ( $r = .63, p = .001$ ), and increased interacting with the stimulus ( $r = .70, p = .001$ ).

### *Examination of Social Referencing*

Given the evidence that suggests that there is a disturbance in social relationships in infants of depressed mothers, it was hypothesized that they would use less social referencing while distressed than infants of nondepressed mothers. Social referencing was defined as looking toward either the mother or experimenter during the same epoch as a distress code occurred. An analysis of variance (ANOVA) was conducted to examine the group difference between infants of depressed mothers and infants of nondepressed mothers in looking toward the examiner. Overall, there was a significant effect for looking toward the mother [ $F(1, 79) = 5.97, p = .02$ ] throughout episodes designed to elicit fear regardless of whether the infant displayed visible distress. A second ANOVA

examining the group difference in number of looks toward the experimenter revealed a similar trend which did not quite reach the level of significance emerged for looking toward the experimenter [ $F(1,79) = 3.45, p = .07$ ] throughout all of the episodes designed to elicit fear. Follow-up analysis revealed that infants of nondepressed mothers ( $M = 3.6, SD = 3.8$ ) looked toward their mother significantly more often than did infants of depressed mothers ( $M = 1.74, SD = 2.26$ )  $t = 2.44, p = .02$ . Additional follow-up analysis revealed a similar pattern, which did not quite reach significance, for looking toward the experimenter where infants of depressed mothers ( $M = 7.87, SD = 5.10$ ) looked toward the experimenter less often than infants of nondepressed mothers ( $M = 9.84, SD = 4.28$ )  $t = 1.86, p = .07$ .

Distressed infants of depressed mothers continued to look toward their mother ( $M = 1.56, SD = .73$ ) significantly less frequently than infants of nondepressed mothers ( $M = 2.72, SD = 2.11$ )  $t = 2.39, p = .02$ . The trend, which was observed for infants of nondepressed mothers, to reference the experimenter during all of the episodes designed to elicit fear did not persist when only epochs in which the infant became distressed were counted ( $t = .17, p = .87$ ). There was relatively even social referencing of the experimenter by infants of depressed mothers ( $M = 4.83, SD = 3.86$ ) and infants of nondepressed mothers ( $M = 4.97, SD = 3.01$ ).

Similar to the pattern observed in episodes designed to elicit fear, there was a significant association between maternal depressive status and looking toward the mother during episodes designed to elicit anger [ $F(1, 79) = 9.35, p = .003$ ]. Follow-up analysis revealed that overall infants of depressed mothers looked toward their mother ( $M = 4.42, SD = 3.87$ ) more than infants of nondepressed mothers ( $M = 1.97, SD = 2.68$ )  $t = 3.06, p$

= .003. There was also a relationship, which did not reach the level of statistical significance, between maternal depressive status and looking toward the experimenter in all episodes designed to evoke an angry response [ $F(1, 79) = 3.68, p = .06$ ]. Although infants of depressed mothers looked toward the experimenters ( $M = 8.48, SD = 4.10$ ) more than did infants of nondepressed mothers ( $M = 6.70, SD = 3.88$ ), the difference between the means did not quite reach the level of significance ( $t = 1.91, p = .06$ ).

Unlike the pattern observed with episodes designed to elicit fears, the significant association between looking toward the mother and maternal depressive status failed to remain significant when only epochs in which the infant was distressed were examined ( $t = -.22, p = .83$ ). The observed mean looks toward the mother when infants were distressed were virtually identical for infants of depressed mothers ( $M = 3.03, SD = 2.22$ ) and infants of nondepressed mothers ( $M = 3.20, SD = 1.62$ ). Similarly, there was not a significant difference between infants of depressed versus nondepressed mothers in looking toward the experimenter when infants were distressed ( $t = .72, p = .48$ ). The mean number of looks to the experimenter exhibited by infants of depressed mothers ( $M = 4.10, SD = 2.47$ ) were similar to those committed by infants of nondepressed mothers ( $M = 4.57, SD = 2.31$ ).

#### *Effectiveness of Putative Regulatory Behaviors*

This project examined the types of behaviors that infants display when they are experiencing negative affect. However, the extent to which these behaviors are effective at reducing the infant's level of distress is unclear. The association between behaviors that infants exhibited while they were distressed and their level of distress was examined. An infant could conceivably exhibit one of three patterns. First, an infant could exhibit

distress, exhibit a regulatory behavior, and then experience a reduction in observed distress. This pattern would be considered effective regulation. Second, an infant could exhibit distress, exhibit a regulatory behavior, and then continue to exhibit the same amount of distress. This pattern is more nuanced and therefore more difficult to explain. It could be that the behavior is only partially successful in reducing the intensity or duration of the emotion, thus complete regulation does not occur. Alternatively, the behavior could be preventing an escalation of affect. Also, that behavior may just be a behavioral manifestation of the distress the infant is experiencing. Finally, infants could exhibit distress, exhibit a regulatory behavior, and then exhibit an increase in negative affect. Behaviors that follow this pattern are thought to not be effective at regulating the infant's emotion. It was hypothesized that infants of depressed mothers are less effective at regulating their negative emotions.

Data analysis took place at two levels. First, the effectiveness of regulatory behaviors was examined using a chi-square goodness of fit, which examined the likelihood that the ratios observed deviated from what would be expected by chance which is conceptualized as an equal likelihood of exhibiting any of the three regulatory patterns. For regulatory behaviors which demonstrated effectiveness beyond chance follow-up chi-square analysis was conducted to determine whether infants of depressed mothers utilized the effective strategies as frequently as infant of nondepressed mothers.

*Fear episodes.* Table 8 below outlines the observed and expected frequencies for each of the putative regulatory behaviors observed during the fear episodes. A 2 x 8 chi-square analysis was conducted which examined the likelihood that infants displayed either an effective or not effective regulatory pattern within the eight putative regulatory

behaviors. The three behaviors within the fear episodes that exceeded chance expectations were playing with clothes, playing with an object, and interacting with the stimulus. Sixty-four percent of infants who played with their clothes did not demonstrate a change in affect  $X^2(2, N = 14) = 7.00, p = .03$ . Playing with object did not lead to a change in affect in 48% of infants  $X^2(2, N = 33) = 8.90, p = .01$ . Forty-three percent of infants who interacted with the stimulus did not experience an increase in fear. In addition 45% of infants who interacted with the stimulus experienced a decrease in affect  $X^2(2, N = 51) = 10.71, p = .01$ .

Table 8

*Observed Frequencies of Putative Regulatory Behaviors during Fear Episodes*

Regulatory Behavior	Change in Affect					
	Increase		No change		Decrease	
	Observed	Expected	Observed	Expected	Observed	Expected
Gaze	7	8	7	8	10	7
Aversion						
Distraction	7	13.3	17	13.3	16	13.3
Look to Mother	13	18	24	18	17	18
Look to Experimenter	19	25.3	31	25.3	26	25.3
Plays with Hair	5	6	7	6	6	6
Oral Behavior	7	5.7	5	5.7	5	5.7
Plays with Clothes	1	4.7	9	4.7	4	4.7
Plays with Object	3	11	16	11	14	11
Interacts with Stimulus	23	17	22	17	6	17

The three behaviors that demonstrated effective regulatory patterns (playing with clothes, playing with an object, and interacting with the stimulus) were further examined to determine if they were used equally effectively by infants of depressed and nondepressed mothers. Table 9 displays the observed frequencies of regulatory behaviors in the context of maternal depressive status. There was not evidence of more effective use of the three behaviors by infants of nondepressed mothers. Eighty-eight percent of infants of nondepressed mothers demonstrated effective patterns of regulation in response to playing with their clothes and 100% in infants of depressed mothers demonstrated effective patterns of regulation. A 2 x 2 chi-square analysis which examined the effectiveness of the behavior (effective vs. not effective) in each of the two groups was conducted. There was not a significant difference in the pattern of effective regulation between infants of depressed mothers and infants of nondepressed mothers  $\chi^2 (1, N = 14) = .81, p = .37$ . Eighty-three percent of infants of depressed mothers experienced effective regulation when they played with an object in contrast to 95% of infants of nondepressed mothers. However, this difference was not significant  $\chi^2 (1, N = 33) = 1.31, p = .25$ . There was not a significant difference in effectiveness in interacting with the stimuli in infants of depressed and nondepressed mothers  $\chi^2 (1, N = 51) = .43, p = .51$ . This strategy was effective for 51% of infants of nondepressed mothers and 61% of infants of depressed mothers.

Table 9

*Observed Frequencies of Effective and Noneffective Regulatory Strategies in Infants of Depressed and Nondepressed Mothers during Episodes Designed to Elicit Fear*

Regulatory Behavior	Maternal Depressive Status			
	Depressed		Not Depressed	
	Effective	Not Effective	Effective	Not Effective
Plays with Clothes	7	1	6	0
Plays with Object	20	1	10	2
Interacts with Stimulus	11	7	17	16

\*  $p < .05$ .

*Toy retraction episode.* Similar to the fear analysis, a 2 x 8 chi-square analysis was conducted which examined the likelihood that infants displayed either an effective or not effective regulatory pattern within the eight putative regulatory behaviors. Within the toy retraction episode several behaviors demonstrated patterns that exceeded chance expectations when analyzed with a chi-square goodness of fit. Table 10 outlines the frequencies of observed regulatory behaviors in the Toy Retraction episode. 75% of observed change scores for gaze aversion revealed no change in affect which was greater than expected by chance  $X^2(2, N = 13) = 9.5, p = .01$ . Infants were also observed to not

experience a change in affect when they played with their hair in 64% of instances  $\chi^2 (2, N = 14) = 7.0, p = .03$ . Oral behavior was observed to lead to no change in affect in 55%

of cases and to a decrease in affect in 35% of cases  $\chi^2 (2, N = 10) = 9.55, p = .01$ .

Interacting with the stimulus led to no change in affect in approximately 47% of observed cases. In an additional 22% of cases interacting with the stimulus led to a decrease in affect  $\chi^2 (2, N = 59) = 5.93, p = .05$ .

Table 10

*Observed Frequencies of Putative Regulatory Behaviors during Toy Retraction*

Regulatory Behavior	Change in Affect					
	Increase		No change		Decrease	
	Observed	Expected	Observed	Expected	Observed	Expected
<b>Gaze</b>						
Aversion	2	4	9	4	1	4
Distraction	9	8	11	8	14	8
Look to	11	12.3	17	12.3	9	12.3
<b>Mother</b>						
Look to	17	22.7	27	22.7	24	22.7
<b>Experimenter</b>						
Plays with	1	4.7	9	4.7	4	4.7
<b>Hair</b>						
Oral	1	3.3	7	3.3	2	3.3
<b>Behavior</b>						
Plays with	3	3	5	3	1	3
<b>Clothes</b>						
Plays with	3	10.3	17	10.3	11	10.3
<b>Object</b>						
Interacts with Stimulus	18	19.7	28	19.7	13	19.7

The four behaviors that demonstrated some regulatory tendencies (gaze aversion, playing with hair, oral behavior, and interacting with the stimulus) were further analyzed to determine if infants of nondepressed mothers utilized these strategies more effectively than did infants of depressed mothers. A 2 x 2 chi-square analysis which examined the effectiveness of the behavior (effective vs. not effective) in each of the two groups was conducted. For the purpose of this analysis, change scores that exhibited either a decrease in affect or no change in affect were considered an effective regulatory behavior. An increase in negative affect was considered to be a noneffective regulatory behavior. Table 11 displays the observed frequencies of effective and non-effective regulatory strategies by maternal depressive status. The only behavior which yield a group difference was gaze aversion  $\chi^2(1, N = 13) = 5.33, p = .02$ . Infants of depressed mothers who used gaze aversions were effective (meaning they did not have an increase in negative affect) 86% of the time. This is in contrast to the 25% effectiveness rate for infants of nondepressed mothers.

Table 11

*Observed Frequencies of Effective and Noneffective Regulatory Strategies in Infants of Depressed and Nondepressed Mothers during the Toy Retraction Episode*

Regulatory Behavior	Maternal Depressive Status			
	Depressed		Not Depressed	
	Effective	Not Effective	Effective	Not Effective
Gaze	6	1	4	1
Aversion*				
Plays with Hair	4	0	7	0
Oral Behavior	3	0	4	0
Plays with Object	4	3	5	2
Interacts with Stimulus	20	2	21	16

\*  $p < .05$

*Restraint in car seat episode.* Within the restraint in car seat episode a 2 x 8 chi-square analysis was conducted which examined the likelihood that infants displayed either an effective or not effective regulatory pattern within the eight putative regulatory behaviors. Table 12 displays the frequencies of observed regulatory behaviors during the

Restraint in Car Seat episode. Only one behavior demonstrated a pattern of effectiveness beyond chance in the restraint in car seat episode. Fifty-five percent of infants experienced no change in affect after they looked toward their mother during this episode. An additional 18% experienced a reduction in negative affect. Taken together, this pattern exceeds chance expectations  $X^2(2, N = 38) = 8.58, p = .01$ . Looking to mother was effective in 90% of infants of depressed mothers and 68% of infants of nondepressed mothers. A 2 x 2 chi-square analysis which examined the effectiveness of the behavior (effective vs. not effective) in each of the two groups was conducted. This difference was not significant  $X^2(1, N = 38) = 1.86, p = .17$ .

Table 12

*Observed Frequencies of Putative Regulatory Behaviors during the Restraint in Car Seat episode*

Regulatory Behavior	Change in Affect					
	Increase		No change		Decrease	
	Observed	Expected	Observed	Expected	Observed	Expected
Gaze Aversion	4	5.3	6	5.3	6	5.3
Distraction	0	1	1	1	1	1
Look to Mother	10	12.7	21	12.7	7	12.7
Look to Experimenter	23	21.7	25	21.7	17	21.7
Plays with Hair	3	4	4	4	5	4
Oral Behavior	4	4.3	6	4.3	3	4.3
Plays with Clothes	4	3	1	3	4	3
Plays with Object	5	4.7	6	4.7	3	4.7
Interacts with Stimulus	19	17	21	17	11	17

## CHAPTER 4

### DISCUSSION

Repeated findings have demonstrated that postpartum depression constitutes a serious risk to the infant that is not remedied by treating maternal depression (Forman et al., 2007). However, a majority of the research that has examined the emotional development of infants of postpartum depressed woman has done so in the context of interactions between the mother-infant dyad. Given the large body of evidence that has demonstrated impairment in this relationship, this represents a potential confound in that it is unclear whether or not the results derive from a general temperamental disposition, malcontentment when interacting with the mother, or a combination of these factors. This study sought to address those concerns by examining the emotional reactivity and regulatory capabilities of infants of postpartum depressed mothers in an established temperamental paradigm, which minimized maternal involvement.

The research described in this paper was designed to contribute to the body of knowledge related to the study of emotional development in a high-risk sample of infants. In addition, this research sought to examine the nature of putative regulatory behaviors and explore the effectiveness of regulatory strategies employed by infant's of depressed and nondepressed mothers. An overview of the major findings of this research, their implications in the context of the larger literature and the limitations of the present study are undertaken in the following sections.

#### *Postpartum Depression and Infant Affective Expression*

Previous research has demonstrated a strong relation between postpartum depression and infant negative affect. Research using a self-report methodology has

demonstrated higher levels of negative affect in infants of mothers who reported more symptoms of depression (Bridget et al., 2009). Furthermore, the more a child expresses negative emotions the greater their risk for developing internalizing disorders (Brody et al., 1988). Because there is a robust body of literature demonstrating that children born to women who experience depression are at increased risk for both anxiety and depression, it is reasonable to infer that infants of depressed mothers should display more negative affect in situations designed to elicit fear and anger. Although there was an association between maternal depressive status and infant fear reactivity, this association did not reach the level of statistical significance. Second, the amount of time that infants spent in fearful displays was examined. Again, infants of depressed mothers had a slight, yet nonsignificant, tendency to remain fearful longer than infants of nondepressed mothers. Finally, for infants who displayed a fearful reaction, the amount of time which elapsed prior to their display of fear was examined. There was not an association between maternal depressive status and latency to display a fearful reaction.

Similar to previous research literatures (Field, 1986; Field et al., 1988), which have demonstrated diminished pleasure displays in infants of depressed mothers during parent-child interactions, infants of depressed mothers displayed significantly less pleasure than infants of nondepressed mothers in response to the stimuli designed to elicit positive affect within this study. Although infants of depressed mothers displayed less intense positive affect, there was not a significant group difference in the amount of time spent displaying positive affect. In addition, there was not a significant difference in latencies to express positive affect. This means that while infants of depressed mothers

expressed less intense positive affect than infants of nondepressed mothers, they spent an equal amount of time in positive affect displays and were not slower to display happiness.

The purpose of this study was to identify patterns of emotional reactivity which may explain, in part, the relationship between postpartum depression and risk for psychopathology. Previous research has demonstrated that infants of postpartum depressed mothers are at increased risk for developing either mood disorders or anxiety disorders (Radke-Yarrow & Klimes-Dougan, 2002). In contrast to longitudinal research that has demonstrated a relationship between maternal depressive status and risk for anxious mood, this study did not find a significant association between infant fear expression and maternal depressed mood. This finding is particularly surprising in the context of research that has demonstrated a relationship between a fearful, anxious, temperament during infancy and risk for developing anxiety disorders during later childhood (Kagan, Reznick, & Snidman, 1988).

The findings of this study related to displays of fear and low positive mood are best understood in the context of the larger literature which has sought to elucidate the relationship between mood disorders and anxiety disorders. At a diagnostic level there is a high level of comorbidity between these two disorders. For example, lines of research which have attempted to clarify the relationship between anxiety and depression at a symptom level have identified low positive mood (such as diminished interest or pleasure in activities) as the distinguishing feature of depressive symptoms within adult populations (Watson et al., 2005, Watson, 2009). Therefore, the results of this research make a strong case for low positive affect in infants of depressed mothers serving as a mechanism of risk for the development of mood disorders.

This mechanism of risk may be conveyed through neurological development which is occurring during this time period. Neuroimaging studies have demonstrated patterns of right frontal activation in depressed women and their infants (Dawson et al., 1999). The right OFC is associated with behavioral and emotional fearfulness (fear or avoidant motivation) in older children whereas the left OFC is most commonly associated with appetitive motivation (goal directed, energetic, positive emotions; Davidson, & Irwin, 1999). The OFC is an enlarged portion of the cortex that is increasingly activated during late infancy when there is an overproduction of synapses and nerve terminals which is necessary in the development of efficient circuitry through synaptogenesis (Schore, 1994; Huttenlocher, 1994).

The convergence between neurobehavioral data and the findings of this study provide an explanation for how risk is conferred. Synaptic firing is experience mediated, which means that the more experience you have with a particular domain the stronger and faster the neural networks in the associated regions of the cortex. Given the data that suggest that women who experience a postpartum depression engage in less positive interactions with their infants, it is likely that they receive less activation of the left orbitofrontal cortex (Field, 1986). This lack of activation during the sensitive period of infancy leads to the development of an inefficient neurological system. The inefficient neurological system serves as a risk factor for developing a mood disorder (Davidson et al, 1995).

The findings of this study, neurological findings, and research that has attempted to clarify the relationship between mood disorders makes a convincing case for continued study of positive affective development during infancy and later childhood. Future

research will need to employ precise methods of diagnosis of maternal mood symptoms, relate behavioral observations to neurological findings, and study the concept of positive affect throughout development.

Although the findings related to positive affect offer a persuasive explanation regarding the conference of risk for developing a mood disorder, it does little to explain how risk for anxiety disorders is conferred. To understand this risk, further discussion related to the comorbidity between anxiety and depression is warranted. Watson et al. (1995) described a general factor that explained the comorbidity between anxiety and mood disorders, which is referred to as general distress. As was the case with depression, anxiety is also composed of specificity at a symptom level marked by somatic feelings associated with anxiety. This means that even though there is overlap between anxiety and depression, each has a unique component that may confer unique risk.

The unique components of anxiety may explain the lack of a significant association between postpartum depression and infant expression of fear. Within the sample of women in this study there were actually low rates of comorbidity relative to other research samples. Previous research has demonstrated that a fearful, inhibited temperament is related to maternal anxiety disorders (Kagan et al., 1988). Therefore, it is likely that the under representation of anxiety disorders within this sample may have led to the lack of significant association between maternally depressed mood and infant fearful temperament.

There is little research that directly examines the impact of postpartum depression on infant's expression of anger. The examination of anger in infants of depressed mothers is important because there is longitudinal research which suggests that maternal

depression conveys equal risk for internalizing and externalizing disorders (Radke-Yarrow & Klimes-Dougan, 2002). Even though there are data that suggest that infants are at risk for developing externalizing disorders (which typically involve expressions of anger) it is unclear how this risk is conferred. Increased expressions of anger during infancy may serve a mechanism of risk for later development of psychopathology. Therefore, it was predicted that infants of depressed mothers would display more anger in response to stimuli designed to elicit that emotion. There was not a difference between the intensity of anger displays in infants of depressed or nondepressed mothers in either the Restraint in Car Seat and Toy Retraction episodes. There was also not a difference in overall time spent in displays of anger between infants of depressed mothers and infants of nondepressed mothers. Finally, there was not a difference in latency to display an angry reaction between the two groups in either episode.

These findings suggest that in contrast to the hypothesized relation, there is not an association between maternal depressive status and infant anger reactivity. However, there is evidence from other research that suggests that anger has significant cross-species, hierarchical, temporal components which are masked when angry displays are averaged over time (Potegal, Kosorok, & Davidson, 2003). The Potegal et al. (2003) study found that for infants at approximately 15-months of age, the temporal pattern of anger expression involved struggle, vocalization, and then facial expression of anger. Furthermore, they found that exhibiting earlier behaviors (such as struggle) increased the probability that infants would display behaviors which occurred later (such as vocalization or facial anger). This suggests that future research should focus on the temporal pattern of behaviors which represent an escalating pattern of infant behavior.

The lack of association between anger expression and maternal depression in this sample also speaks to the importance of assessing children in at-risk populations at varying stages of development. Infants of depressed mothers in this sample did not display levels of anger as was hypothesized given their later risk for externalizing disorders. However, they were also not yet cognitively capable of engaging in the appraisals which are heavily emphasized in models relating emotion to aggressive behavior. Also the infants in this sample had not had the same amount of experience with familial conflict, harsh parenting, and recurrent depressive episodes which have been emphasized as important factors in the development of antisocial behavior (Radke-Yarrow & Klimes-Dougan, 2002). Therefore, these results cannot speak to the cumulative risk that these children will develop throughout their childhood and emphasizes the need for longitudinal research documenting changes in emotion and cognition throughout the development of infants in high-risk populations.

#### *Postpartum Depression and Infant Emotional Regulation*

What does it mean to effectively regulate negative affect? Regardless of whether the concept is considered from a behavioral or biological perspective there is some consensus that emotional regulation involves a reduction in the intensity of negative emotion such that the individual can continue in goal directed activity. From a behavioral perspective, there are several unanswered questions. First, what constitutes an effective regulatory behavior? Second, are regulatory behaviors ubiquitous or are they emotions specific? Third, how do researchers distinguish between regulation and behavioral demonstrations of distress? Finally, how do regulatory behaviors change as children become more sophisticated?

In addition to examining the emotional reactivity of infants of depressed and nondepressed mothers to stimuli designed to elicit fear, anger, and positive affect, this study sought to further the literature related to emotional regulation by employing current methodology for examining emotional regulation to address the emotional regulatory capacity of infants of depressed mothers. A majority of the research which has previously examined the emotional expressivity and regulation of infants of depressed mothers has done so in social interaction paradigms. Given that this research has demonstrated that infants of depressed mothers utilize their mother less efficiently, it is important to examine the regulatory capabilities of infants of depressed mothers both within and outside of the social context (Field, 1986).

The present study sought to expand the literature that has examined emotional regulation in a social context by exploring the extent to which infants of depressed mothers engaged in social referencing during situations designed to elicit fear and anxiety. In addition, this study sought to contribute to the understanding of emotional regulation from a behavioral perspective by exploring the effectiveness of all putative regulatory strategies. Furthermore, this study sought to contribute to the understanding of regulatory capabilities of infants of depressed mothers by examining the relative frequency with which infants of depressed mothers employ effective strategies.

### *Social Referencing*

Based on previous research that has demonstrated a tendency of infants of depressed mothers to engage in social referencing and research that demonstrated infant disengagement from the mother, it was predicted that infants of depressed mothers would engage in less social referencing when distressed (Campos, Sorce, Emde, & Svejda,

1983; Field, 1986). Consistent with that hypothesis, results from the current tendency demonstrated that infants of depressed mothers looked toward their mother less often than infants of nondepressed mothers.

It is important to examine this finding in the context of the broader literature which has examined mother-infant interactions in maternally depressed dyads. There is a large body of evidence that has emerged out of the still-face paradigm that demonstrates a disturbance in the mother-infant relationship of depressed dyads (Cohn et al., 1986; Field, 1985; Field, 1994). That literature has consistently demonstrated impairments in maternal interaction style marked by increased tendency to display negative emotions, talk less, and disengage during face-to-face interactions (Cohn & Tronick, 1989; Cohn et al., 1986; Field, 1985; Field, 1994). Given the research that demonstrates the dysfunctional interactions in maternally depressed mother-infant dyads (Cohn et al., 1986; Cohn & Tronick, 1989), it is likely that the infant has learned through trial and error not to seek reassurance or encouragement from their mother when confronted with novel situations and are therefore less likely to employ this tactic.

Findings from the present study suggest that the infant's tendency to not seek reassurance from the mother may generalize to other adults. Infants of depressed mothers tended to look toward the experimenter less often than infants of depressed mothers; however this finding did not quite reach the level of significance. Although this trend did not quite reach the level of significance, it is consistent with research conducted by Field (1986) which has demonstrated that infants depressed mothers appear withdrawn both in their interaction with their mothers but also in their interactions with strangers.

### *Effectiveness of Putative Regulatory Behaviors*

It is important to discuss regulatory behaviors with demonstrations of their effectiveness. Without some demonstration of effectiveness it is unclear what function these behaviors serve. Three of the regulatory behaviors examined during the fear episodes either yielded a stabilizing impact on fear expression or a decrease in fear expression. Two of these behaviors involved interacting with other objects (playing with clothing or playing with an object). The other behavior involved interacting directly with the stimulus. Because of the lack of coherence in the episodes designed to elicit anger, the episodes were examined separately. During the Toy Retraction Episode, four behaviors demonstrated a regulatory pattern (gaze aversion, playing with hair, oral behavior, and interacting with the stimulus). In contrast, only one regulatory behavior demonstrated an effective pattern of regulation during the Restraint in Car Seat episode, looking toward the mother. It is interesting to note that interacting with the stimulus was effective in both the fear episodes and the toy retraction episodes, but not in the restraint in car seat episode, which is consistent with previous research that employed a similar methodology and found that interaction with the stimulus effectively regulated both fear and anger (Buss & Goldsmith, 1998).

The utility of approaching or interacting with the stimulus to regulate expressions of fear is consistent with a large body of literature which demonstrates a reduction in fear after interacting with the fearful stimulus (Mineka & Cannon, 1999). This hallmark finding in psychology is the cornerstone of behavioral interventions for the specific phobias, which are effective at reducing fear related to a specific object or event by

exposing a person to it either gradually or fully until fear subsides. The representation of this pattern as an effective means of regulation within this study lends credibility to the validity of emotional regulation. Although interacting with the stimulus was also effective during one of the anger episodes, it is unlikely that the same mechanism is at work within the fear and anger episodes. During the toy retraction episode, removal of the toy (stimulus) was the impetus for the negative affective display; therefore returning the stimulus to the child would lead to a reduction in anger. During the Restraint in Car Seat episode, physical restraint is designed to elicit negative affect. Pushing on the car seat or interacting with the stimulus is not likely to result in freedom. Therefore, the child has little to gain by interacting with the stimulus and it is not an effective regulatory strategy.

Infants' use of gaze orientation during the two anger episodes is another important finding. During toy retraction, which is a more social episode during which the examiner removes an enjoyed toy from the child, gaze aversion is an effective pattern of regulation. This is somewhat consistent with previous findings by Buss and Goldsmith (1998) who used an equivalent paradigm and found that distraction effectively regulated anger, but was less effective at regulating expressions of fear. The effectiveness of gaze aversion may, in part, reflect the violation of social expectations inherent in the toy retraction episode. During normal play interactions infants are used to displays of positive affect and are typically encouraged to explore (provided that exploration does not result in harm). In contrast, during the Restraint in Car Seat episode the child is restrained in a car seat and there is not the same level of social interaction. During that episode looking toward the mother demonstrated a pattern of effective regulation.

As previously stated, it is important to consider the effectiveness of regulatory behavior during research which explores the regulatory capabilities of any populations. Within this study a stabilization of affect (meaning no change in affect) constituted a majority of cases of “effective” regulation. This pattern accounted for up to 75% of cases of effective regulation. This pattern of affective display is particularly difficult to explain because it is unclear whether the employed behavior is only partially effective at moderating the infant’s emotional display or is merely a behavioral manifestation of their distress. It will likely be impossible to answer this question without concordant physiological and neurological findings, as there is not a definitive way to answer this question at the behavioral level.

#### *Effective Regulatory Behavior and Depression*

Because dysregulated emotions (marked by an increase in time spent displaying the emotion) are associated with risk for development of psychopathology, it was predicted that infants of depressed parents would display less effective regulatory strategies. Contrary to prediction, infants of depressed mothers were more effective at using gaze aversion than were infants of nondepressed mothers during the toy retraction episode. Infants of depressed mother did not use any of the regulatory behaviors which had demonstrated an effective pattern less than infants of nondepressed mothers within the fear episodes (playing with clothes, playing with an object, and interacting with the stimulus). Nor were there group differences on any of the additional regulatory behaviors displayed during the Toy Retraction episode (playing with hair, oral behavior, and interacting with the stimulus). There was not a group difference in effectiveness in looking toward the mother during the Restraint in Car Seat episode.

## *Limitations and Future Directions*

### *Methodological Considerations*

The present research has several limitations that both impact the conclusions that can be made from the current research and hinder the generalizability of the finding of this study to the public. Of primary importance were several difficulties obtaining the intended level of participation in this study, which contributed to the smaller than expected sample size, particularly in terms of depressed mother-infant dyads.

The difficulties recruiting women efficiently also contributed to a broader age-range of infants than was intended in the original proposal for this age-range. Given the rapid changes and reorganizations in emotions at this age, it is not optimal to have a sample of infants which spans a six - month period. The expanded age range of infants introduces a potential confound, in that experience with certain activities (such as walking) change your interactions with stimuli (such as car seats). This means that certain episodes may be particularly vulnerable to age effects caused by the range of ages of the infants in this study.

The sample of women who participated in this study is typical of Iowans in terms of minority representation (US Census, 2004). Therefore, caution should be exercised when generalizing the findings described in this paper to minority populations that are not well represented in the current research. In addition, the women who participated in this study reported depressive symptoms that were mild to moderate in intensity. For example, very few of the women displayed significant symptoms of depression including suicidal ideation or attempts. Therefore, the results obtained during this research project

may not be applicable for mother-infant dyads characterized by more severe maternal psychopathology.

### *Measurement of Maternal Negative Affect*

The focus of the present research was on maternal symptoms of depression which met DSM-IV criteria for Major Depressive Disorder. However, there is now an impressive body of evidence which indicates that examination of Major Depressive Disorder alone is insufficient to understand the nature of psychological difficulties experienced by these women or the risk they confer to their infants. The overlap between anxiety and depression can be observed at both the symptom and the diagnostic level. At the symptom level, several of the diagnostic criteria for depressive disorders and anxiety disorders overlap (American Psychiatric Association, 1994). For example, difficulty with concentration is listed in the criteria for both Major Depressive Disorder (MDD) and Generalized Anxiety Disorder (GAD). At the diagnostic level, approximately 50% of patients diagnosed with an anxiety disorder will also meet criteria for a depressive disorder and conversely approximately 50% of patients diagnosed with a depressive disorder will meet criteria for an anxiety disorder (Mineka, Watson, & Clark, 1998).

Research that has examined the comorbidity between anxiety and depression has suggested that it is easiest to discuss the comorbidity between anxiety and depression at a symptom level (Watson et al., 1995). Based on a symptoms level analysis Watson and colleagues (1995) developed a tri-partite model which explains the relationship between anxiety and depression. The symptoms shared by anxiety and depression can be described most easily as generalized distress. Depression alone is characterized by symptoms of anhedonia, or a lack of interest or pleasure in things that were previously

interesting to the person. The unique aspect of anxiety is somatic anxiety, or the physical manifestations of feeling anxious (e.g. nervous stomach, hyperarousal). Given the marked overlap between anxiety and depression, it will be important to develop more sophisticated clinical instruments which can fully explain the interplay between anxiety and depressive symptoms.

### *Measurement and Understanding of Infants Emotions*

Several coding schemes designed to measure infant emotions have been developed and each has distinct advantages and disadvantages. However, the question remains. Do infants display distinct emotions (such as anger and fear)? Recent research suggested that nonfacial behavior differed across episodes designed to elicit fear and anger in 11-month old infants suggesting that there is some specificity to the specific emotions elicited. However, facial expressions did not differ between the two groups, which indicates that at 11-months of age, infants do not display distinct facial expressions for fear and anger (Camras, Oster, Bakeman, Meng, Ujiie, & Campos, 2007). This suggests that methods of aggregating data which combine facial and body movements may mask some of the emotional specificity of the results and thus obscure the results. In the future it will be important to consider carefully the coding system in the context of these recent findings in order to further the evolution of the field of emotional development.

Beyond concerns related to the coding of emotions, there is research which suggests that forming composite scores across time intervals does not accurately describe how infants experience anger. In a study which examined 15-month old infants' response to repeated administration of the Gentle Arm Restraint episode from the Lab-TAB an

intra-trial hierarchy was found which involved struggling against the arm restraint first, followed by vocalizations, followed by facial expressions of anger (Potegal et al., 2007). Averaging these individual behaviors across trials masks what appears to be a normative hierarchy of anger displays. Therefore, future research will need to examine the temporal pattern of anger in order to replicate this finding and expand the current base of knowledge related to angry displays in infancy. It will also be important to determine if similar hierarchies exist for displays of fear and positive emotionality.

#### *Measurement and Understanding of Emotional Regulation*

Although examination of change scores represents a first step toward understanding the emerging emotional regulation capabilities of infants, it is by no means the definitive answer. Within both the fear and tantrum literatures, behaviors have been identified that lead to shortened expressions of their respective behaviors. For example, in interacting with a feared object reduces the time spent afraid. In addition, behaviors such as a child throwing himself or herself to the floor are associated with shorter duration of tantrums and lower likelihood of parental involvement (Potegal, Kosorok, and Davidson, 2003). Taken together, these findings suggest that there should be emerging behaviors in infancy which lead to a reduction in displayed affect or predict a shorter overall duration of displayed affect. In this study, a majority of observed effects led to no change in emotion in the following epoch, which suggests that the observed behaviors are not leading to an escalation of emotion. However, this is not equivalent to predicting a reduction in intensity or frequency of emotion. Future research should focus on identifying these behaviors in the context of the temporal nature of emotional displays.

In addition, the underlying theory of emotional regulation posits a physiological underpinning to behavioral manifestations of emotional regulation. More specifically, there is a theoretical return to a physiological “baseline” as a result of successful regulation. Different physiological mechanisms, such as vagal tone, have been hypothesized to represent the physiological nature of emotional regulation. If there is a true physiological underpinning to emotional regulation, methods which rely on behavioral observation are inadequate to determine the exact nature of emotional regulation. Therefore it will be important to continue to develop more precise observational methods and more precise physiological methods to explore this physiological substrate.

It is important to recognize that behavioral regulation (or emotional expression) does not occur independently of other cognitive processes. There is a growing and increasingly compelling body of literature which indicates that cognitive processes, such as perception and attention, are important in determining the valence and intensity of emotional expression as well as influencing regulatory capabilities (Kopp, 1989). Concordant evidence from neuroimaging studies suggests that the Anterior Cingulate Cortex (ACC) serves as a point of integration for visceral, attentional, and affective information and may serve as the neuroanatomical substrate of emotional control (Thayer & Lane, 2000). There is evidence which suggests that the ACC is activated when behavior is not going to achieve a desired outcome or in novel situations (Ochsner & Barrett, 2001). Increased activation of the ACC has also been observed in populations of individuals with anxiety disorders (Rauch et al., 1995; Rauch et al., 1997). Therefore, it is important to consider the role of emotion in the context of other cognitive processes and

determine the relationships between basic cognitive processes (such as attention) and emotional expression and regulation.

### *Conclusions and Implications*

When considering the implications of this study it is important to also consider the complexity of emotional expression. The study of children's socio-emotional development represents a complex puzzle which involves consideration of children in the context of their social relationships, at their current stage in development. In addition, consideration of emotional behavior must occur at many different levels. Emotion, like cognition or perception, is governed by cognitive and physiological processes which are interdependent, meaning that emotion shares cognitive processes with other systems (such as attention and vision). These emotions are expressed, interpreted by others, and interpreted by the child. Expression of emotions also changes how individuals remember information. Furthermore, the child is not a passive entity; rather the child is a dynamic force which impacts and changes their environment, which in turn alters the likelihood that they will engage in a particular emotional expression in the future.

It is within the larger context of the complexity of emotional development that the implications of this study will be discussed. Of primary importance is the finding that infants of depressed mothers display less intense positive affect in response to stimuli designed to elicit that emotion. This finding has important implications for future research. This finding provides a bridge between studies that have identified low positive affect as a key symptom of depression, physiological findings which have demonstrated reduced activation in areas of the brain associated with negative affect, and research literature which has demonstrated increased negative affect in depressed infants during

play. Future research should focus on precise identification of positive affect throughout infancy, childhood, and adolescence. Within high-risk samples, more sophisticated nosologies which identify the components of depression will be important to determine the strength of association between maternal low positive affect and infant low positive affect. In addition, physiological and neurological markers of positive affect should be identified and studied within high risk populations.

There were less robust findings with regard to expression of fear and anger. However, it is unlikely that these emotions are unimportant in consideration of the emotional development of this high-risk population. This is particularly salient given the multiple lines of research which have identified fear expression as integral to the development of positive and negative developmental sequelae. It is likely the case that more precise measurement of both maternal mood symptoms and infant emotional expression will clarify the role that these emotions play in the socio-emotional development of this population.

Although this research was designed to minimize maternal influence, the results of this study are largely consistent with the body of evidence which has examined emotional regulation within mother-infant interactions. The findings that infants of depressed mothers engage in social referencing significantly less often than nondepressed mothers and that they are more likely to employ gaze aversion when angry are indicative of dysfunctional interactions within the mother-infant relationship of maternally depressed dyads. It will be important to identify the process which contribute to this dysfunctional regulation within this population in future research. As children become more sophisticated they rely more on internal (rather than relational) processes to regulate

their emotions. Therefore, it will important to study older infants and children to determine whether the dysfunctional relationship continues to impact their ability to regulate their emotions.

These findings also have important treatment implications. The results described above provide support for therapies which instruct and encourage the mother to engage in positive interactions with their child. These therapies, which involve improving the quality of mother-child interactions, may serve to improve the quality of interactions so that the infant spends more time in positive affective displays during “sensitive periods” of neurological and emotional development. Furthermore, more positive mother-infant relationships will enable the infant to learn effective, socially based, regulatory strategies.

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