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Mother-Infant Synchrony and the Relationship Between

Prenatal Depression and Infant Emotion Regulation

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B.A., Williams College, 2012

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An abstract of a thesis submitted to the Faculty of the
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Abstract

Mother-Infant Synchrony and the Relationship Between
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By Meeka S. Halperin

Accumulating evidence suggests that mothers' prenatal depression predicts infants' emotion dysregulation. We examined mother-infant positive affect and gaze synchrony as potential moderators and mediators in this relationship. In a population of mothers who were at risk for prenatal depression, given their history of a major depressive episode, we examined synchrony when infants were 3-months old and behavioral (temperament) and physiological emotion regulation when those infants were 6-months of age. We found that when gaze synchrony was high, there was a significant negative relationship between prenatal depression and infant behavioral emotion regulation. However, gaze synchrony did not significantly moderate the relationship between prenatal depression and infant physiological emotion regulation. Positive affect synchrony did not significantly moderate the relationship between prenatal depression and infant behavioral or physiological emotion regulation. There was no evidence of positive affect or gaze synchrony mediating the relationship between prenatal depression and infant behavioral and/or physiological emotion regulation. We discuss limitations and strengths, as well as important next steps in this line of studies.

Keywords: prenatal depression; synchrony; infant; emotion regulation

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Mother-Infant Synchrony and the Relationship Between Prenatal Depression and Infant Emotion Regulation

Emotion dysregulation is characterized by over- or under-controlled emotion experience and/or expression that interferes with appropriate goal-directed behavior (Beauchaine, 2015; Beauchaine & Gatzke-Kopp, 2012). Cole, Hall, and Hajal (2008) identified four key features of emotion dysregulation: emotions endure and regulatory attempts are ineffective, emotions interfere with appropriate behavior, expressed or experienced emotions are context inappropriate, and emotions either change too abruptly or too slowly. Better understanding of emotion dysregulation has the potential to inform knowledge of how and why emotions influence other psychological domains that are essential for psychological well-being, e.g., attention, interpersonal relationships, and problem solving abilities (Cole, Martin, & Dennis, 2004).

Emotion dysregulation emerges as early as infancy (Calkins & Hill, 2007; Kopp, 1989; Stifter, 2002) and individual differences are reflected in a number of systems, including behavioral and stress response systems – specifically the neuroendocrine and autonomic nervous systems. Emotion dysregulation is often seen in the context of a disconnect between the infant's emotion regulation resources and environmental demands, as well as in the context of maladaptive parenting (Cole, Michel, & Teti, 1994). Emotion regulation is complex in that it is dependent on interactions among infants' biological predispositions, the environment, and parenting (Calkins, 1994).

Emotion dysregulation in infancy is important in that it has been prospectively related to higher levels of psychopathology in childhood (Chaplin, 2005; Degangi, 2000).

As infants age and the environment becomes more complex, situations acquire more cognitive meaning and elicit more diverse emotional and behavioral responses (Dodge, Coie, & Lynam, 2006; Lewis & Todd, 2007). Thus, emotionally dysregulated infants may be less suited to meet demands and conflicts within their environment as they move from infancy to childhood. The inability to resolve the conflicts and inefficiencies associated with social and physiological needs is fundamental to psychopathology (Lewis, 2014). Since emotion dysregulation as early as infancy may indicate a vulnerability to the development of later psychopathology, it is important to understand the factors that may influence its development.

Even though emotion dysregulation has been recognized as a complex construct involving interplay between closely linked systems (behavioral, physiological, and hormonal) (Calkins, Dedmon, Gill, Lomax, & Johnson, 2002; Stifter, 2002), many studies address only one of these systems. Bauer, Quas, and Boyce (2002) stressed the advantages of taking a multisystem approach in an effort to better predict the development of psychopathology. Their additive model asserts that the more highly two systems are intercorrelated, the greater the risk for developing psychopathology, as the systems contribute independently or additively to the risk. Their interactive model, however, states that the less highly two systems are correlated, the greater the risk for developing psychopathology due to the interaction of the systems. Since high and low correlations are associated with the development of psychopathology, each suggests different ways that the systems might work together in the prediction of developmental psychopathology. The correlation between behavioral and biological systems of emotion regulation may also change over the course of development (Beauchaine, 2001). Thus, the current study takes a multisystem approach, including behavioral and physiological emotion regulation systems.

Behavioral Emotion Regulation Systems

Perhaps the most common behavioral approach to assessing emotion dysregulation during infancy is the study of temperament. Temperament describes the individual differences in emotional reactivity, self-regulation, and behavioral inhibition (Cole et al., 2004), and is made up of three factors: negative affectivity, orienting/regulation, and surgency/extraversion (Gartstein, 2003). Infants spend much of their time orienting, or selecting information from environmental stimuli, and because some stimuli decrease distress more than others, individual differences in infants' efficiency of attention contribute to infants' emotion regulation abilities (Rothbart & Sheese, 2007). Moreover, interactions with parents can influence both how infants cognitively interpret and emotionally respond to stimuli (Calkins, 1994).

Differences in temperament may be reliably detected through observations of behaviors such as: activity level, smiling and laughter, sadness, approach, fear, cuddliness, and soothability (Gartstein & Rothbart, 2003). Temperament as assessed during infancy has been found to be stable over time (Putnam, Rothbart, & Gartstein, 2008), and associated with childhood measures of temperament, emotional, social and personality development and the development of psychopathology (Kagan, Snidman, & Arcus, 1998; Komsi et al., 2008; Komsi et al., 2006; Putnam & Stifter, 2005; Rothbart, 2007) . Thus, early emotion regulation as assessed by temperamental observations is informative regarding the potential for development of psychopathology.

Physiological Emotion Regulation Systems

A routinely used physiological indicator of emotion regulation is cardiac activity, including in studies of infants. Cardiac vagal tone is a standard index of emotion regulation, which has been measured via the amplitude of respiratory sinus arrhythmia (RSA). Amplitude changes are detected in response to challenging environmental sensory, cognitive, and visceral demands and reflect emotion, communication, and motion activity (Porges, Doussard-Roosevelt, Portales, & Greenspan, 1996). Vagal tone maintains homeostasis and modulates metabolic output in response to challenging environmental demand (Porges, Doussard-Roosevelt, & Maiti, 1994).

Even early in infancy, individual differences in baseline RSA scores have been found to be reliable and to reflect capacity for emotion regulation (Porges et al., 1996). Among infants, greater vagal tone, quantified by RSA, has been associated with affect and attention, and regulation of approach and withdrawal processes, which have major implications for social behaviors during infancy (Porges et al., 1996). Prospectively, 9-month-old infants' higher vagal tone has been associated with 3-year-old children's lower maternal ratings of temperament difficulty and lower behavioral reactivity (Porges, Doussard-Roosevelt, Portales, & Suess, 1994). Baseline RSA during infancy may therefore be an indicator of later child emotion regulation.

Prenatal Depression and Mothers and Infants' Emotion Dysregulation

In efforts to understand the characteristics or qualities associated with elevated levels of emotion dysregulation in infants, researchers have focused their studies on populations believed to be particularly vulnerable. As we will next discuss, infants of prenatally depressed mothers may experience challenges to their development of emotion regulation due to qualities of both their pre- and post-natal environment. For such reasons, it is important to better understand potential buffering factors against vulnerabilities to the development of psychopathology by examining emotion regulation in infants prenatally exposed to maternal depression.

Given the emerging understanding of role of emotion dysregulation in the later development of psychopathology, it is important to identify predictors or correlates of emotion dysregulation. For this, we turn to infants of prenatally depressed mothers. Between 10 and 20% of pregnant women experience depression, whether they meet diagnostic criteria for major depressive disorder or exceed established cut offs for clinically significant levels of depression (Daw, Mintzes, Law, Hanley, & Morgan, 2012; Grote et al., 2010; Oberlander, Warburton, Misri, Aghajanian, & Hertzman, 2006). Rates of depression are even higher among pregnant women with histories of depression prior to pregnancy (Goodman & Tully, 2009).

Depression in mothers during pregnancy has been found to be associated with adverse infant development, specifically within the construct of emotion dysregulation, such as: lower vagal tone (Jones et al., 1998), negative reactivity to novelty (Davis et al., 2004), more fearful temperament (Davis et al., 2007; Davis et al., 2004), and greater temperament negative affectivity (Rouse & Goodman, 2014). Thus, infants of prenatally depressed mothers, relative to those not prenatally exposed to their mothers' depression, represent a population predisposed to greater emotion dysregulation, as demonstrated through behavioral and physiological systems.

Postnatal Depression and Infants' Emotion Dysregulation

Prenatal depression is a concern for the development of emotion dysregulation in infancy not only because of the prenatal exposures, but also because depression during pregnancy is highly predictive of depression during the postpartum period (Robertson, Grace, Wallington, & Stewart, 2004). Thus, not only might infants be exposed to depression during both developmental periods, but postpartum depression is also associated with qualities of parenting that may contribute to infants' emotion dysregulation (Field, 2010). Emotion dysregulation can occur in an infant when the mother is physically absent or emotionally unavailable, which are two behavioral features that have been found to be associated with depression in mothers (Field, 1994). In a meta-analytic review, depression in mothers of infants was found to be associated with their being less sensitively responsive (Lovejoy, Graczyk, O'Hare, & Neuman, 2000), which is a critical factor for the development of infant emotion regulation (Calkins, 1994). Depression in mothers was also found to be associated with higher observed negative affect and lower observed positive affect (Lovejoy et al., 2000).

Mother-Infant Synchrony as a Potential Moderator and Mediator of the Association between Perinatal Depression in Mothers and Infant Emotion Regulation

Given the evidence for the risk of the development of psychopathology associated with infants' emotion dysregulation, as well as the evidence for associations between both pre- and postnatal depression and infants' emotion dysregulation, and mothers' depression being associated with inadequate caregiving, it is compelling to examine caregiving qualities as potential mediators and moderators of the association between perinatal depression and infants' emotion dysregulation. One factor that has been proposed to play both mediating and moderating roles in that association is mother-infant synchrony.

Definition of mother-infant synchrony. As applied to parenting, synchrony has been defined as a structure of dynamic, reciprocal behaviors, and shared affect between mother and child (Leclere et al., 2014). The basic aspects of synchronous behavior are derived from essential components of human social behavior that include gaze, touch, vocalizations, proximity, and arousal (Calkins, 2015). Terms such as mutuality, reciprocity, rhythmicity, harmonious interaction, turn taking, and shared affect have commonly been used to describe synchronous mother-child interactions (Leclere et al., 2014). Thus, researchers tend to focus on affect, gaze, touch, and vocal matching as the most common ways of conceptualizing and measuring synchrony.

Mother-infant synchrony and infants' emotion regulation. Synchrony may play a role in the development of emotion regulation for infants of prenatally depressed mothers, as it involves socialization from both the mother and the infant, and early dyadic interactions between a mother and her baby are considered to be crucial for establishing infants' behavioral and physiological organization that underlies emotion regulation (Field, 1994). During the first months of life, children shift their reliance from parental co-regulation to independent strategies for emotion regulation (Calkins, 2015). This shift mirrors the tendency for infants before 6 months of age to follow their mother's emotional cues, whereas subsequently, beginning at 6 months, they engage in mutual affective exchange (Cole et al., 1994). These dyadic interactions are driven by mother and infant responding to one another's behavioral and physiological cues and are the primary learning experiences for infants' development of emotion regulation (Field, 1994). Brazelton and colleagues found that mothers respond to their infants' signals in one of the following ways: by synching their rhythm with their infants', by following their infants' gaze cues while increasing and decreasing stimulation, or by neglecting their infants or failing to adjust their rhythm to their infants', thus reinforcing the infants' gaze away (Brazelton, Koslowski, & Main, 1974).

Given these social expectations that infants typically have of their caregiver, maternal responsiveness, defined as responding both appropriately and promptly, is a key component in the establishment of mother-infant synchrony (Ainsworth, 1979). In a study comparing mothers' responsiveness between different societies, the authors found that, in general, mothers display a similar way of responding to their infants' bids, but that mothers differ by society in the way that they respond to their infants' affect (Broesch, Rochat, Olah, Broesch, & Henrich, 2016). Mothers also vary greatly in their degree of responsivity, and infants react to the degree of responsivity patterns (Bigelow & Birch, 1999; Striano & Rochat, 1999). Since maternal responsivity has been so closely linked to children's later socioemotional and cognitive development (Bigelow & Birch, 1999), it is important to understand variations in these behaviors.

Early synchronous interactions with parents facilitate infants' optimal development of physiological, cognitive, social, and behavioral self-regulatory skills that are necessary for coping with frustrating or emotionally taxing tasks (Tronick & Cohn, 1989). Thus, the responsivity between infant and mother is essential to the development of emotion regulation in infants (Tronick, 2007). Greater mother-infant affect and vocal synchrony at 3 months has concurrently been associated concurrently with coordinated heart rhythms between the mother and infant (Feldman, Magori-Cohen, Galili, Singer, & Louzoun, 2011). Prospectively, greater mother-infant affect and gaze synchrony at 9 months has been related to higher child self-control at 2 years of age (Feldman, Greenbaum, & Yirmiya, 1999). Greater mother-infant affect and gaze synchrony (at 3 and 9 months) has also been associated with even longer term outcomes, i.e. greater verbal IQ and behavior adaptation at ages 2 to 6 years old and higher capacity for empathy in adolescence (Feldman, 2007). Generally, greater synchrony during mother-infant interactions relates concurrently and prospectively to infants' greater physiological and behavioral regulation and more typical, relative to psychopathological development (Leclere et al., 2014; Tronick, 1989).

Mother-infant synchrony and emotion dysregulation in infants of prenatally depressed mothers. Given the well-established associations between synchrony and emotion regulation in normative samples, it is compelling to consider these associations in mothers whose prenatal depression levels may predispose them to be less synchronous with their infants (as was reviewed earlier) and in infants of prenatally depressed mothers who may be born with vulnerabilities to the development of emotion regulation (as was reviewed earlier). Building on these bodies of literature, an important next step is to examine the role(s) that mother-infant synchrony may play in associations between prenatal depression and infant emotion regulation.

Conceptual models. Two conceptual models offer alternative roles for mother-infant synchrony in the association between prenatal depression and infant emotion regulation: synchrony as a moderator or as a mediator in that association. In terms of moderation, we did not find any published studies that reported tests of moderation. Our question is driven by knowledge that associations between prenatal depression and infant emotion regulation are typically small to moderate in effect size, suggesting that there may be subsets of individuals for whom the association is stronger and others for whom it is weaker. The theoretical and empirical evidence we reviewed suggests the importance of testing the conceptual model of mother-infant synchrony as a moderator of the association between prenatal depression and infant emotion dysregulation: Among infants of depressed mothers, might it be that those who are exposed to lower mother-infant synchrony have greater emotion dysregulation than those with higher levels of mother-infant synchrony? Support for this proposed moderation model may lead to greater understanding of potential factors that may buffer risk for the development of psychopathology in some infants and exacerbate it in others. If support is found for mother-infant synchrony as a moderator, this knowledge would guide limited resources for interventions to target the subset of prenatally depressed mothers who show low levels of mother-infant synchrony.

In terms of mediation, it is important to understand the pathways through which prenatal depression affects infants' emotion regulation. Despite the strong evidence that prenatal depression and infant emotion dysregulation are positively correlated, and that high mother-infant synchrony and infant emotion dysregulation are negatively correlated, we found no published studies that reported tests of mother-infant synchrony as a potential mechanism in the pathway from prenatal depression to infant emotion regulation. Support for mother-infant synchrony as a mediator would guide the design of interventions, such that enhancing synchrony would be an empirically supported target of intervention.

Thus, an essential next step in this line of research is to study infants who had been exposed to maternal depression in utero in order to identify the possible moderating and mediating roles of mother-infant synchrony in the association between prenatal depression and infants' emotion regulation. Testing these proposed models has the potential to lead to a greater understanding of the influence of mother-infant synchrony during early development in infants exposed to prenatal depression, with further implications for intervention for depressed mothers and their infants.

Current Study. The current study aimed to examine mother-infant synchrony as both a moderator and a mediator in the relationship between prenatal depression and infant emotion regulation. We sampled pregnant women with histories of depression given that such history is highly predictive of depression during pregnancy maternal depression throughout pregnancy is highly predictive of postnatal depression (Rich-Edwards et al., 2006; Robertson et al., 2004). Depressive symptoms were measured prospectively during pregnancy. Positive affect and gaze synchrony were measured at 3 months of age during a mother-infant play session. We restricted the focus of our hypotheses and analyses to positive affect synchrony, rather than negative affect, or general affect synchrony because we did not find any studies that provided justification for the most appropriate maternal response to infant negative affect. We supposed that while it may be good if a mother is in positive affect trying to bring her infant out of negative affect, it may not be good for the mother’s affect to be discordant. Future studies are needed that examine infant developmental outcomes in relation to various maternal affective responses to infant negative affect to better understand the most appropriate maternal response. Further, two indicators of infant emotion regulation, baseline RSA and temperament dysregulation, were measured at 6 months of age in order to establish temporal precedence of the purported mediator relative to these later infant outcomes.

We hypothesized the following: (1) high prenatal depression levels will be less strongly associated with infant emotion dysregulation (temperament regulation and RSA) at 6-months in the context of high mother-infant positive affect and gaze synchrony at 3-months, relative to when affect and gaze synchrony are low; (2) mother-infant positive affect and gaze synchrony at 3-months will at least partially mediate the relationship between prenatal maternal depression and infant emotion dysregulation at 6-months.

Post-hoc exploratory analyses. We conducted exploratory analyses to determine if positive affect synchrony and gaze synchrony might have a stronger effect as potential moderators when calculated as the percentage of time spent in positive affect synchrony out of the total amount of time the infant spent in positive affect throughout the segment, following (Goodman, Bakeman, McCallum, Rouse, & Thompson, 2017), and percentage of time spent in gaze to face synchrony (social gaze) out of the total amount of time the infant spent gazing to the mother's face throughout the segment, respectively, rather than out of the total time of the segment. We hypothesized that each of these variables would have a significant moderating effect in the relationship between prenatal depression and infant behavioral and physiological emotion regulation.

Method

Participants

Participants included 135 mothers and their infants (73 male, 62 female), who were recruited as part of a larger longitudinal study at Emory University, called "Perinatal Stress and Gene Influences: Pathways to Infant Vulnerability." Of the 163 dyads who participated in the 3-month visit, 135 dyads (83%) completed the 6-month follow-up visit and were used in analyses. For the full sample, pregnant women were recruited through the Emory University Department of Psychiatry and Behavioral Sciences, through a women's mental health program. Referred participants came from their doctors, other clinics, the community, and other research studies. Women were enrolled if they were <16 weeks pregnant and between 18 and 45 years of age. All met DSM-IV criteria for a previous Major Depressive Episode and many of the women also were diagnosed with Generalized Anxiety Disorder, Obsessive Compulsive Disorder, or Post Traumatic Stress Disorder. Women were excluded for meeting DSM-IV criteria for bipolar disorder, schizophrenia or an active eating disorder, having psychotic symptoms, active suicidality, active homicidality, an active substance use disorder within 6 months prior to last menstrual period or positive urine drug screen, illness related to infant outcomes (autoimmune disorders, asthma, and epilepsy), anemia, and/or abnormal thyroid stimulating hormone.

Procedure

This study was approved by the Emory University Institutional Review Board and all women were engaged in informed consent. The following procedures are a subset of those used in the larger study of which this is a part. To confirm that women met diagnostic criteria for at least one major depressive episode, participants completed the Structured Clinical Interview for DSM-IV at their first visit during pregnancy (First, Spitzer, Gibbon, & Williams, 1995). Maternal depressive symptoms were measured at multiple time points throughout pregnancy ($M = 5.48$ times) ranging from 1 to 10 times ($SD = 1.79$) with the Beck Depression Inventory (BDI) (Beck, 1961).

Mothers and infants in the current study visited Emory University for 3- and 6-month follow-ups. At infant age 3 months, mothers and their infants were video-recorded during a 5-minute face-to-face play segment, as part of a standardized protocol (Dawson et al., 1999). Infants sat in an infant seat on a table and mothers sat in a chair facing their infants and within arm's reach of the infant. Mothers were instructed to play with their children in any way that they liked and were provided with a set of age appropriate toys. Video recorded interactions were later coded by use of the INTERACT (Mangold, 2010) system.

At 6 months of infants' age, mothers completed the Infant Behavior Questionnaire – Revised (IBQ-R) (Gartstein & Rothbart, 2003) and infants' electrocardiogram (ECG) data were recorded during a 3-minute baseline segment. During the baseline condition, infants sat on their mother's lap and watched a research assistant blow bubbles, following Dawson et al. (1999) protocol. Mothers were instructed to refrain from speaking to their children during this baseline segment.

Measures

Maternal depression. The Structured Clinical Interview for DSM-IV Axis I Disorders-Patient Edition (First et al., 1995) was conducted at each patient's initial visit. All interviews were audio recorded to maintain inter-rater reliability, and were conducted by a psychiatric nurse, master's level psychologist, or social worker. Diagnoses were made by a licensed clinical psychologist, who listened to the recorded interviews and reviewed notes.

Maternal depressive symptoms. To measure maternal depressive symptoms during pregnancy, mothers completed the Beck Depression Inventory (BDI-I) (Beck, 1961). The BDI-I is a 21-item self-report measures of depressive symptoms and has been found to be a reliable and valid measure of depression severity (Beck, 1997; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Higher scores indicate more severe depression. Depressive symptom scores were internally consistent throughout pregnancy, with a

Cronbach's alpha of .84. An area under the curve (AUC) score was computed for each participant of BDI scores throughout pregnancy, which was used in analyses as an overall prenatal depression severity score.

Mother-infant synchrony. Positive affect and gaze synchrony scores were calculated from coding of mothers' and infants' affect and gaze during the 5-minute video-recorded observations of mothers in face-to-face play interactions with their 3-month old infants during a laboratory visit. Four independent teams coded mothers' and infants' observed moment-to-moment affect and gaze from video-recordings of a 5-minute play session. Mother and infant behaviors were coded separately, and affect and gaze were coded separately using Mangold International's Interact Video Coding Software (Mangold, 2010). Coders were undergraduate research assistants who underwent a training process in which they practiced coding and discussed disagreements with a graduate student and principal investigator. Once inter-rater reliability was demonstrated by a kappa greater than .80 on four consecutive coded segments, coders were deemed trained.

For affect, both mothers' and infants' expressions were coded moment-to-moment as different valences of negative (tension/negative interest, brief distress/frown/protest/fuss, and marked distress/cry), neutral, or positive (positive interest, smile/excitement, and laughter/squeal) affect, with codes modified from Dawson et al. (1999). From the coded affect, following Feldman et al. (2011), we computed a score for positive affect synchrony as the proportion of time mothers and infants matched their positive affect out of the total duration of the segment. In exploratory analyses, we computed positive affect synchrony as the proportion of time mothers and infants matched their positive affect out of the total amount of time that infants spent in positive affect during the segment, based on (Goodman et al., 2017).

For gaze, both mothers and infants were coded continuously as engaging in: gaze to face, gaze to object, joint attention, gaze to body, or gaze away, based on a modification of Feldman's Micro-Coding for Parent-Infant Interactions (Feldman). Gaze synchrony was computed as the proportion of time mothers and infants matched their gaze out of the total duration of the segment, based on (Feldman et al., 2011). In exploratory analyses, we computed gaze to face synchrony as the proportion of time mothers and infants matched their gaze to one another's face out of the total time that infants spent gazing to their mother's face during the segment, based on Goodman et al.'s approach to calculating affect synchrony (Goodman et al., 2017).

We also included codes for when the segment was uncodable (infant's and/or mother's eyes off screen for more than 3 seconds), and a protocol violation (e.g., research assistant walked into room, mom picked baby up out of seat). The total uncodable and protocol violation time was subtracted from each segment. Thus, the codes for mother and infant affect and gaze synchrony do not add up to 100%.

Inter-rater reliability for the positive affect coding, computed for a randomly selected 19% of segments that were coded by two individuals who were not aware of which segments were selected for reliability, yielded a kappa of .90 for maternal affect and .60 for infant affect. Inter-rater reliability for gaze coding, computed for a randomly selected 20% of segments that were coded by two individuals who were not aware of which segments were selected for reliability, was .85 for maternal gaze and .79 for infant gaze.

Emotion regulation. Infants' emotion regulation was assessed by measures of infant temperament and respiratory sinus arrhythmia (RSA).

Infant temperament. Mothers completed the Infant Behavior Questionnaire – Revised (IBQ-R) within a few days prior to the 6-month laboratory visit (Gartstein, 2003). The IBQ-R is a 191-item factor-analytically derived measure of temperament, based on Rothbart and Derryberry's (1981) definition. Each item is rated on a 7-point scale, ranging from 1 (Never) to 7 (Always). Gartstein and Rothbart's factor analyses yielded three factors: extraversion/surgency, negative affectivity, and orienting/regulating. Scores are the means of the items that make up each factor, where higher scores indicate more of the factor. The IBQ-R has acceptable internal and inter-rater reliability, as well as discriminant validity (Gartstein, 2003; Parade & Leerkes, 2008). Based on more recent work with the scales, we constructed a factor score for regulation, with low scores representing regulation and high scores representing dysregulation, by calculating the mean of the following five subscales: (1) Smiling/Laughter; (2) Soothability; (3) Duration of Orienting; (4) Low-Intensity Pleasure; (5) Cuddliness/Affiliation, following direction of Gartstein (personal electronic mail, June, 2017).

***RSA*.** Prior to the baseline segment, disposable electrodes were placed on infants. Trained research assistants edited the infant ECG recordings using CardioEdit (Brain-Body Center, 2006-2007). Following procedures developed by Porges (1985), and using CardioBatch (Brain-Body Center, 2006-2007) software, time-domain filters were used to calculate Respiratory Sinus Arrhythmia and calculate amplitude (Porges, 1985; Porges, Doussard-Roosevelt, & Maiti, 1994).

Results

Preliminary Analyses

Before testing hypotheses, frequency analyses were conducted to check the distribution of scores for each variable. See Table 1 for demographic characteristics of the participants. See Table 2 for descriptive characteristics of coded affect and gaze variables and the calculated synchrony scores.

Associations among the Predictor, Moderator/Mediator, and Outcome Variables. Pearson's correlations were conducted to investigate relationships between study variables (see Table 3).

Hypothesis Testing

Moderation. The first hypothesis was tested using PROCESS macro for SPSS model 1 for moderation (Hayes, 2012). We tested the following regression equations: (1) prenatal depression severity predicting behavioral emotion regulation with positive affect synchrony as a moderator; (2) prenatal depression severity predicting behavioral emotion regulation with gaze synchrony as a moderator; (3) prenatal depression severity predicting physiological emotion regulation with positive affect synchrony as a moderator; (4) prenatal depression severity predicting physiological emotion regulation with gaze synchrony as a moderator. To follow up on significant interactions, we ran Pearson's correlations between prenatal depression severity and temperamental emotion regulation (our only significant outcome variable) for each gaze group (our only significant moderating variable in this relationship): low, medium, and high.

First, as shown in Table 4, there was not a significant interaction effect of prenatal depression by 3-month positive affect synchrony in predicting 6-month infant behavioral emotion regulation (IBQ-R dysregulation), *b* = 0.00, 95% CI [0.00, 0.00], *t* = 0.45, *p* = .66. That is, we failed to support this part of the hypothesis in that the relationship between prenatal depression and infant behavioral emotion regulation at 6 months is moderated by positive affect synchrony at 3-months.

Second, as shown in Table 4, there was a significant interaction effect of prenatal depression by 3-month gaze synchrony in predicting 6-month infant behavioral emotion regulation (IBQ-R dysregulation), *b* = .00, 95% CI [0.00, 0.00], *t* = -2.38, $p < .05$. That is, we partially supported the hypothesis in that the relationship between prenatal depression and infant behavioral emotion regulation at 6 months is moderated by gaze synchrony. Follow up analyses revealed that when gaze synchrony is low, there was a non-significant positive relationship between prenatal depression and infant behavioral emotion regulation at 6 months, *b* = 0.00, 95% CI [0.00, 0.00], *t* = 0.05, *p* = .96. At the mean value of gaze synchrony, there was a non-significant negative relationship between prenatal depression and infant temperament dysregulation at 6 months, *b* = 0.00, 95% CI [0.00, -0.00], *t* = -1.37, *p* = .17. When gaze synchrony was high, there is a significant negative relationship between prenatal depression and infant emotion temperament at 6 months, *b* = 0.00, 95% CI [0.00, 0.00], *t* = -2.69, $p < .01$. Thus, the relationship between depression and behavioral emotion regulation emerges in those dyads that have higher levels of gaze matching.

Next, we conducted follow-up Pearson's correlations between prenatal depression severity and infant temperamental emotion regulation by tertile group: (1) low gaze synchrony; (2) medium gaze synchrony; and (3) high gaze synchrony. For the low and medium gaze synchrony groups, there were small and not statistically significant correlations between prenatal depression severity and infant temperamental emotion regulation ($r = .22$, $p = .15$) and ($r = -.26$, $p = .08$), respectively. For the high gaze synchrony group, there was a medium effect size, statistically significant association between prenatal depression severity and infant temperamental emotion regulation ($r = -.35$, $p < .05$).

Third, turning to physiological, rather than behavioral emotion regulation, as shown in Table 5, there was not a significant interaction effect of prenatal depression by 3-month positive affect synchrony in predicting 6-month infant physiological emotion regulation, $b = 0.000$, 95% CI [0.000, 0.000], $t = -0.87$, $p = .39$. That is, we failed to support this part of the hypothesis in that the relationship between prenatal depression and infant physiological emotion regulation at 6 months is not moderated by positive affect synchrony.

Fourth, for the final test of moderation (Hyp. 1), as shown in Table 5, there was not a significant interaction effect of prenatal depression by 3-month gaze synchrony in predicting 6-month infant physiological emotion regulation, $b = 0.000$, 95% CI [0.000, 0.000], $t = -0.80$, $p = .42$. That is, we failed to support this part of the hypothesis in that the relationship between prenatal depression and infant physiological emotion regulation at 6 months is not moderated by gaze synchrony.

Mediation. The second hypothesis was tested using PROCESS macro for SPSS model 4 for mediation (Hayes, 2012)**.** Our tests of mediation did not yield any significant findings (see tables 6-9). That is, there was no evidence of positive affect or gaze synchrony mediating the relationship between prenatal depression and infant behavioral and/or physiological emotion regulation.

Post-hoc exploratory analyses: Alternative calculation of synchrony. We examined positive affect synchrony as a potential moderator in the relationship between prenatal depression and infant behavioral and physiological emotion regulation when calculated as the percentage of time spent in positive affect synchrony out of the total amount of time the infant spent in positive affect throughout the segment. We also examined gaze to face synchrony (social gaze synchrony) as a potential moderator in the relationship between prenatal depression and infant behavioral and physiological emotion regulation when calculated as the percentage of time spent in gaze to face synchrony out of the total amount of time the infant spent gazing to his/her mother's face throughout the segment.

There was not a significant interaction effect of prenatal depression by 3-month positive affect synchrony out of total time infant spent in positive affect in predicting 6-month infant behavioral emotion regulation, $b = 0.00$, 95% CI [0.00, 0.00], $t = -1.55$, $p = .12$, indicating that the relationship between prenatal depression and infant behavioral emotion regulation at 6 months is not moderated by positive affect synchrony.

There was not a significant interaction effect of prenatal depression by 3-month positive affect synchrony out of total time infant spent in positive affect in predicting 6-month infant physiological emotion regulation, $b = 0.00$, 95% CI [0.00, 0.00], $t = -0.73$, $p = .47$, indicating that the relationship between prenatal depression and infant behavioral emotion regulation at 6 months is not moderated by positive affect synchrony.

We examined gaze to face synchrony as a potential moderator in the relationship between prenatal depression and infant behavioral and physiological emotion regulation when calculated as the percentage of time spent in gaze to face synchrony out of the total amount of time the infant spent gazing to his/her mother's face throughout the segment.

There was not a significant interaction effect of prenatal depression by 3-month gaze to face synchrony out of total time infant spent gazing to mother's face in predicting 6-month infant behavioral emotion regulation, $b = 0.00$, 95% CI [0.00, 0.00], $t = 1.22$, $p = .22$, indicating that the relationship between prenatal depression and infant behavioral emotion regulation at 6 months is not moderated by gaze to face synchrony.

There was not a significant interaction effect of prenatal depression by 3-month gaze to face synchrony out of total time infant spent gazing to mother's in predicting 6-month infant physiological emotion regulation, $b = 0.00$, 95% CI [0.00, 0.00], $t = .75$, $p = .47$, indicating that the relationship between prenatal depression and infant behavioral emotion regulation at 6 months is not moderated by gaze to face synchrony.

Discussion

Accumulating evidence suggests that prenatal depression predicts infant' emotion regulation. In an effort to better understand what factors may moderate or mediate this relationship, this study examined mother-infant positive affect and gaze synchrony as potential moderators and mediators. In a population of mothers who were at risk for prenatal depression, given their history of a major depressive episode, we examined synchrony when infants were 3-months old and temperament and physiological emotion regulation when those infants were 6-months of age. Our hypothesis that gaze synchrony would moderate the relationship between prenatal depression and infant behavioral emotion regulation was supported, but in the opposite direction than we predicted. When gaze synchrony was high, there was a significant negative relationship between prenatal depression and infant behavioral emotion regulation. However, gaze synchrony did not significantly moderate the relationship between prenatal depression and infant physiological emotion regulation. Positive affect synchrony did not significantly moderate the relationship between prenatal depression and infant behavioral or physiological emotion regulation. We also failed to support our mediation hypotheses that gaze and positive affect synchrony would at least partially mediate the relationship between prenatal depression and infant behavioral and physiological emotion regulation.

We found support in our study for prenatal depression severity predicting infant temperamental emotion regulation, whereby higher depressive symptoms predicted lower temperament emotion regulation (more dysregulation). Since our regulation factor score consisted of smiling/laughter, soothability, duration of orienting, low-intensity pleasure, and cuddliness/affiliation subscale scores, our finding was in line with previous related findings of higher levels of prenatal depression predicting infant negative reactivity to novelty (Davis et al., 2004) and greater negative affect (Rouse & Goodman, 2014).

Prenatal depression severity did not significantly predict physiological emotion regulation. In studies of mothers with postpartum depression, there have been similar null findings. Infants of depressed mothers at 3-months of age did not show associations between RSA amplitude and observed positive affect, compared to infants of non-depressed mothers, who did have these associations, suggesting maternal depression's influence on systems involved in physiological emotion regulation (Pickens & Field, 1995). In another study comparing 3-month-old infants of depressed mothers to those of non-depressed mothers, there were no significant differences in vagal tone. At 6-months of age, however, infants of depressed mothers had lower vagal tone than infants of non-depressed mothers (Field, Pickens, Fox, Nawrocki, & Gonzalez, 1995). Thus, differences in vagal tone between infants of depressed and non-depressed mothers may emerge after 3-months of age.

Depression during pregnancy was not a significant predictor of gaze or positive affect synchrony at 3-months of age, which was surprising given that difficulties with mother-infant interactions with even sub-clinically depressed mothers have been found among 3-month-old infants (Braarud et al., 2017; Weinberg & Tronick, 1998). In contrast to these findings, ours did not suggest an influence of prenatal depression severity on the mother-infant interaction. It is possible that since our sample did not consist of women without a history of depression that differences could not be detected among the women in our sample who all had at least one prior major depressive episode (restriction of range). It is also possible that postpartum depression status may have a greater impact on synchrony at this time point, given that recurrent depression has been related to interpersonal, cognitive, affective, and biological vulnerabilities (Phillips, Sharpe, Matthey, & Charles, 2010; Williams, 2008), which may compromise sensitive parenting. Thus, perhaps those mothers who were depressed during pregnancy, but not during the postnatal period are able to compensate for their prenatal depressive symptoms with more sensitive and synchronous interactions with their infants. An important next step in future research will be to examine depression throughout the entire perinatal period and its influences on gaze and positive affect synchrony, depending on different combinations of pre- and postnatal depression (e.g., depressed during the prenatal and postpartum period, depressed during prenatal only, depressed during postnatal only, not depressed at either but have a history of depression).

Positive affect synchrony did not significantly moderate the relationship between prenatal depression and infant behavioral emotion regulation. Although we were unable to find published studies that have tested positive affect synchrony as a moderator in a similar model, these findings are inconsistent with our rationale for moderation and the predicted directionality in this relationship, which was that higher positive affect synchrony may be a buffer for infants of prenatally depressed moms who are at risk for social, emotional, and behavioral problems and that lower positive affect synchrony might exacerbate the association. These findings are also inconsistent with parallel work by Meaney and colleagues that found that the frequency of mothers stroking their infants moderated the relationship between prenatal depression and infants' proneness to fear and anger (Sharp et al., 2012).

One limitation on our being able to find support for our hypothesis is that the range of positive affect synchrony in our sample was restricted. That is, 37 dyads did not display any positive affect synchrony. The mean percentage of time dyads spent in positive affect synchrony out of the duration of the segment was 18.7 (*SD* = 19.8). Since social smiling typically emerges by 2-months of age (Wolff, 1987) it was surprising to find that infants on average only spent 22.5% of the segment (*SD* = 21.9) in positive affect. Also, our inter-rater reliability kappa of .60 for coding infant affect was relatively low, especially compared to our kappa of .90 for maternal affect. This may be due to difficulties that some of our raters reported in being able to see the infants' small features clearly. Further, the percent time in positive affect synchrony was not correlated with depression severity, which suggests that something else must be explaining this relationship. Given this, we conducted exploratory analyses to determine if positive affect synchrony might matter more when calculated as the percentage of time spent in positive affect synchrony out of the total amount of time the infant spent in positive affect throughout the segment, following (Goodman et al., 2017), rather than the total time of the segment. However, this variable also did not significantly moderate the relationship between prenatal depression and infant emotion regulation. Thus, it may be that such a restricted range in positive affect synchrony may have interfered with our ability to detect statistically significant relationships using this variable as a moderator.

The results of this study indicate that mother-infant gaze synchrony at 3-months is a significant moderator in the relationship between maternal prenatal depression and infant behavioral emotion regulation at 6-months of age. Though this supports our hypothesis of the role of gaze synchrony as a moderator in this relationship, the directionality was not as hypothesized. We predicted that high prenatal depression levels would be less strongly associated with infant behavioral dysregulation in the context of high gaze synchrony, but found that there was a significant negative relationship between prenatal depression and infant behavioral emotion regulation in the context of high gaze synchrony. Although we were unable to find published studies that have tested gaze synchrony as a moderator in a similar relationship, these findings are inconsistent with our rationale for the directionality of our predicted test of moderation, which was that higher synchrony may be a buffer for infants of prenatally depressed moms who are at risk for social, emotional, and behavioral problems. Our findings instead suggest that increased gaze synchrony between a mother with elevated prenatal depression severity throughout pregnancy and her 3-month old infant may relate to lower behavioral emotion regulation at 6-months of age. Perhaps gaze synchrony does not necessarily imply responsivity or involvement. It is possible that these mothers with high prenatal depression and their infants are able to match one another's gaze, but they may be missing other crucial elements that are involved in social interaction, perhaps it may be a combination of positive affect, vocalizations, and/or touch synchrony that matters most for infant development. Future studies should assess the potential role of these forms of synchrony together with one another on infant development.

Neither positive affect synchrony nor gaze synchrony significantly moderated the relationship between prenatal depression and infant physiological emotion regulation. These findings are inconsistent with the finding that the frequency mothers reported stroking their infants was a significant moderator in the relationship between prenatal depression and infant vagal reactivity in response to a stressor (Sharp et al., 2012). Though baseline RSA has been supported as an index of infant emotion regulation (Porges et al., 1996), studies with children found differences only in RSA reactivity, rather than baseline RSA between children of depressed and non-depressed mothers (Ashman, Dawson, & Panagiotides, 2008). Other studies with infants have used RSA reactivity as an index of emotion regulation (Moore, 2009; Stifter & Fox, 1990), as well as the aforementioned study by Sharp et al.. Thus, perhaps RSA reactivity during a stressful lab task may be a stronger and/or more accurate indicator of physiological emotion regulation in our sample.

Our mediation hypotheses that gaze and positive affect synchrony would at least partially mediate the relationship between prenatal depression and infant behavioral and physiological emotion regulation were not supported. These findings are inconsistent with our rationale for mediation, that given the evidence that prenatal depression and infant emotion regulation are negatively correlated, and that higher mother-infant synchrony and infant emotion regulation are positively correlated, mother-infant positive affect and gaze synchrony may be potential pathways in the relationship between prenatal depression and infant behavioral and physiological regulation. We found no published studies that tested synchrony as a mediator in this relationship. Explanations for our null mediation findings have been previously discussed: the restricted range of positive affect synchrony; the potential for postpartum depression to play a greater role in the path model than prenatal depression, or to have additive effects; and the possibility that RSA reactivity may be a better index of emotion regulation than baseline RSA.

Limitations

There are several limitations of our study that need to be considered in the interpretation of our findings. First, because our sample did not include women without a history of at least one major depressive episode, our findings can only be generalized to women with a history of depression prior to pregnancy. Though this is an important sample to understand since a history of depression predicts risk for depression during the perinatal period, they may differ from those women who experience depression for the first time during pregnancy. Second, our sample was comprised of primarily of women who were European American, married, well educated, and of relatively high socioeconomic status and thus may not be generalizable to more ethnically diverse and less socio-demographically advantaged women. Third, the range in our sample of positive affect synchrony was restricted, as previously discussed. Further, we did not consider any comorbidities with prenatal depression. Trait anxiety, for instance, in combination with prenatal depression may be related to less sensitive parenting between mothers and infants (Goodman et al., 2017). Mothers with both depression and anxiety may exhibit under-responsiveness (Kaitz & Maytal, 2005), which would likely compromise synchrony between the dyad, given that a key component of synchrony is responding to infants' cues. We also did not examine other postnatal influences, such as the mothers' postnatal depression severity or the role of the father.

Despite these limitations, the study had several strengths. First, we used a prospective, longitudinal design, which allowed us to establish temporal precedence of the potential moderators and mediators that we tested, following Cole and Maxwell (2003). Second, depressive symptoms were reported multiple times throughout pregnancy, which allowed us to calculate a more comprehensive score of prenatal depression chronicity. Third, we examined both temperamental and physiological emotion regulation. Since we did not find the two measures of emotion regulation to be correlated, our findings support the potential importance of a multi-method measurement of emotion regulation, at least in young infants.

Conclusion

This study examined the role of quality of mother-infant gaze and positive affect synchrony as a potential moderator and mediator in the relationship between maternal prenatal depression and physiological and behavioral emotion regulation at 6-months of age. Despite our null findings and study design limitations, our findings have implications for future research in this area of study. First, it is important to understand the development of synchrony in this sample, since as discussed previously, this sample may look different from samples of mothers who are not depressed during pregnancy and from those who experience depression for the first time during the prenatal period. Since our sample had a restricted range of positive affect synchrony at infants' 3-month age, which may have contributed to our lack of significant effects while testing positive affect synchrony as a moderator and mediator, this suggests the need to examine this sample at a later time point when the range may not be as restricted. Second, future studies might monitor to what extent the relationship between behavioral and physiological emotion regulation changes over time, and what role might pre- or post-natal depression and synchrony play in those patterns. Further, a physiological stress reactivity measure of emotion regulation, rather than baseline, should be considered as a potential index which might better relate to a behavioral index of emotion regulation.

Findings from these suggested studies have the potential to inform theory and practice. Identification of a potential moderator and/or mediator in the relationship between prenatal depression and infant emotion regulation may inform the development of programs directed toward improving developmental outcomes of infants who are prenatally exposed to maternal depression. Such programs may target the improvement of mother-infant reciprocal interactions, focusing on maternal response to infant cues, to contribute to optimal emotion regulation.

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Table 1
Participant Demographics

Variable	*Mean*	*SD*	%
Mothers' Age at delivery (years)	33.7	4.2	
Mothers' Education (%)			
Completed high school			100
Completed college			78.5
Some post-college			44.4
Socioeconomic Status (Hollingshead Score)	51.1	8.2	
Marital Status (%)			
Married			88.1
Mother's Ethnicity (%)			
European American			89.6
African American			7.4
Sex of baby: Female (%)			45.9

Note. N = 135 for the study sample.

For interpretation of Hollingshead Score:
8-19: Unskilled laborers, menial service workers
20-29: Machine operators, semi-skilled workers
30-39: Skilled craftsman, clerical and sales workers
40-54: Medium business and minor professional, technical
55-66: Major business and professional (Hollingshead, 1975).

Table 2

Descriptive Statistics for Positive Affect and Gaze Component Variables

Variable	*M*	*SD*	*min*	*max*
Positive Affect				
% time infant	22.5	21.9	0	91.0
% time mother	78.0	20.3	0	100.0
% time synchrony out of total segment	18.7	19.8	0	87.0
% time synchrony out of time infant spent in PA	66.0	39.9	0	100.0
Gaze				
% time infant –to mom's face	18.3	18.3	0	100.0
% time infant –to object	24.4	19.0	0	79.0
% time infant –away	9.8	13.4	0	79.0
% time mother –to infant's face	56.2	21.7	0	100.0
% time mother –to object	4.2	3.2	0	16.0
% time mother –away	4.7	2.8	0	17.0
% time joint attention	30.4	21.3	0	84.7
% time synchrony out of total segment	46.7	21.0	0	99.9
% time synchrony out of time infant gaze to mother's face	73.4	23.9	0	100

Note: PA = positive affect

Table 3
Intercorrelations Between Study Variables and Descriptive Statistics

Variable	1	2	3	4	5	6	7	Mean (*M*)	Standard Deviation (*SD*)
1. Prenatal Depression (BDI) AUC	—							402.20	260.99
2. Emotion Regulation (IBQ-R)	–.22**	—						5.07	0.59
3. Emotion Regulation (RSA)	.06	.03	—					2.94	1.07
4. % Time Positive Affect Synchrony out of total segment	.06	–.07	–.05	—				18.70	18.77
5. % Time Gaze Synchrony out of total segment	–.04	.00	.15	.26**	—			46.67	21.03
6. % Time Positive Affect Synchrony out of time infant spent in PA	.03	-.01	.05	.56**	.24**	—		65.99	39.86
7. % Time Gaze Synchrony out of time infant gaze to mother's face	-.08	.03	-.01	.06	.07	.05	—	73.36	23.87

** $p \leq .01$. Note: BDI = Beck depression inventory; AUC = area under the curve score; IBQ-R = infant behavior questionnaire – revised; RSA = respiratory sinus arrhythmia; PA = positive affect.

Table 4
Moderation Models of Prenatal Depression Severity Predicting Temperament Emotion Regulation

Predictor	Temperament Emotion Regulation (IBQ-R)			
	Positive Affect Synchrony		Gaze Synchrony	
	ΔR^2	β	ΔR^2	β
Step 1	.04		.05	
Synchrony		.00		.00
Prenatal Depression		.00		.00
Prenatal Depression x Synchrony		.00		.00*

*p < .05. Note: IBQ-R = infant behavior questionnaire – revised.

Table 5
Moderation Models of Prenatal Depression Severity Predicting Physiological Emotion Regulation

	Physiological Emotion Regulation (RSA)			
	Positive Affect Synchrony		Gaze Synchrony	
Predictor	ΔR^2	β	ΔR^2	β
Step 1	.00		.07	
Synchrony		.00		.00
Prenatal Depression		.00		.00
Prenatal Depression x Synchrony		.00		.00

Note: RSA = respiratory sinus arrhythmia.

Table 6

Testing mother-infant positive affect (PA) synchrony at 3-months as a mediator in the relationship between prenatal depression and infant behavioral emotion regulation (IBQ-R) at 6-months:

	Estimate	S.E.	P-Value	CI
IBQ-R regulation on Prenatal Depression	-.002	.001	.061	
IBQ-R regulation on PA Synchrony	.017	.016	.298	
PA Synchrony on Prenatal Depression	.009	.006	.142	
Direct effect from Prenatal Depression to IBQ_R	-.002	.001	.047	
Indirect effect from Prenatal Depression to IBQ-R regulation	.000	.000		-.000, .001

Note: IBQ-R = infant behavior questionnaire – revised.

Table 7
Testing mother-infant gaze synchrony at 3-months as a mediator in the relationship between prenatal depression and infant behavioral emotion regulation (IBQ-R) at 6-months:

	Estimate	S.E.	P-Value	CI
IBQ-R regulation on Prenatal Depression	-.002	.001	.060	
IBQ-R regulation on Gaze Synchrony	-.005	.013	.730	
Gaze Synchrony on Prenatal Depression	-.006	.008	.423	
Direct effect from Prenatal Depression to IBQ_R	-.002	.001	.059	
Indirect effect from Prenatal Depression to IBQ-R regulation	.000	.000		-.000, .000

Note: IBQ-R = infant behavior questionnaire – revised.

Table 8
Testing mother-infant positive affect synchrony at 3-months as a mediator in the relationship between prenatal depression and infant physiological emotion regulation (RSA) at 6-months:

	Estimate	S.E.	P-Value	CI
RSA on Prenatal Depression	.000	.000	.141	
RSA on PA Synchrony	.003	.004	.453	
PA Synchrony on Prenatal Depression	.004	.006	.569	
Direct effect from Prenatal Depression to RSA	.000	.000	.154	
Indirect effect from Prenatal Depression to RSA	.000	.000		.000, .000

Note: RSA = respiratory sinus arrhythmia.

Table 9

Testing mother-infant gaze synchrony at 3-months as a mediator in the relationship between prenatal depression and infant physiological emotion regulation (RSA) at 6-months:

	Estimate	S.E.	P-Value	CI
RSA on Prenatal Depression	.000	.000	.141	
RSA on Gaze Synchrony	.009	.004	.028	
Gaze Synchrony on Prenatal Depression	.002	.007	.734	
Direct effect from Prenatal Depression to RSA	.000	.000	.154	
Indirect effect from Prenatal Depression to RSA	.000	.000		-.000, .000

Note: RSA = respiratory sinus arrhythmia.

Figure 1

3 month gaze synchrony as a moderator of the relationship between prenatal depression and 6 month infant behavioral regulation

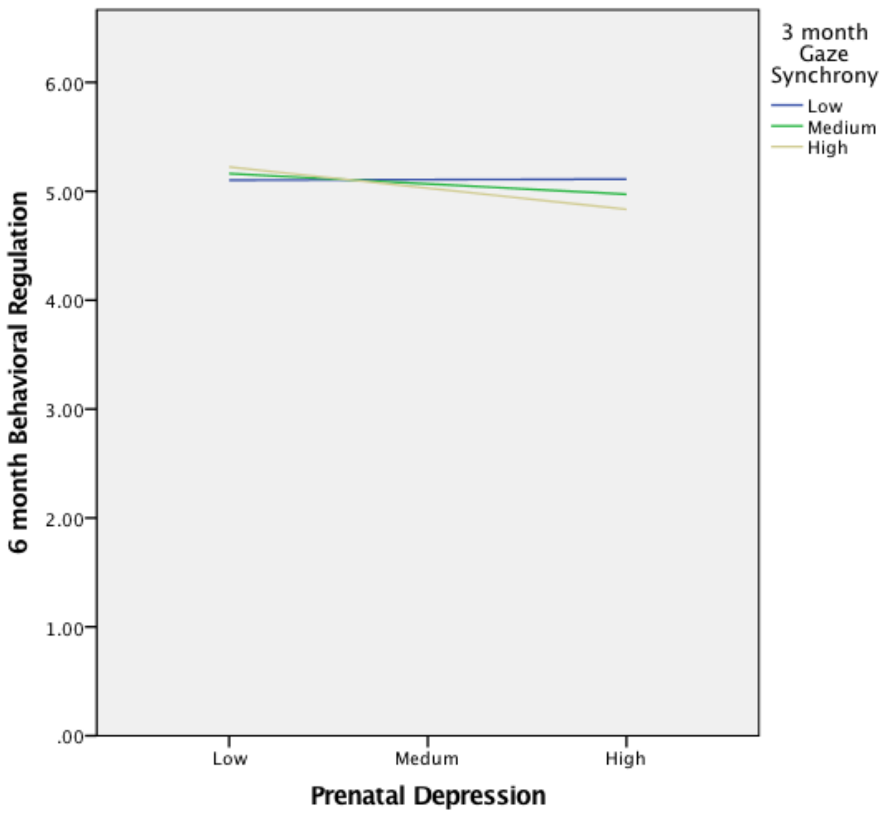

Figure 2
3 month gaze synchrony as a moderator of the relationship between prenatal depression and 6 month infant behavioral regulation Z scores