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Associations between Maternal Depression and Infant Temperament: Investigations of a Transactional Model

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Abstract

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Maternal depression, both prenatal and postpartum, has been consistently shown to predict infant temperament (McGrath, Records, & Rice, 2008; Sugawara, Kitamura, Toda, & Shima, 1999). Additionally, few studies have examined the contribution of infant temperament to maternal depression. Previous literature has shown longitudinal correlations, but has not controlled for the continuity of depression and temperament over time. We investigated associations between maternal depression and infant temperament over the first year of the infant's life, while controlling for the stability of these factors. Additionally, we incorporated both prenatal and postpartum depression in order to further address this continuity. Maternal depression was operationalized as a mean of monthly BDI-II scores during the prenatal period, while BDI-II scores were used at three, six, and 12 months. Infant temperament was operationalized as infant negative affectivity, as assessed via the IBQ-R. Prenatal depression was found through regression analysis to be predictive of infant negative affectivity at three months ($p<.001$) and correlated with infant negative affectivity at six ($r=.297$) and 12 ($r=.263$) months. While the postpartum transactional model pathways proposed and tested through hierarchical regression analyses were not supported, there is limited correlational support for the influence of postpartum maternal depression on infant negative affectivity. The continuity of maternal depression and infant negative affectivity over the first year was shown. This study suggests that postpartum maternal depression does not predict infant negative affectivity above and beyond what would be predicted by previous measures of infant negative affectivity. Future directions for longitudinal models examining the relationship between maternal depression and infant temperament should examine further subscales of the IBQ-R measures of infant temperament. Additionally, further research into the role of perceptions versus behavioral constructs on infant temperament should be compared.

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According to recent reports by the Center for Disease Control, approximately 10-15% of mothers suffer from postpartum depression ("Prevalence of Self-Reported Postpartum Ddepressive Symptoms-17 States, 2004-2005," 2008). Due to the high occurrence of maternal depression, it is highly relevant to understand how a mother's depression may impact her infant as well as what might contribute to the occurrence or severity of her depression. Maternal depression has been shown to predict several characteristics of infant temperament, e.g. low rhythmicity (McGrath, Records, & Rice, 2008; Sugawara, Kitamura, Toda, & Shima, 1999).

Although much of the literature examining the relationship between maternal depression and infant temperament characteristics has focused on the direction of the association from mother to child, the infant's contribution to the relationship between maternal depression and infant temperament should also be addressed. It is import to know if the infant's temperament may be contributing to maternal depression, as opposed to only being predicted by maternal depression. There is support for different levels of infant temperament characteristics, e.g. low rhythmicity, predicting an increase over time in the severity of maternal depression (Sugawara et al., 1999). Some evidence exists that lends itself to proposing a transactional model in which depression and temperament are reciprocally influential over time; however, to our knowledge no study tests such a model. There is some support for the idea that the mutual influence of maternal depression and infant temperament is through parenting, although to our knowledge, no study has tested for parenting as a mediator between maternal depression and infant temperament.

This study examined the relationship between maternal depression and infant temperament, and through the use of a transactional model, examined if this relationship is

bidirectional across time. This study also looked at parenting as a potential mediator of this relationship.

Temperament

Definition of temperament. As a seed can be thought of as the basis for a plant, an infant's temperament can be thought of as a base for personality (Rothbart & Bates, 1998). Temperament is often thought of as the core that personality builds on and develops from. Rothbart and Derryberry (1981) defined temperament as "constitutionally based individual differences in reactivity and self-regulation, influenced over time by heredity, maturation, and experience". In the research literature, temperament is conceptualized and operationalized through several varying constructs. Temperament can be conceptualized through many variables such as rhythmicity, mood, reactions to the environment, and ability to respond to the environment (Rothbart, Ahadi, Hersey, & Fisher, 2001). A questionnaire for measuring temperament, the Infant Behavioral Questionnaire Revised (IBQ-R) provides three broad dimensions of temperament including "surgency/extraversion" (encompassed by measures of approach, vocal reactivity, high intensity pleasure, smiling and laughter, activity level, and perceptual sensitivity), "negative affectivity" (encompassed by measures of sadness, distress to limitations, fear and low falling reactivity), and "orienting/regulation" (thought of as regulatory functioning and includes measures of low intensity pleasure, cuddliness/affiliation, duration of orienting, and soothability). In contrast, this dimensional approach or looking at individual factors, difficult temperament is a construct that has been used to describe a pattern of temperament. Difficult temperament is characterized as showing low rhythmicity, high withdrawal, slow adaptation to change, high frequency of negative mood, and intense reactions (Rothbart, Chew, & Gartstein, 2001).

Change in Temperament over Time. In order to study infant temperament, it is necessary to understand the development of infant temperament, including change of temperament across the first year of life. Understanding the context of temperament development allows for a clearer understanding of how maternal depression may influence temperament. Temperament is relatively stable, supporting the idea of an intrinsic factor of the individual, but it also changes over the first years of life (Gartstein & Rothbart, 2003; Rothbart & Derryberry, 1981). Temperament is influenced over time by both internal and external factors, as are many developmental changes. For instance, younger infants show higher instances of low intensity pleasure, cuddliness, and higher duration of orienting whereas older infants display higher approach, vocal reactivity, high intensity pleasure, activity, perceptual sensitivity, distress to limitations, and fear (Gartstein & Rothbart, 2003). Recognizing typical developmental change is especially pertinent when examining how other factors may affect infant temperament. Rothbart and Derryberry's (1981) definition of temperament includes what the child is biologically born with as well as both maturation and experience with the environment.

Factors such as maternal depression could theoretically change an infant's temperament in either a positive or negative way. A reason investigating factors that might influence infant temperament is important is that infant temperament has been shown to be associated with later psychopathology. For example, higher levels of negative affect in infants are associated with childhood and adult depression and anxiety (Gartstein et al., 2010). Due to the relationship between temperament and psychological wellbeing, it is important to investigate if maternal depression may predict infant temperament.

Concurrent Associations between Maternal Depression and Infant Temperament

That maternal depression and infant temperament are concurrently associated is a well-replicated finding. Based on two meta-analytic reviews, postpartum depression and infant temperament are moderately associated (C. T. Beck, 1996, 2001). In addition to these meta-analytic reviews, more recent research has lent additional support for the association. Higher levels of maternal depressive symptoms are associated with decreased infant adaptability, reduced approach, increased negative mood, and increased sensory threshold (Galler, Harrison, Ramsey, Butler, & Forde, 2004). Moreover, the correlation between depression and infant temperament remained significant after controlling for socio-economic status, which was independently correlated with infant temperament (Galler et al., 2004). Infant sleeping difficulties, or a lack of rhythmicity, are also moderately related to postpartum depression (Dudley, Roy, Kelk, & Bernard, 2001). The relationship between maternal depression and temperament has been seen as early as one month of age. Maternal ratings of infant temperament at one month were positively correlated with depressed mood (Britton, 2011).

Maternal Depression as a Predictor of Infant Temperament

Antenatal depression and infant temperament. While these previous cross-sectional studies establish a relationship between maternal depression and infant temperament, there is a need to examine longitudinal associations to determine the direction of the association. Associations between prenatal depression and infant temperament are impossible to look at effectively without prospective studies. Perhaps because of this, there is more literature on the associations between postpartum depression and infant temperament than there is on the relationship between prenatal maternal depression and infant temperament. Considering that the prenatal period is an essential time of infant development, it is critical to investigate possible implications prenatal depression may have on the developing infant. For instance, depression at

32 weeks gestation was associated with higher levels of infant difficult temperament at four and six months (Austin, Hadzi-Pavlovic, Leader, Saint, & Parker, 2005). Austin et al. (2005) found that both mothers and fathers rated infants as more difficult on the Short Infant Temperament Questionnaire (SITQ), with moderate inter-rater reliability, at four and six months, when mothers had antenatal depression at an average of 32 weeks gestation. Although there is some support for prenatal depression being associated with infant temperament, the literature exploring this association is fairly limited. In addition, few studies have included both prenatal and postpartum measures of maternal depression. Depression during the prenatal period may significantly change the prenatal environment and thus influence the developing infant, including temperament. This prenatal exposure may be as much or more salient than post-partum exposure to depression. For instance, Rouse and Goodman (2012) found that after prenatal exposure to depression, additional exposure to postnatal depression did not predict higher negative affectivity than exposure to prenatal depression alone. Antenatal depression symptoms measured via the Beck Depression Inventory-Revised (BDI-II) predicted infant negative affectivity at three months postpartum. Concurrent measures of maternal depression were not significantly related to infant negative affectivity. Antenatal BDI-II scores were also predictive of the IBQ-R measure of "distress to limitations" (Rouse & Goodman, 2012). Davis et al. (2007) found that the averages of three prenatal measures of depression on the Short form of the Center for Epidemiological Studies Depression Inventory (CES-D) were correlated with report of infant negative reactivity at two months. The relationship remained significant after controlling for maternal postpartum psychological state, cortisol (both pre- and postpartum), and postpartum depression (Davis et al., 2007).

Maternal cortisol may serve as the mechanism through which prenatal depression predicts infant temperament. Maternal cortisol in utero, a hormone that is the body's response to stress and has been linked to depression, has also been found to be related to infant temperament. Maternal cortisol at 30-32 weeks gestation, but not cortisol measures earlier or later, was predictive of maternal report of infant negative reactivity at two months of age (Davis et al., 2007). Prenatal maternal depression has been shown to predict later infant temperament. The association between cortisol and infant temperament has support, but has also failed to be supported. Rouse and Goodman (2012) failed to find cortisol as a mediator for the significant relationship between antenatal depression severity and infant negative affectivity. As cortisol has failed to be shown as a mediator, it is important to explore other possible mediators of the relationship between maternal depression, both prenatal and postpartum, and infant temperament.

Postpartum depression and infant temperament. There is more extensive support for the association between postpartum maternal depression and infant temperament. McGrath et al. (2008) considered mothers who scored above a 12 on the Edinburgh Postnatal Depression Scale (EPDS) as depressed. McGrath et al. (2008) found that difficult infant temperament, measured on the Predictors of Postpartum Depression Inventory-revised (PDPI-R), was reported as higher by depressed mothers at two and six months. Differences between the depressed and non-depressed mothers were found in the level of difficult infant temperament reported. Depressed mothers reported significantly more difficult infant temperament at two and six months. Neither depressed nor non-depressed mothers changed significantly over time in the level of difficult infant temperament they reported from two months to six months (McGrath et al., 2008). Moreover, mothers with an EPDS score above 12 had infants who had higher scores of child

mood and intensity measured on the Carey Scale at 24 months (Hanington, Ramchandani, & Stein, 2010). As it has been shown that the relationship between maternal depression and infant temperament continues into the second year, it is clear that the associations between maternal depression and infant temperament have long term implications.

In order to consider these implications further, it is important to look at not only associations, but the trajectory of these associations over time. Austin et al. (2005) found that depression predicted steeper increases in infant fearfulness on the SITQ. Additionally, more frequent and severe maternal depressive symptoms predicted steeper increases in infant fearfulness from four to 12 months, but did not account for initial levels of fear at four months (Gartstein & Rothbart, 2003). Sugawara et al (1999) used five factors of the Japanese version of the Revised Infant Temperament Questionnaire (RITQ) to investigate the bidirectional relationship of maternal depression and infant temperament over time. Depression at five days was negatively correlated with infant scores of "rhythmicity", "attention span and persistence", and "frustration tolerance" at six months (Sugawara et al., 1999). It was also found that depression at 12 months was negatively correlated with "rhythmicity", "attention span and persistence", and "frustration tolerance" and positively correlated with maternal report of the infant's "fear of strangers and strange situations" at 18 months (Sugawara et al., 1999). It is important to note that depression predicted different temperamental factors at different times. These results suggest that maternal depression may predict infant temperament only at certain developmental periods or predict different factors in varying ways depending on the developmental stage of the infant. This lends support for a developmental approach to studying temperament that addresses the relationship between depression and temperament over time (Goodman & Gotlib, 1999; Rothbart, Chew, et al., 2001). This study aims to examine both the

association between these factors as well as how these associations may change over the first year.

Infant Temperament as a Predictor of Maternal Depression

Whereas many studies investigate whether maternal depression predicts infant temperament, few studies have examined whether infant temperament predicts maternal depression. Perhaps a difficult, fussy, negative infant predicts or exacerbates the mother's depression. The idea that infant temperament may predict the mother's depression has limited support. Infant "rhythmicity" and "persistence and attention span" at six months each independently predicted maternal depression at 12 months (Sugawara et al., 1999). The effect of temperament on parental depression may also be specific to the mother as mood and intensity measured on the Carey Scale at six months predicted maternal, but not paternal, depression at 21 months (Hanington et al., 2010). Maternal depression at four months postpartum was also predicted by the Neonatal Behavioral Assessment Scale (NBAS) scores of infant regulation of state, autonomic stability, and irritability at ten days old (Murray, Stanley, Hooper, & King, 1996). Infant motor activity and infant irritability each were independently predictive of the occurrence of maternal depression, whereas regulation of state and autonomic stability were not (Murray et al., 1996).

Maternal Depression, Parenting, and Infant Temperament

Although cortisol failed to be shown as a mediator between prenatal maternal depression and infant temperament, parenting may be a mechanism through which maternal depression and infant temperament are related (Rouse & Goodman, 2012). Parenting could potentially explain the association between prenatal depression and infant temperament at three months, especially if her depression affects her parenting style as soon as the baby is born. Additionally, parenting

may explain associations between postpartum depression and later infant temperament. The way the mother interacts with the child may predict infant temperament (Goodman & Gotlib, 1999; Lengua & Kovacs, 2005; Tronick & Reck, 2009). Maternal depression has been found to be associated with infant temperament and has also been associated with parenting quality, which in turn has been shown to be related to infant temperament. Maternal depression is associated with qualities of parenting infants including irritability, hostility, negativity, coercion, insensitivity, and intrusiveness (Lovejoy, Graczyk, O'Hare, & Neuman, 2000). Mothers who suffer from depression may also show less positivity toward the child and have trouble recognizing and responding appropriately to infant states (Tronick & Reck, 2009). A theory for why depression is linked to less positive parenting is that depressed mothers may have trouble providing proper caregiving by recognizing and responding appropriately to infant states, resulting in increased negative affect for both the mother and the infant (Tronick & Reck, 2009). The mother's increased negative affect may be because she has both the internal stressor of feeling she is not meeting her infant's needs as well as the external stress of a distressed infant (Tronick & Reck, 2009). Theoretically, this altered parenting may affect the infant's developing temperament. While this finding, to our knowledge, has not been tested with infants, the theory is supported in older ages as inconsistent parenting has been shown to predict fearfulness and irritability in early childhood (Lengua & Kovacs, 2005). Finally, infants show increased negative affect when mothers who suffered from depression showed more negative affect during interactions (Tronick & Reck, 2009). According to one theory proposed by Gartstein et al. (2010), repeated episodes of nonresponsive caregiving over time can lead to steeper increases in infant fearfulness Additionally, Tronick and Reck (2009) proposed that the mother's depression is affecting her

ability to parent appropriately and thus the infant may become more irritable, negative, and fearful.

In addition to depression, infant temperament may also influence the parents' patterns of caregiving (Tronick & Reck, 2009). An infant that is inherently fussy, or that the parent is unable to sooth may influence caregiving patterns in the future. For example, an infant that is fussy may lead parents to respond differently, i.e. may respond less often or differently to an infant who cries more often than an infant who rarely cries. While there is a lack of infant studies testing this association, the idea is supported by older age groups. For example, fearfulness and irritability in seven to 11 year olds predicted greater inconsistent discipline one year later (Lengua & Kovacs, 2005). Within the context of maternal depression, theoretically, the mother's parenting behaviors are negatively influenced by her depression and may influence how she responds to her infant; changes in the mother's pattern of parenting or her behavior may predict infant temperament. This study seeks to see if parenting acts as the mediator in the relationship between postpartum depression and infant negative affectivity.

Bidirectional Associations between Maternal Depression and Infant Temperament

As it has been shown that maternal depression predicts infant temperament and it has been shown separately that infant temperament predicts maternal depression, these associations can be examined as a potentially bidirectional relationship between infant and mother. A bidirectional relationship is one in which the inverse of a relationship also exists. In this case, maternal depression predicts infant temperament which also predicts maternal depression. Sugawara et al. (1999) measured depression at five days and 12 months and measured infant temperament at six and 18 months. They found a bidirectional relationship between maternal depression and infant temperament factors (Sugawara et al., 1999). Depression at five days

predicted infant rhythmicity at six months and rhythmicity at six months predicted depression at 12 months, which in turn predicted rhythmicity at 18 months (Sugawara et al., 1999). A similar relationship was found for depression and infant attention span and persistence, except that the relationship did not continue from 12 to 18 months (Sugawara et al., 1999). In a study that also found a bidirectional relationship between maternal depression and infant temperament, Hanington et al. (2010) measured temperament at six and 24 months with the Carey Scale and measured maternal (and paternal) depression at eight and 21 months. Infant temperament at six months predicted maternal, but not paternal, depression at 21 months (Hanington et al., 2010). Paternal and maternal depression at eight months predicted child mood and intensity at 24 months (Hanington et al., 2010). Although understanding how depression and temperament interact over time is essential to understanding the mutual relationship between the two, to our knowledge these two studies are the only published studies examining bidirectional associations between maternal depression and infant temperament.

Transactional Model

In addition to considering the relationship between maternal depression and infant temperament as bidirectional, a transactional model has also been proposed (Sameroff & MacKenzie, 2003). A transactional model is one in which bidirectional effects occur between the individual and the individual's experience (Sameroff & MacKenzie, 2003). When applied to the relationship between mothers with depression and infants, the interactions between the two influence future reactions. In this model the mothers' depression is tied in a cyclical fashion to the infants' temperament. An infant with a difficult temperament, high negative affectivity, and/or low rhythmicity may further exacerbate his or her mother's depression. The depressed mother may have trouble responding appropriately to the infant, which causes the infant to

exhibit more negative affectivity, which further exacerbates the mother's feelings of inadequacy, hopelessness, and/or sadness and thus her depression (Tronick & Reck, 2009). No study has tested a transactional model between maternal depression and infant temperament. Using this model, we seek to incorporate the environment of the individual into the outcome, offering a broader understanding of the relationship between the two factors. It shows not just that depression predicts temperament or vice versa, but that each is mutually influenced by the other across time. It also allows us to incorporate the continuity of the measures across time. This allows for not just the knowledge of an association, but a better understanding of the pathways of the relationship over time.

Present Study

Past literature has investigated the associations between maternal depression and infant temperament. More attention has been given to maternal depression predicting infant temperament as opposed to infant temperament predicting maternal depression. Both are associated with parenting quality. As depression predicts parenting and parenting predicts temperament, this shows a relationship in which parenting serves as the function by which depression may predict temperament. The previous literature, for the most part, investigates the association between maternal depression and infant temperament, but fails to compare this association to the continuity of either variable over time. In order to explore a transactional model, to investigate both the bidirectional correlations and the relative influence of each variable to the predicted variable, multiple concurrent measures over time of both maternal depression and infant temperament are required. This is something that is lacking in previous literature. Previous studies have looked at bidirectional effects over time, but have not been able to control for concurrent measures (Hanington et al., 2010; McGrath et al., 2008; Sugawara et

al., 1999). Additionally, without concurrent measures, it is impossible to determine if it was the previous measure, or the concurrent measure, that is having the effect. Having concurrent measures of temperament and depression makes it possible to control for the stability of these measures across time (Sugawara et al., 1999). Additionally, while there is substantial support for the correlation between maternal depression and infant temperament, there are also some failures to support this association (Jones, McFall, & Diego, 2004). Concurrent measures, as well as longitudinal measures, can allow for a closer look at how depression might predict infant temperament across the first year. In addition to a lack of concurrent measures of both depression and temperament, the vast majority of the studies lack both prenatal and postnatal measures of depression. This study has both prenatal and postpartum measures of depression. During the postpartum period, all measures of depression also have accompanying concurrent measures of temperament.

Using longitudinal data this study seeks to investigate associations between maternal depression and infant temperament, and test a transactional model of influence. This study includes multiple prenatal measures of depression and concurrent measures of both maternal depression and infant temperament at three, six, and 12 months. We have parental report measurements of infant temperament, using the IBQ-R, and will examine the negative affectivity scale. This scale was chosen as this construct, while one of many temperament constructs that has been linked with maternal depression, is one of the few that has been replicated and incorporates individual factors, such as fear, that have been linked with maternal depression.

In order to examine this transactional model between maternal depression and infant temperament, we will examine individual pathways of the model. These pathways are illustrated in Figure 1 and correspond to each hypothesis. Our first hypothesis is that prenatal maternal

depression will predict infant negative affectivity at three months. Our second hypothesis is that maternal depression at three months will predict infant negative affectivity at six months, controlling for the infants' previous levels of negative affectivity. For our third hypothesis, we expect that infant negative affectivity at three months will predict maternal depression at six months, above the influence of depression at three months.. In turn, our fourth hypothesis is that maternal depression at six months will predict infant negative affectivity at 12 months, again accounting for the variance beyond what is accounted for by previous negative affectivity Additionally, our fifth hypothesis expects that infant negative affectivity at six months will predict maternal depression at twelve months, explaining the variance not accounted for by depression at six months. Finally, we propose that parenting will act as a mediator of the association between maternal depression and infant temperament.

Method

Participants

A total of 77 women and their infants participated in the study. At the first laboratory visit the infants were three months old (*M* = 14.87 weeks, *SD* = 1.71, Range = 13-24 weeks).

In order to adjust for the potential confound of infants who were premature, or before 37 weeks of gestation, data was collected measured from the time of their due dates. At the first visit the average age was 14.18 weeks (*SD* = 1.47, Range = 12-18 weeks). Of the 78 infants (including one set of twins) 54% were female and 46% were male.

Women were recruited from both obstetrics practices in Atlanta, Georgia and media announcements. Potential participants were screened by phone, followed by an in-person Structured Clinical Interview for the Diagnostic and Statistical Manual- IV Axis I Disorders – Patient Edition (SCID) (First, Spitzer, Gibbon, & Williams, 1995). In order to be included in the

study the mother had to meet DSM-IV criteria for a Major Depressive Episode (MDE) that began prior to pregnancy, be no further along in the pregnancy than five months, be between the ages of 18 and 40, be pregnant with her first child, and be married, cohabiting with a significant other, or some other stable living situation, and be either African-American or European-American. Mothers were excluded from the study for the following factors: experiencing active suicidal ideation; meeting DSM-IV criteria for an organic mental disorder, a substance use disorder, schizophrenia or other psychotic disorder or the presence of psychotic features, bipolar disorder, or delusional disorder; testing positive in a urine toxicology screen; or having a pre-existing medical condition that had not been stable for at least six months. 30% of the women were African-American, and 70% were European-American; 70% were college educated; 74% were married. The mean age was 30.43; the median household income group was $71,000-$75,000 (range $10,000-$15,000 to $100,000+).

Missing data. Of the 77 women and 78 infants who were included in the study, due to various reasons such as an inability to schedule a visit, complete a visit, or missing data, data for portions of the study may not have been available. 78 infants and 74 moms who had data for the three month visit were included in the preliminary analysis and three month sample. 71 infants and 72 moms were included in the 6 month sample, and 74 infants and 73 moms were included in the twelve month sample.

Procedure

Participants gave informed consent before participating in diagnostic interviews and completing mood questionnaires. The full SCID was administered at the first prenatal visit. The BDI-II and mood questionnaires were both completed on a monthly basis from their entry into the study through six months postpartum and again at 12 months postpartum. Three laboratory

visits were conducted with the mother and infant at three, six, and 12 months. Women were paid $25 at each study visit. During the three postpartum visits with the babies, mothers and infants were video-recorded interacting with their infants during a baseline, feeding, and freeplay segments. During the freeplay segment mothers were face to face with their infant, provided with a box of age-appropriate toys, and instructed to play with their child as they would normally. This segment allowed for the observation of maternal parenting qualities. A split-screen camera recorded the faces of mother and child. The IBQ-R was completed at three, six, and 12 months of age.

Measures

The Infant Behavior Questionnaire - Revised (IBQ-R; Gartstein & Rothbart, 2003). The IBQ-R is a measure of infant temperament based on the definition by Rothbart and Derryberry (1981). Derived from factor-analysis, it has 14 scales that cluster into three global scores of orienting/regulatory capacity, surgency/extraversion, and negative affectivity. These scales are completed by a parent, generally the mother, who rates the infant's behavior over the past week. There are 10 to 18 items per each of the 14 scales; each of the items are rated on a seven-point scale, from one (never) to seven (always). Total global scores are the mean of items on the scale. For this study we only used the negative affectivity global score, which is calculated from the mean of the following four scales: falling reactivity, fear, frustration/distress to limitations, and sadness. For each of the four scales that comprise negative affectivity, Gartstein and Rothbart (2003) found good internal consistency within each of the normative sampling groups (3-6 months, 6-9 months, 9-12 months), with Cronbach's alphas as follows: falling reactivity (0.84, 0.79, 0.83), fear (0.90, 0.89, 0.87), frustration/distress to limitations (0.81, 0.83, 0.82), and sadness (0.85, 0.85, 0.71).

Structured Clinical Interview for DSM-IV Axis I Disorders (SCID; First et al., 1995). The SCID is a semi-structured diagnostic interview designed to assess Axis I disorders of the DSM-IV. In this study the SCID was used to assess for any psychological disorders across the participants' lifetime, including from conception through the time of the initial interview in pregnancy. All interviews were conducted by master's level clinical psychologists, a psychiatric nurse, or a social worker and audiotaped. Interviews were listened to by a licensed clinical psychologist, blind to other information on the participants, who derived diagnoses. Diagnostic decisions were ultimately made by a licensed clinical psychologist based on discussion with the interviewer, written notes of responses to interview questions, and reviewing the tape-recorded interview. The full interview covering all Axis I disorders was administered only during the first visit and served as the final screener for entry into the study. At the three-, six- and twelve-month visits, the SCID screener and mood module were given. The SCID provides a diagnosis and determines whether or not the mother, judging by DSM-IV criteria, either in the past or currently, met full criteria for a Major Depressive Disorder or an Anxiety Disorder.

Beck Depression Inventory-II (A. T. Beck, Steer, & Brown, 1997). The BDI-II is a 21-item self-report scale that measures the intensity of symptoms of depression in the past two weeks. A higher BDI-II score indicates more severe depression symptoms. Depression scores ranging from 0 to 13 indicate a non-depressed individual or one with minimal depression; 14-19 indicates mild depression; 20-28 suggests moderate depression; 29-63 indicates a severely depressed individual (A. T. Beck et al., 1997). A score of 14 or higher indicates clinically significant levels of depression (A. T. Beck et al., 1997). The BDI-II has been found to be reliable and valid in measuring depression severity, with high content validity, construct validity, and internal consistency (A. T. Beck et al., 1997).

Maternal Interactive Quality Ratings. A trained team of research assistants rated the digital video-recorded freeplay segments using the Maternal Interactive Quality Ratings, 14 rating scales taken from the standardized rating scales of Ainsworth (Ainsworth, Blehar, Waters, & Wall, 1978), Clark (1985), and Campbell (1991). This set of scales was selected to assess the quality of the mother's interactive behavior with her child. The five categories of interactive quality included; insensitive parenting, intrusiveness, withdrawal, positive affect, and negative affect. Insensitive parenting was measured with two scales from Campbell: sensitivity/responsiveness to distress and sensitivity/responsiveness to nondistress. Intrusiveness was also measured with two scales: Campbell's intrusiveness and Ainsworth and colleagues' cooperation vs. interference. Withdrawal was measured with detachment/disengagement and flatness of affect and positive affect was measured with positive regard for the child, warmth, and stimulation of development (Campbell, 1991). Two more scales from Clark (1985), quality of verbalizations and structures and mediates environment, were added to measure positive affect following the initial compilation of the rating scales. Finally, negative affect was measured using three scales from Clark (1985). They included quality and amount of physical contact: negative; angry, hostile mood; and displeasure, disapproval, criticism. Scores for each of the scales were based upon a 4- or 5-point Likert scale, and took into consideration both the quality and quantity or intensity of the behavior measured in the scale. For most of the scales, raters assigned a score based on whether the behavior was 'characteristic' or 'not characteristic' of the mother (or some gradient in between). For this study we looked at the relative duration of negative affect.

Raters were undergraduate research assistants who had been extensively trained on the rating scales prior to the rating period. Training involved each member of the rating team independently rating freeplay segments from a previous study and then discussing the segment

with a senior clinical psychologist until the group reached a consensus. The rating period began once the team members consistently demonstrated high inter-rater reliability in their rating of the segments (disagreeing by no more than one point on no more than a few scales). Raters were blind to the past and current depression status of the mothers they observed. Each week a subset of segments was randomly selected to also be rated by another team member in order to assess reliability throughout the study. Segment assignments were designed so that each team member was paired with each of the other team members an equal number of times, and so that each member served as the primary and reliability rater equally often. The group met weekly to discuss the segments that had been rated for reliability, and to discuss any questions they had regarding the segments they had rated independently. This meeting was designed to maintain the team's skills and overall reliability throughout the rating period.

Of the total rated *freeplay* segments rated on the Maternal Interactive Quality Ratings, 33 at three months, 13 at six months, and 13 at 12 months were also rated by a reliability rater. Inter-rater reliability was assessed at the scale level. Kappa values were calculated for each of the three summary scales (quality and amount of physical contact: negative; angry, hostile mood; and displeasure, disapproval, criticism) between the scores given by the primary rater and the reliability rater at each of the three times. For quality and amount of physical contact: negative kappa values were .308, .847, and .764 for three, six, and 12 months respectively. For angry, hostile mood kappa values were .205, 1.00, and .133 for three, six, and 12 months respectively. Finally, for displeasure, disapproval, and criticism kappa values were .429, 1.00, and .576 for three, six, and 12 months respectively. Low kappas, especially at three months, were due to limited occurrences of the behavior being measured e.g., 1 or 2 occurrences.

Planned Analysis

Multiple regressions were used to examine the extent to which infant temperament and maternal depression would predict each other from the prenatal period to 12 months postpartum. The variable used for prenatal maternal depression was the mean score of all BDI-II scores collected during the prenatal period. For each postpartum measure, the BDI-II score collected at three, six, and 12 months postpartum was used. The variable used for infant temperament was the negative affectivity scale of the IBQ-R. First correlations between demographic variables, infant negative affectivity, and maternal depression were examined. Second, correlations between maternal depression during the prenatal period, at three, six and 12 months postpartum and infant negative affectivity at three, six, and 12 months were examined. Third, multiple regression analysis was utilized to test the longitudinal relationships between infant negative affectivity and maternal depression. Finally, if maternal depression was found to be a predictor of infant negative affectivity, parenting was explored as a potential mediator of this relationship.

In hierarchical multiple regression analysis, the predictors for time one (depression and temperament) were entered in two steps to predict time two (depression or temperament). This approach allowed the examination of prediction of temperament variables by depression variables controlling for prior levels of temperament and depression. This explained how much of the variance in each variable (e.g. infant temperament) was accounted for by the other variable (e.g. maternal depression).

To examine the longitudinal associations of these variables over time we looked at the individual pathways of the transactional model. First, we hypothesized that prenatal depression will predict infant negative affectivity at three months. As a negative affectivity measure is not available for the prenatal period, this case had only one predictor for depression and

temperament at three months. Second, we hypothesized that maternal depression at three months will predict infant negative affectivity at six months, controlling for the infants' previous levels of negative affectivity, and third we further hypothesized that maternal depression at six months will predict infant negative affectivity at 12 months, again accounting for the variance beyond what is accounted for by previous negative affectivity. Fourth, we also hypothesized that infant negative affectivity at three months will predict maternal depression at six months, above the influence of depression at 3 months. Fifth, we also hypothesized that infant negative affectivity at six months will predict maternal depression at twelve months, explaining the variance not accounted for by depression at six months.

We hypothesized that parenting will act as a mediator for maternal depression predicting infant negative affectivity. Using the method from Baron and Kenny (1986), in order to test for the potential mediating relationship of parenting for maternal depression predicting infant negative affectivity, three correlational relationships must be found to be statistically significant before testing for the mediation. These correlations must be present between the independent variable (depression) and the potential mediator (parenting), the potential mediator and the dependent variable (negative affectivity), and between the dependent and independent variables. If these correlations were significant, the independent variable is then regressed onto the dependent variable, and if the strength of the association decreased it supported the mediation model.

Results

Descriptive and Preliminary Analyses

Infant Negative affectivity. IBQ-R Negative affectivity score means and SD (on a scale of 1-7) are reported in Table 1. Independent sample t-tests were conducted for each age group for

gender, ethnicity, and marital status. There was a significant difference for Negative Affectivity at three months for infants of European American (M=3.411, SD=.469) and African American (M=3.752, SD=.732) women; t(75)=2.435, p<.05; as well as for infants of mothers who lived with a spouse (M=3.407, SD=.466) or partner (M=3.821, SD=.748); t(75)= -2.864, p<.01. There was also a significant difference for Negative Affectivity at six months for infants of mothers who lived with a spouse (M=3.477, SD=.457) or partner (M=3.770, SD=.611); t(71)= -2.097, p<.05. There was a significant difference only for negative affectivity scores at 12 months for male (M=3.752, SD=.406) and female (M=3.985, SD=.479) infants; t(76)= 2.281, p<.05. The association between mother's education and negative affectivity was tested with nonparametric correlations. No significant relationships were found as shown by Table 3. Correlations between negative affectivity and mother's age and household income was also tested. Only three month negative affectivity was associated with mother's age. Results are summarized in Table 4. Hypothesis testing was tested without controlling for demographics and if significance resulted, tested again while controlling for demographic variables to further understand the relationship.

Maternal Depression: mean prenatal; 3, 6, and 12 month BDI-II scores: BDI-II score means and SD are reported in Table 1. Independent sample t-tests were conducted for each age group for gender, ethnicity, and marital status.

There was a significant difference only for prenatal BDI-II scores for European American (M=7.940, SD=4.413) and African American (M=12.601, SD=6.037) women; t(102)=4.420, p<.001.

The association between mother's education and BDI-II scores was tested with nonparametric correlations. No significant relationships were found as shown by Table 2. Correlations between BDI-II scores and mother's age and household income was also tested. No

significant relationships were found as shown by Table 3. Hypothesis testing was tested without controlling for demographics and if the hypothesized predicting variable was found to be significant, tested again while controlling for demographic variables to see if the predictor remained significant. This was done in two steps to explore the relationship further.

Correlations: Correlations were also run between each of the seven predicting variables to assess the continuity of the measures across time as well as explore the relationships between the variables at all time points. Pearson's r effect sizes of small ≥ .10, medium ≥ .30, and large ≥ 0.5 were used.

Correlations of negative affectivity scores across time was high with negative affectivity at three months being correlated with negative affectivity at six and 12 months all with large effect sizes; negative affectivity at six months was also correlated with negative affectivity at 12 months with a large effect size.

Correlations of BDI-II scores across time was also high with prenatal BDI-II being correlated with three month DI-II with a large effect size and with six and 12 month BDI-II scores with a medium effect size; BDI-II at three months was correlated with BDI-II at six and 12 months with a large effect size; BDI-II at six months was also correlated with BDI-II at 12 months with a large effect size.

Prenatal depression was significantly predictive of each of the negative affectivity scores for three months with a medium effect size and for six and 12 months with a small effect size. Maternal depression at 3 months was also significantly predictive of negative affectivity at 12 months with a small effect size. Results for all intercorrelations and descriptive data for BDI-II and negative affectivity scores are reported in Table 1.

Hypothesis Testing

Hypothesis one. In order to test the hypothesis that maternal depression during the prenatal period will predict infant negative affectivity at three months, linear regression was used to assess the ability of prenatal maternal depression to predict the level of negative affectivity at three months. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity, of which none were violated. Prenatal BDI-II mean was a significant predictor of infant negative affectivity and explained 18.7% of the variance in negative affectivity at three months, $F(1, 75) = 17.236$, $p<.001$. Results for this regression is summarized in Table 4.

As the linear regression was significant, and as a demographic variable, mother's age, was found to be significantly correlated to infant affectivity at three months, a hierarchical multiple regression was run including this variable in order to control for it and see if Prenatal BDI-II mean remained a significant predictor of infant negative affectivity at three months. Maternal age was entered in the model in step 1, explaining 13% of the variance in negative affectivity. After entry of the mean of prenatal depression scores at step 2 the total variance explained by the model as a whole was 26.6%, $F(2, 74) = 13.392$, $p<.001$. The prenatal measure explained an additional 13.6% of the variance in stress, after controlling for age, R squared change = .136, F change $(1, 74) = 13.699$, $p<.001$. In the final model, both of the measures were statistically significant, with age recording a lower beta value ($beta=-.286$, $p<.001$) than prenatal depression mean ($beta = .376$, $p<.001$). Results for this regression is summarized in Table 5. After controlling for mother's age, prenatal depression was still a significant predictor of negative affectivity at three months. Our first hypothesis was supported.

Hypothesis two. In order to test the hypothesis that maternal depression at three months will predict infant negative affectivity at six months, controlling for previous infant negative

affectivity at three months, hierarchical multiple regression was used to assess the ability of maternal depression at three months to predict the level of negative affectivity at six months, controlling for previous infant negative affectivity at three months. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, and multicollinearity, of which none were violated. Depression scores at three months were entered in step 1, explaining 4.3% of the variance in negative affectivity at six months. After entry of negative affectivity scores at three months at step 2 the total variance explained by the model as a whole was 43.8%, $F(2, 65) = 25.340$, $p<.001$. The three month negative affectivity score measure explained an additional 39.5% of the variance in negative affectivity at six months, R squared change = .395, F change $(2, 65) = 45.709$, $p<.001$.In the final model, only negative affectivity at three months was statistically significant with a beta value (beta= .641, $p<.001$). Results for the regression are summarized in Table 6. Our second hypothesis failed to be supported.

Hypothesis three. In order to test the hypothesis that infant negative affectivity at three months will predict maternal depression at six months, controlling for previous maternal depression at three months, hierarchical multiple regression was used to assess the ability of infant negative affectivity at three months to predict the level of maternal depression at six months, controlling for previous maternal depression at three months. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, and multicollinearity, of which none were violated. After entry of the negative affectivity scores at three months at step 1, while not significant, the R Square value was .022, $F(1, 64) = 1.458$, $p=2.32$. The three month depression score measure explained an additional 48.3% of the variance in negative affectivity, R squared change = .483, F change $(2, 63) = .709$, $p<.001$. After entry of the maternal depression scores at three months at step 2 the total variance explained by the model as a whole

was 50.6%, F (2, 63) = 32.223, p<.001. In the final model, only maternal depression at three months was statistically significant with a beta value (beta= .709, p<.001). Results are summarized in Table 7. Our third hypothesis failed to be supported.

Hypothesis four. In order to test the hypothesis that maternal depression at six months will predict infant negative affectivity at twelve months, controlling for previous infant negative affectivity at six months, hierarchical multiple regression was used to assess the ability of maternal depression at six months to predict the level of negative affectivity at twelve months, controlling for previous infant negative affectivity at six months. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, and multicollinearity, of which none were violated. After entry of the depression scores at six months at step 1 explaining 3.3% of the variance in negative affectivity at 12 months. After entry of the negative affectivity scores at six months at step 2 the total variance explained by the model as a whole was 38.2%, F (2, 67) = 20.381, p<.001. The six month negative affectivity score measure explained an additional 34.9% of the variance in negative affectivity, R squared change = .349, F change (2, 66) = 37.268, p<.001.In the final model, only negative affectivity at six months was statistically significant with a beta value (beta= .593, p<.001). Results are summarized in Table 8. Our fourth hypothesis failed to be supported.

Hypothesis five. In order to test the hypothesis that Infant negative affectivity at six months will predict maternal depression at twelve months, controlling for previous maternal depression at six months, hierarchical multiple regression was used to assess the ability of infant negative affectivity at six months to predict the level of maternal depression at twelve months, controlling for previous maternal depression at six months. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, and multicollinearity, of which

none were violated. The negative affectivity scores at six months were entered in the model in step 1, explaining 2.2% of the variance in maternal depression at 12 months. After the entry of the six month depression score measure at step 2, the total variance explained by the model as a whole was 33.9%, $F(2, 65) = 16.441$, $p<.001$. Maternal depression at six months explained an additional 31.8% of the variance in maternal depression at twelve months, R squared change = .318, F change $(1, 64) = 30.776$, $p<.001$. In the final model, only maternal depression at six months was statistically significant with a beta value (beta= .566, $p<.001$). Results are summarized in Table 9. Our fifth hypothesis failed to be supported.

The regression beta coefficients are summarized with the pathways in Figure 2. The first is the beta coefficient before controlling for the previous measure; the second is the beta for the predictor in the overall path model.

As our hypothesis that maternal depression at three months would predict infant negative affectivity at six months controlling for earlier infant negative affectivity was not supported, as was our hypothesis that maternal depression at six months would predict infant negative affectivity at twelve months controlling for earlier infant negative affectivity, the mediation model that parenting would mediate the relationship between maternal depression and infant negative affectivity was not tested (Baron & Kenny, 1986).

Discussion

Previous literature has found that maternal depression predicts infant temperament and that infant temperament is associated with maternal depression. The main goal of this study was to further explore the nature of this relationship and investigate a transactional model. This transactional model allowed for controlling for earlier measures of depression and temperament.

This transactional model also allowed us to look at the continuity of maternal depression and infant temperament over the first year. Finally, this model allowed us to tease apart how much of infant temperament was a result of this continuity or of maternal depression.

Our first confirmed hypothesis supported previous literature. Prenatal depression predicts infant temperament, as has been shown by several studies (Rouse & Goodman, 2012). Additionally, besides the supported linear regression, prenatal depression was correlated with infant negative affectivity at all three time points, lending support to the idea that prenatal exposure to maternal depression may be most salient to the development of infant temperament when compared to postpartum depression. As Rouse and Goodman (2012) found, these results suggest that prenatal depression may have a stronger influence on the first year of temperament development than later time periods. This suggests that prenatal depression is related to the prenatal environment in some way or it may be related to the mother's care or interaction with her infant over the first year. These results may also be interpreted as there may be a biological risk factor involved as a mother who experiences depression, and thus experiences negative affectivity states, e.g. sadness, also has an infant who shows more negative affectivity.

While maternal depression at three months did not predict infant negative affect at six months after controlling for previous negative affect, it did before controlling for 3 month negative affectivity. Additionally, three month BDI scores were correlated with negative affect at twelve months. These correlations suggest that not only does maternal depression predict infant negative affectivity, but that the pathways may be different than in the model we tested. For instance, we looked at the influence of maternal depression after three months, but it may be that it takes longer exposure to maternal depression to predict infant negative affectivity. Supporting previous literature, there is some evidence that maternal depression predicts infant temperament

(Hanington et al., 2010; McGrath et al., 2008; Sugawara et al., 1999). However, we did not find support for the transactional model we proposed using the pathways over time we proposed. This is most likely due to the high correlation of infant negative affectivity at three and six months. As previous measures have never been controlled for, to our knowledge, this shows the important contribution of considering temperament continuity in research on the relationship between maternal depression and infant temperament.

Our hypotheses that negative affectivity at three months would predict maternal depression at six months, controlling for previous maternal depression, that maternal depression at six months would predict negative affect at 12 months, controlling for previous negative affect, and that negative affect at six months would predict maternal depression at 12 months, controlling for previous maternal depression were not supported which does disagree with previous literature; however, Jones et al. (2004) did fail to support the association between maternal depression and infant temperament as in the current study (Hanington et al., 2010; McGrath et al., 2008; Sugawara et al., 1999). Again, this seems due to our consideration of the continuity of both depression and temperament across time, with substantial correlations between these measures over time.

Infant temperament has been shown to predict maternal depression, but the studies that have found this link have looked at other constructs and were also large population studies with sample sizes of 615-14,663 (Hanington et al., 2010; Sugawara et al., 1999). For our predictions that were nonsignificant, correlations between the variables did have small effect sizes which could contribute to nonsignificant findings within a small sample. While previous literature has found a relationship between maternal depression and infant temperament, the specific factor of temperament that the relationship has focused on has varied widely. For example, past studies

have examined the construct of difficult temperament (Britton, 2011; Hanington et al., 2010; McGrath et al., 2008). Other studies have focused on more specific subscales of infant temperament, such as infant rhythmicity, attention span and persistence, frustration tolerance, and fear (Gartstein et al., 2010; Sugawara et al., 1999). Finally, constructs related to the mother's perceptions of temperament measures have been emphasized (C. T. Beck, 1996; Dudley et al., 2001). Perceptions of infant temperament and infant temperament measures focused on more behaviorally worded questions, like the IBQ-R, are often grouped together; however this study may reveal an important difference in the association between maternal depression and infant temperament. There may be a difference between the association of maternal depression and the mother's perception of infant temperament versus behavioral differences in infant temperament.

Another main difference between this study and previous ones is that we used BDI-II scores to measure maternal depression. Some of the previous literature has often looked at depressed versus non-depressed mothers in statistical analyses, using either depression diagnoses or cut scores (Hanington et al., 2010; McGrath et al., 2008). Finally, no previous literature has controlled for previous measures of the predicted variable, making the tests in this study much more stringent than previous literature when the highly correlated measures of temperament and depression across time are controlled for. Because of this fact, this study gives a significant contribution by presenting evidence that maternal depression, beyond the prenatal period, may not be sufficient to predict negative affectivity during the first year.

Strengths and Weaknesses

One strength of our study was that we had a unique population. All the women in the study were recruited during pregnancy because they were suffering from prenatal depression.

This clinical sample has higher percentages of instances of major depressive disorder when compared to a general population sample of women. Another strength of this study was a relatively broad SES sample, allowing more generalizable results. Finally, this study used a behaviorally based measure of infant temperament, the IBQ-R, which controlled for a potential confound of the mother's perceptions of her infant due to her depression.

Future directions

It would follow for future research to examine different longitudinal pathways or pathways with longer periods of time between measures. Additionally, as this study only examined the overall negative affectivity scale score on the IBQ-R, the literature has limited support for the relationship between maternal depression and infant temperament looking at individual factors on the Negative Affectivity scale such as fear and distress to limitations as well as on the Orienting/Regulation scale through findings of orienting and duration on attention span/persistence (Sugawara et al., 1999). While we used one BDI-II score as one time point for our postpartum measures, since we are attempting to capture the effect of exposure to depression over time, there is an argument to look at means of depression measures over periods of time. While this was done during the prenatal period, there were not equal occurrences of depression measures on the BDI-II during the postpartum periods between laboratory visits in order to make this possible. Finally, it would also be beneficial to investigate potential biological or genetic factors that may be related to depression and temperament to explain both the association between the two as well as the stability of the measures across time.

Conclusions

Overall this study provides further insight into the relationship between maternal depression and infant temperament. It was found that prenatal maternal depression predicted infant negative affectivity, but that postpartum maternal depression did not significantly predict infant negative affectivity above and beyond what was predicted by the infant's previous levels of negative affectivity. This study did add to the literature by incorporating the stability of maternal depression and infant negative affectivity across the first year into the test of the association between the two. Additionally this study provided new directions in which to explore the relationship between prenatal depression and infant temperament.

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Table 1

Summary of Intercorrelations, Means, and Standard Deviations for Scores on BDI-II and Negative Affectivity (NA)

Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*M*	*SD*
1. Prenatal BDI-II	-	.525**	.425**	.321**	.432**	.297*	.263*	9.58	5.48
2. 3 month BDI-II	.525**	-	.712**	.551**	.197	.207	.250*	6.97	5.86
3. 6 month BDI-II	.425**	.712**	-	.607**	.149	.050	.153	5.73	6.12
4. 12 month BDI-II	.321**	.551**	.607**	-	-.001	.146	.218	5.76	6.13
5. 3 month NA	.432**	.197	.149	-.001	-	.657**	.543**	3.50	0.57
6. 6 month NA	.297*	.207	.050	.146	.657**	-	.555**	3.51	0.46
7. 12 month NA	.263*	.250*	.153	.218	.543**	.555**	-	3.87	0.46

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

Table 2

Nonparametric Correlational Data Between Maternal Education and Negative Affectivity & Maternal Depression

	BDI-II				Negative affectivity		
	Prenatal	3 month	6 month	12 month	3 month	6 month	12 month
Mothers Education	-.133	.188	.212	.040	-.161	-.196	.002

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3

Correlational Data Between Demographics and Negative Affectivity & Maternal Depression

	BDI-II				Negative affectivity		
	Prenatal	3 month	6 month	12 month	3 month	6 month	12 month
Mothers Age	-.142	.203	.166	.183	-.359*	-.311	-.119
Household Income	-.137	.069	.175	.071	-.205	-.150	-.104

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4

Hierarchical Multiple Regression Analysis Predicting Three Month Infant Negative Affectivity (NA) From Prenatal BDI-II mean Step 1

	3 month NA
Variable	Model 1 *B*
Prenatal BDI-II mean	.432***
R^2	.187
F	17.236***

* p < .05. ** p < .01. *** p < .001.

Table 5

Hierarchical Multiple Regression Analysis Predicting Three Month Infant Negative Affectivity (NA) From Prenatal BDI-II mean Step 2 Controlling For Mother's Age

	3 month NA	
Variable	Model 1 *B*	Model 2 *B*
Prenatal BDI-II mean		.376***
Mother's age	-.360**	-.286**
R^2	.118	.266
F	11.190**	11.190**
ΔR^2		.130**
ΔF		13699***

* p < .05. ** p < .01. *** p < .001.

Table 6

Hierarchical Multiple Regression Analysis Predicting Six Month Infant Negative Affectivity (NA) From Three Month BDI-II

	6 month NA	
		Model 2
Variable	Model 1 *B*	*B*
3 month BDI-II	.207	.081
3 month NA		.641***
R^2	.043	.438
F	2.963	25.340***
ΔR^2		.395
ΔF		45.709***

* p < .05. ** p < .01. ** p <.001.

Table 7

Hierarchical Multiple Regression Analysis Predicting Six Month BDI-II From Three Month Infant Negative Affectivity (NA)

	6 month BDI-II	
		Model 2
Variable	Model 1 *B*	*B*
3 month NA	.149	.009
3 month BDI-II		.709***
R^2	.022	.506
F	1.458	32.223***
ΔR^2		.483
ΔF		61.67***

* p < .05. ** p < .01. ** p <.001.

Table 8

Hierarchical Multiple Regression Analysis Predicting 12 Month Infant Negative Affectivity (NA) From Six Month BDI-II

	12 month NA	
		Model 2
Variable	Model 1 *B*	*B*
6 month BDI-II	.181	.128
6 month NA		.593***
R^2	.033	.382
F	2.267	20.381***
ΔR^2		.349
ΔF		37.268***

* p < .05. ** p < .01. ** p <.001.

Table 9

Hierarchical Multiple Regression Analysis Predicting 12 Month BDI-II From Six Month Infant Negative Affectivity (NA)

	12 month BDI-II	
		Model 2
Variable	Model 1 *B*	*B*
6 month NA	.147	.097
6 month BDI-II		.566***
R^2	.022	.339
F	1.444	16.441***
ΔR^2		.339
ΔF		30.776***

* p < .05. ** p < .01. ** p <.001.

Figure 1. Transactional Model

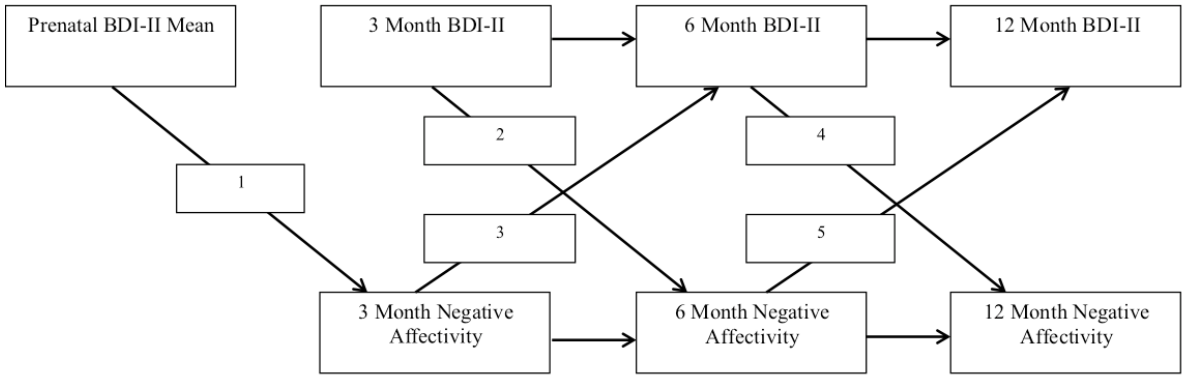

Figure 1. Transactional model for hypotheses pathways. Each numbered pathway corresponds to the numbered hypotheses.

Figure 2. Final Beta Values for Hypotheses Testing

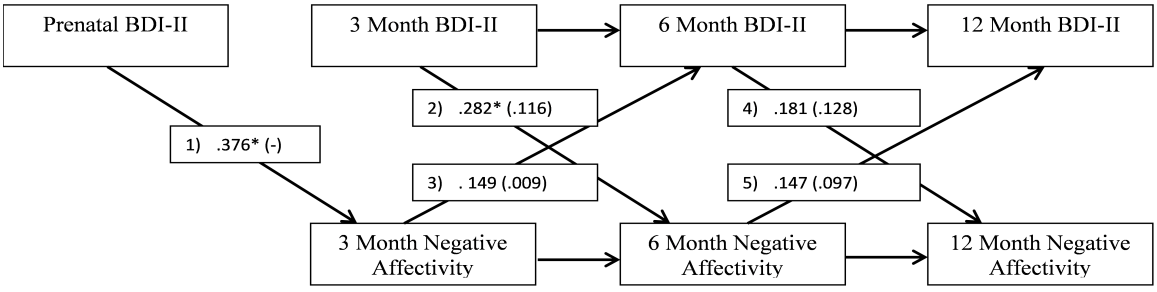

Figure 2. Final beta values for hypotheses pathways. Each numbered pathway corresponds to the numbered hypotheses.