Published in final edited form as:

Attach Hum Dev. 2013 March ; 15(2): 133–153. doi:10.1080/14616734.2013.743256.

Maternal Antenatal Depression and Infant Disorganized Attachment at 12 months

Lisa J. Hayes,

Department of Psychology, Emory University

Sherryl H. Goodman, and

Department of Psychology, Emory University

Elizabeth Carlson

Institute of Child Development, University of Minnesota

Abstract

Although high rates of attachment disorganization have been observed in infants of depressed mothers, little is known about the role of antenatal depression as a precursor to infant attachment disorganization. The primary aim of this study was to examine associations between maternal antenatal depression and infant disorganization at 12 months in a sample of women ($N = 79$) at risk for perinatal depression. A secondary aim was to test the roles of maternal postpartum depression and maternal parenting quality as potential moderators of this predicted association. Among women with histories of major depressive episodes, maternal depressive symptoms were assessed at multiple times during pregnancy and the first year postpartum, maternal parenting quality was measured at 3 months postpartum, and attachment disorganization was assessed at 12 months postpartum. Results revealed that infants classified as disorganized had mothers with higher levels of depressive symptoms during pregnancy compared to infants classified as organized. Maternal parenting quality moderated this association, as exposure to higher levels of maternal depressive symptoms during pregnancy was only associated with higher rates of infant disorganized attachment when maternal parenting at 3 months was less optimal. These findings suggest that enhancing maternal parenting behaviors during this early period in development has the potential to alter pathways to disorganized attachment among infants exposed to antenatal maternal depressive symptoms, which could have enduring consequences for child wellbeing.

Keywords

disorganized attachment; maternal depression; parenting

Disorganized attachment in infants has been recognized as an early index of vulnerability for the later development of psychopathology. As such, researchers have stressed the importance of examining predictors of disorganization (Kochanska, 2001). Maternal antenatal depression may be one such precursor given theory-based links to disorganized attachment (Kammerer, Taylor, & Glover, 2006; Van den Bergh, Mulder, Mennes, & Glover, 2005), yet there have been few reports to date of prospective tests of the association between antenatal depression and disorganized attachment. Thus, the primary aim of this study was to examine associations between maternal antenatal depression and infant disorganization at 12 months. In order to enhance the likelihood of occurrence of antenatal

depression, we sampled women with lifetime histories of depression, who were thus at elevated risk for perinatal depression relative to general population samples (O'Hara & Swain, 1996). A secondary aim was to test the roles of maternal postpartum depression and maternal parenting quality as potential moderators of this predicted relationship, given both empirical and theoretical support for the contributions of maternal postpartum depression and less optimal parenting quality to infant disorganized attachment, as well as diathesis stress models that suggest that prenatal exposure to maternal depression may increase infants' vulnerability to maternal postpartum depression and inadequate parenting (Pluess & Belsky, 2011).

Disorganized Attachment

Disorganized attachment is conceptualized as the breakdown of an otherwise consistent and organized strategy of emotion regulation. This classification emerged from observations of infants who appeared unable to effectively cope with the stress of the Strange Situation Procedure (Main & Solomon, 1990). Although the behaviors of most infants can be classified into one of the well-defined, goal-directed strategies for reducing distress (i.e. secure, insecure avoidant, insecure ambivalent), disorganized infants display an array of contradictory and bizarre responses that are unclassifiable based on these terms. Disorganized behaviors can include (a) simultaneous contradictory behaviors or affects; (b) freezing, stilling, or apparent dissociation; (c) abnormal movements; (d) direct indices of apprehension of the parent; or (e) the complete absence of an apparent attachment strategy (Main & Hesse, 1990). Disorganized behaviors are not simply incoherent or strange behaviors; instead, they are indicators that an infant is unable to utilize organized strategies toward a caregiver when seeking comfort (Kochanska, 2001). Attachment disorganization is not related to constitutional or temperamental traits of the infant (Carlson, 1998), and may be distinguished from neurological signs (Barnett et al., 1999). Moreover, disorganized attachment is specific to a caregiver, with infants being unlikely to be classified as disorganized with their second parent or other caregiver (Lyons-Ruth & Jacobvitz, 2008; Main & Solomon, 1990; van IJzendoorn, Schuengel, & Bakermans-Kranenburg, 1999).

Given the compelling nature of these disorganized behaviors, researchers have examined long-term outcomes of disorganized infants and have generated extensive empirical support for infants classified as disorganized being at elevated risk for the later development of psychopathology, even relative to insecurely attached infants (Kochanska, 2001; van IJzendoorn et al., 1999). Meta-analytic findings support an association between disorganized attachment in infancy and externalizing behavior problems in childhood (Groh, Roisman, van IJzendoorn, & Bakermans-Kranenburg, 2012; van IJzendoorn et al., 1999). In addition, disorganized attachment assessed in infancy (typically between 12 and 18 months), has been associated with higher levels of anger at 33 months of age (Kochanska, 2001), more internalizing problems from grades 1 through 6 (Carlson, 1998), poorer peer interactions and unusual or bizarre behavior in the classroom during middle childhood (Jacobvitz & Hazan, 1999), and higher rates of psychopathology in adolescence (Carlson, 1998). Moreover, the NICHD Study of Early Child Care followed more than 1000 children from birth through preschool, kindergarten, and first grade and found that children who had been classified as disorganized at 15 months displayed more internalizing behaviors compared to children classified as organized (NICHD-ECCRN, 2006). Finally, among children identified by teachers at age 7 as being highly externalizing, 83% had been classified as disorganized during infancy (compared to only 13% of children without externalizing problems) (Lyons-Ruth, Easterbrooks, & Cibelli, 1997).

Of further concern is the finding that rates of disorganization are relatively high even in low-risk (middle income, non-clinical) samples (15%) and even higher in high risk samples (van

IJzendoorn et al., 1999). Twenty-one percent of infants of depressed mothers are classified as disorganized, and this rate only increases when other risk factors are present, including alcohol or drug abuse and child maltreatment (van IJzendoorn et al., 1999). Also of concern is the moderate stability of disorganized attachment classification across infancy and into early childhood, barring major, disruptive family events (van IJzendoorn et al., 1999; Vondra, Shaw, Swearingen, Cohen, & Owens, 2001). Given the high rates of disorganized attachment in infants of depressed mothers and strong evidence for the relation between disorganized attachment and later psychopathology, it is critical to better understand the origins of this phenomenon.

Maternal Antenatal Depression and Infant Disorganization

The fetal programming theory posits that the environment in utero can alter the development of the fetus during sensitive periods, with a permanent effect on the phenotype of the child (Barker, Eriksson, Forsen, & Osmond, 2002; Gluckman & Hanson, 2005). Antenatal depression is one environmental stressor that has the potential to alter fetal development, and may have enduring consequences for disorganization of attachment in children. Rates of depression are relatively high during pregnancy, with 10% of women meeting criteria for major depression and up to 18% showing elevated depressive symptomatology (Marcus, 2009).

The specific pathways through which antenatal depression may contribute to disorganized attachment have not yet been elucidated. However, one possible pathway may be through prenatal exposure to elevations in maternal glucocorticoid levels, which can act on the fetus in two ways: (1) by crossing the placenta directly to impact fetal development, or (2) by constricting uterine blood flow, thereby diminishing the delivery of oxygen and nutrients to the fetus (Gitau, Cameron, Fisk, & Glover, 1998). There is evidence that antenatal maternal depression is associated with elevations in maternal cortisol levels (Field, Diego, & Hernandez-Reif, 2006), although others fail to find this association (Davis et al., 2007; Rouse & Goodman, under review). Animal studies suggest that early glucocorticoid exposure may have lasting effects on the neurodevelopment of offspring, including subsequent higher cortisol levels in infant offspring and offspring behavioral profiles indicative of greater emotionality (Coe et al., 2003; Maccari et al., 2003). There is also accumulating evidence in studies of humans that exposure to elevated levels of cortisol during pregnancy results in alterations of developing fetal neuroregulatory systems, and is associated with regulation problems at the cognitive, behavioral, and emotional levels throughout infancy, childhood, and adolescence (Van den Bergh et al., 2005). Thus, maternal depression during the antenatal period may alter the uterine environment in such a way that a programming effect takes place on the fetal brain, which may interfere with stress regulation in a manner that manifests itself as disorganized attachment.

Although empirical tests of this theoretical model are scarce, a few studies lend support for the association between maternal antenatal depression and infant disorganized attachment. First, higher maternal cortisol levels during late pregnancy were associated with higher cortisol levels in the infants 24 hours after delivery (Lundy et al., 1999). Second, infants with disorganized or insecure attachment have higher cortisol levels following brief separations from their attachment figures compared to secure infants (Hertsgaard, Gunnar, Erickson, & Nachmias, 1995; Spangler & Grossman, 1993). Although the focus of this paper will not be on examining biological mechanisms, these studies provide theoretical support for a potential pathway whereby maternal antenatal depression may be associated with infant attachment disorganization by interfering with the development of stress regulation systems. That is, infants of antenatally depressed mothers may be born with

dysfunctional stress regulatory systems, interfering with their ability to develop organized strategies for coping with stressors like brief separations from their primary caregivers.

One recent study of a large, low-risk, population-based Dutch sample failed to find a predicted association between prenatal maternal depressive symptoms and infant attachment disorganization at 14 months (Tharner et al., 2012). However, the authors stress that a likely explanation for the absence of this association was that prevalence of lifetime history of depression as well as severity of prenatal depressive symptoms in this sample were very low (12.3% of women had suffered a depressive episode at some point during their life, and only 3.5% reported high depression symptoms during pregnancy). Thus, one conclusion of this study was that nonclinical levels of depressive symptoms during pregnancy may not be severe enough to impact infant-mother attachment more than one year later (Tharner et al., 2012). The current study adds to the literature by addressing the question of whether higher levels of antenatal depressive symptoms in a sample of women who had all experienced a major depressive episode during their lifetime are associated with infant attachment disorganization.

Maternal Postpartum Depression, Parenting Quality, and Infant Disorganization

There is growing evidence that the early postnatal period presents critical opportunities for exacerbating or ameliorating the effects of prenatal stress on infant development (Glover, 2011). Among infants of antenatally depressed mothers, who may be born with dysfunctional stress regulatory systems, exposure to maternal depression in the postpartum may be crucial in terms of either intensifying or alleviating the newborn's challenges. It is well known that depression is an episodic disorder and that one of the strongest predictors of postpartum depression is depression during pregnancy (Leigh & Milgrom, 2008; O'Hara & Swain, 1996). Thus, many children are dually exposed. Postpartum depression, at least if severe and chronic, has been associated with disorganized attachment (Martins & Gaffan, 2000). In fact, infants and preschool children with disorganized attachment have been found to have mothers with more chronic and severe levels of depressive symptoms compared to children with organized attachment strategies (Teti, Gelfand, Messinger, & Isabella, 1995). Yet researchers have not yet tested a model that considers the role of both pre- and post-natal depression in predicting infant disorganization.

Most theory and research delving into the association between postpartum depression and infant disorganization has implicated parenting qualities associated with depression in mothers. Depression in mothers has been associated with parenting of infants that is negative (including hostile), less responsive, disengaging (Gelfand & Teti, 1990; Lovejoy, Graczyk, O'Hare, & Neuman, 2000) and at times inconsistent (Lyons-Ruth, Lyubchik, Wolfe, & Bronfman, 2002). Depressed mothers have more difficulty reading their infants' affective communications and in responding appropriately, leading to mismatches between maternal and infant affective states (Tronick & Reck, 2009). Meta-analytic reviews of associations between positive parenting and depression in mothers have revealed that the association is specific to families with socioeconomic disadvantage (Lovejoy et al., 2000). Nonetheless, levels of optimal parenting would be expected to vary even among non-disadvantaged families. Thus, parenting quality may moderate associations between prenatal depression and infant disorganized attachment such that less optimal parenting exacerbates the risk for disorganized attachment among infants who are exposed to antenatal depression.

Independent of attention to perinatal depression, a central question has been whether and how mother-infant interactive processes are related to disorganization (Main & Hesse, 1990). Overall, mothers of infants classified as disorganized demonstrate the least optimal

parenting behaviors during interactions with their children compared to mothers of children with organized attachments (Lyons-Ruth, Repacholi, McLeod, & Silva, 1991). Meta-analytic findings support a small but significant association between infant disorganization and parental insensitivity ($r = .10$, $p = .004$) (van IJzendoorn et al., 1999). More specifically, the mother-infant interactive process of disrupted affective communication from the mother contributes to attachment disorganization (Lyons-Ruth, Bronfman, & Parsons, 1999). These findings are consistent with theory suggesting that parental behavior must be responsive enough that an organized strategy is effective for the infant. A mother's repeated failure to alter her caregiving behavior toward her infant in the face of clear and repeated cues by the infant would leave the infant without an effective means of regulating arousal, which could contribute to attachment disorganization. This association between maternal disrupted affective communication and attachment disorganization has received consistent support in the empirical literature (Goldberg, Benoit, Blokland, & Madigan, 2003; Grienemberger, Kelly, & Slade, 2005; Madigan, Bakermans-Kranenburg, et al., 2006; Madigan, Moran, & Pederson, 2006) (also see Gervai et al., 2007, although the association was specific to infants with DRD4 gene polymorphism).

Thus, both mothers with depression and mothers of disorganized infants exhibit parenting behaviors with their infants that are characterized by low levels of sensitivity and problems with affective communication. Given these similarities, it is important to explore the potential moderating roles of both maternal postpartum depression and parenting quality in the association between antenatal depression and infant disorganized attachment. Given evidence for the importance of parenting behaviors in the emergence of disorganized attachment in infants, more optimal parenting behaviors (e.g., displaying high levels of sensitivity and positive affect toward the infant) may serve as a protective factor for infants made vulnerable by their exposure to maternal depression in utero. Less optimal parenting, conversely, could exacerbate the effects of infants' exposure to maternal antenatal depression and increase the likelihood of these infants being classified as disorganized. Preventive interventions have provided evidence for the potential protective role of high quality parenting among disorganized infants. A meta-analysis of 15 interventions designed to prevent infant disorganized attachment found that interventions that focused on increasing maternal sensitivity were effective in reducing attachment disorganization ($d = 0.24$) (Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2005). Moreover, in a sample of women who had experienced a major depressive episode at some point since the birth of their child, a randomized preventive intervention designed to optimize the quality of the mother-child relationship was effective in decreasing rates of disorganized attachment in their 36-month-old children (Toth, Rogosch, Manly, & Cicchetti, 2006). It should be noted, however, that these studies did not take prenatal depression into consideration.

Hypotheses

The primary aim of this study was to examine associations between maternal antenatal depression and infant disorganization at 12 months. This question is tested in a sample of women with lifetime histories of depression, a risk factor that is associated with an increased likelihood of developing depression during pregnancy. It was hypothesized that exposure to higher levels of maternal depressive symptoms during the antenatal period will be associated with higher rates of disorganized attachment in infants at 12 months.

The second aim of this study was to test the role of two purported moderators of this predicted relationship: postpartum maternal depression and postpartum parenting quality. Although pathways have been found between maternal postpartum depression and infant disorganization, and between maternal parenting quality and infant disorganization, few researchers have tested a model that considers the role of both prenatal depression and these

postpartum variables in predicting infant disorganized attachment. Consistent with diathesis-stress models such as gene-environment associations, we propose that infants prenatally exposed to their mothers' depression will be more vulnerable to exposure to their mothers' symptoms of depression in the postpartum and to inadequate parenting. Specifically, we predicted that the association between maternal antenatal depression and infant disorganization will be stronger for infants also exposed to high levels of maternal depression in the first year postpartum. We also hypothesized that the association between maternal antenatal depression and infant disorganization will be stronger for infants exposed early to less optimal parenting. Parenting quality was examined at three months of age, a developmental period when infants begin to actively participate in affective exchanges with the caregiver. Because interactions are still largely orchestrated by the caregiver, young infants are highly sensitive to the nature of the exchange (Sroufe, 1996). In contrast to older infants, three months is also an age before most infants have started grasping objects, and thus are dependent on the caregiver for sensory stimulation (Völker, 2005).

Method

Participants

Participants were 79 women who met DSM-IV (American Psychiatric Association, 1994) criteria for at least one major depressive episode (MDE) before pregnancy. Eligible women were pregnant with their first child, married or cohabiting, having a medically uncomplicated pregnancy, age 19 or older, no more than 6 months pregnant on entry into the study, and either European-American or African-American (the major racial/ethnic groups in the area from which the sample was recruited). Exclusion criteria were: (1) active suicidality; (2) substance use disorders, schizophrenia, psychotic, or bipolar disorders; and (3) positive urine toxicology screen for drug or alcohol use. Participants were recruited from obstetrical offices (65%) or through media announcements (35%). Eligibility was determined through a two-stage process. First, a brief phone depression screen determined if the women were likely to have ever experienced a depression episode. Second, eligible women were invited to the lab where, after giving informed consent, they were administered a diagnostic interview to determine if they met DSM-IV criteria for at least one lifetime MDE. Participants had a mean age of 30.3 years ($SD = 5.4$, range 19–42), and had a median household income of between \$66,000 and \$70,000 (range \$10,000 to over \$100,000). Most (70%) were college graduates, 73% were married, and 29% were African-American and 71% were European-American. Fifty-four percent of the infants were female and 46% were male.

Procedure

Participants completed a psychiatric diagnostic interview at the first visit during pregnancy to determine eligibility for the study and then completed a questionnaire measure of depression symptom levels (the Beck Depression Inventory-II) on a monthly basis from their entry into the study (typically the third or fourth month of pregnancy) through 6 months postpartum and then again at 12 months postpartum. Women completed the BDI-II on average 5.10 times ($SD = 1.53$) during pregnancy and 7.71 ($SD = 1.19$) times during the first year postpartum.

At infant age 3 months, mothers and infants were videotaped in 5-minute face-to-face play interactions in the lab. Mothers were provided a box of age appropriate toys and instructed to play with their infant as they would at home, in order to observe mothers' spontaneous affective behavior toward their infants as well as mothers' warmth and sensitivity when responding to infants' cues. Interactions were videotaped and then rated for two indicators of maternal parenting quality: warmth and positive regard. Raters were undergraduate

research assistants who had been extensively trained but were unaware of mothers' depression scores. Training involved each member of the rating team independently rating free-play segments from a previous study and then discussing any disagreements with a senior clinical psychologist (the second author) until the group reached a consensus. The rating period began once the team members consistently demonstrated high inter-rater reliability (disagreeing by no more than one point, on no more than two scales). Each week a subset of segments was randomly selected to also be rated by another team member in order to assess reliability regularly throughout the study. A total of 23.8% of the segments were rated by a second observer.

At infant age 12 months, mothers returned to the laboratory with their infants and participated in the Strange Situation procedure to assess infant attachment classifications (Ainsworth, Blehar, Waters, & Wall, 1978). This procedure consists of eight episodes presented in a standard order and is described in more detail below. Video recordings of the Strange Situation were then sent to expert coders at the Institute for Child Development at the University of Minnesota, who classified each infant into disorganized or not, blind to any other data on the mother or infant.

Measures

Structured Clinical Interview for DSM-IV Axis I Disorders-Patient Edition

(SCID-I/P)—The SCID (First, Spitzer, Gibbon, & Williams, 2002) was administered at the initial visit, and determined if the women met the eligibility criteria of having had a history of at least one major depressive episode (MDE) prior to pregnancy. All interviews were conducted by a master's level clinical psychologist, psychiatric nurse, or social worker and audio recorded for purposes of establishing inter-rater reliability. A licensed clinical psychologist, blind to other information on the participants, listened to all interviews, reviewed the notes, and derived diagnoses.

Beck Depression Inventory-II—To assess current maternal depressive symptom severity levels, the Beck Depression Inventory-II (BDI-II) (Beck, Steer, & Brown, 1996) was administered. The BDI-II is a 21-item scale assessing the intensity of depressive symptoms in the previous 2 weeks on a scale of 0 to 3, and has strong evidence of reliability and validity in clinical and nonclinical samples including during pregnancy (Holcomb, Stone, Lustman, Gavard, & Mostello, 1996; Steer, Scholl, & Beck, 1990). Scores range potentially from 0 to 63, with higher scores indicating more severe depression; scores greater than 13 indicate at least mild depression (Beck et al., 1996).

Mean BDI-II scores were calculated separately for pregnancy and the postpartum. During pregnancy, women with higher depressive symptoms completed fewer BDI-II scales ($r = -.28, p < .05$), suggesting that they either started the study later or missed more visits relative to participants with lower levels of depressive symptoms. Number of BDI-II scores and mean BDI-II scores were not related during the postpartum ($r = -.00, p = .99$). Women on average reported a moderate level of depressive symptoms during pregnancy ($M = 9.6, SD = 5.6$) and during the postpartum ($M = 6.9, SD = 5.1$). At the same time, 43% exceeded the clinical cut off for clinically significant levels of depression at least once in pregnancy and 43% exceeded the cutoff at least once during the first year postpartum.

Maternal Parenting Quality—In order to best capture the parenting qualities of sensitivity and disrupted affective communication, which have been found to be associated both with depression in mothers and with disorganized attachment in infants, mothers' interactions during face-to-face play with their infants were rated on two scales, borrowing from Cohn, Campbell and colleagues (1990) and Clark (1999). First, maternal warmth

reflects the quality of the mother's affection toward her child, and includes the extent to which the mother expresses affection toward her baby in a pleasurable way. This scale captures warmth expressed in vocal affect or content, facial expression, and direct handling. Maternal warmth was rated on a 5-point Likert scale. A score of 1 corresponded to a mother whose behavior generally lacked tenderness, caring, and affection throughout the interaction; a score of 2 corresponded to a mother who displayed little warmth; a score of 3 corresponded to a mother who usually expressed some warmth during the interaction, but on some or many occasions her behavior lacked tenderness, caring, and affection; a score of 4 corresponded to a mother who expressed much warmth during the interaction; and a score of 5 corresponded to a mother whose behavior during the interaction always expressed warmth, and who was very tender, caring, and affectionate toward her infant.

Second, ratings of maternal positive regard for the child reflect both the quantity and quality of positive regard, which is indicated by the following actions: (a) speaking in a warm tone of voice; (b) hugging or other expressions of physical affection; (c) an expressive face; (d) smiling; (e) laughing with the child; (f) enthusiasm about the child; (g) praising the child; and (h) general enjoyment of the child. A mother was rated high on positive regard when she listened, watched attentively, looked into the child's face when talking to him or her, displayed affectionate physical contact, and was playful with her child during the interaction. This variable was rated on a 4-point Likert scale. A score of 1 was given to mothers for whom positive regard for the child was not at all characteristic of their behavior. These mothers often expressed flat or negative affect toward the child, or expressed positive emotions in inappropriate situations (e.g., when her child hurt himself). A score of 1 on positive regard also corresponded to mothers who were expressionless or displayed flat or negative affect. A score of 2 was given to mothers for whom positive regard was minimally characteristic. These mothers displayed infrequent or weak signals of positive regard, and the intensity and frequency of the behavioral indicators listed above were low. A score of 3 was given to mothers for whom positive regard was moderately characteristic. This rating was given to mothers who predominately displayed positive regard during the interactions with their infants, but the mother was not strongly and consistently positive at all points during the interaction. A score of 4 corresponded to mothers who were exceptionally positive in their facial and vocal expressions and behavior directed at the infant, and their affect was both positive and spontaneous. These mothers displayed a range of expressions and behaviors, all of which were clearly positive, and also displayed clear "delight" in their infant.

The scores of maternal warmth and positive regard were highly correlated ($r = .78, p < .001$). Because these items were on different scales, the scores for each participant were standardized and the mean of these two scores was used to indicate maternal parenting quality. Higher scores (e.g., high levels of warmth and positive regard toward the infant) indicate more optimal parenting.

Strange Situation—The Strange Situation (Ainsworth et al., 1978) is the most widely used procedure for measuring the quality of attachment between 1 and 2 years of age. The Strange Situation is a 24-minute video recorded laboratory procedure that involves observing the infant in a comfortable but unfamiliar room with the mother, with the mother and a stranger, with the stranger, and alone across multiple 3-minute episodes. The infant's attachment security is coded based on his or her behavior during reunions with the mother. Infants were assigned one of the following primary classifications: (A) Insecure-avoidant; (B) Secure; (C) Ambivalent-Resistant; and (D) Disorganized. Disorganized infants were also given a secondary attachment classification (A, B, or C). Based upon these classifications a dichotomous variable was created that identified infants who were classified as disorganized as their primary attachment category versus infants classified as organized. In this sample

32% of infants ($n = 25$) were classified as disorganized for their primary attachment category. This percentage is in line with rates of disorganized attachment found in other at-risk or clinical groups (van IJzendoorn et al., 1999). Regarding secondary attachment classifications, 11 of the Disorganized infants were classified as Disorganized/Secure (B) and 14 were classified as Disorganized/Insecure (A or C).

Results

Preliminary Analyses

Analyses were first conducted to determine if any demographic variables were associated with infant attachment disorganization at 12 months. The following demographic variables were tested: maternal age, maternal race (African American, Caucasian), marital status (married, not married), household income, maternal education, and infant gender. Antidepressant usage was also examined for associations with attachment disorganization ($n = 11$ [14%] mothers used an antidepressant for at least 1 month during pregnancy). The only significant association found was between infant gender and disorganization, $\chi^2(1, N = 79) = 5.01, p < .05$. Boys were more likely to be classified as disorganized compared to girls (44%, $N = 16$ versus 21%, $N = 9$). Infant gender was subsequently controlled for in all analyses. Correlations among study variables are reported in Table 1. Correlations with the dichotomous variable attachment disorganization are point bi-serial correlations; all others are Pearson's correlations. Consistent with Lovejoy and colleagues' (Lovejoy et al., 2000) finding that associations between maternal depression and positive parenting are moderated by socioeconomic status, in this mid- to high SES sample maternal depressive symptoms during pregnancy and during the postpartum were not significantly correlated with maternal parenting quality.

Hypotheses Testing

To test the first hypothesis, a two-way analysis of variance was conducted to examine whether infants classified as disorganized had mothers with higher levels of depressive symptoms during pregnancy compared to infants classified as organized. Infant gender was also included as an independent variable in order to test for a potential interaction effect, given that attachment disorganization was found to differ by gender. The interaction effect between attachment disorganization and infant gender was not statistically significant, $F(1, 79) = .01, p = .90$. The main effect for gender was also not significant, $F(1, 79) = .01, p = .99$. Consistent with the first hypothesis, there was a statistically significant main effect for attachment disorganization, $F(1, 79) = 7.01, p < .01$, eta-squared = .09. Disorganized infants had mothers with higher mean depressive symptoms during pregnancy ($M = 12.0, SD = 5.9$) compared to mothers of infants not classified as disorganized ($M = 8.4, SD = 5.0$).

Although comparing secure and insecure infants was not a central focus of this paper, an independent samples t-test was conducted to examine whether maternal antenatal depressive symptoms differed for infants classified as Disorganized/Secure and those classified as Disorganized/Insecure. There was no significant difference in maternal antenatal depressive symptoms for Disorganized/Secure ($M = 10.81, SD = 5.00$) and Disorganized/Insecure ($M = 12.96, SD = 6.55$), $t(23) = .90, p = .38$. In order to test the second hypothesis, that the association between maternal antenatal depression and infant disorganization would be stronger for infants also exposed to high levels of maternal postpartum depression, a logistic regression equation was tested. This model assessed the impact of mean depressive symptoms during pregnancy, mean depressive symptoms during the first year postpartum, and the interaction between prenatal and postpartum depression on the likelihood that infants would be classified as disorganized at 12 months. Infant gender and number of BDI-II scores during pregnancy were entered as control variables. The full model containing the

three predictors and the two control variables was statistically significant, $\chi^2(5, N = 79) = 13.44, p < .05$, indicating that the model was able to distinguish between infants classified as disorganized and infants classified as organized. The model as a whole explained between 16.0% (Cox and Snell R square) and 22.4% (Nagelkerke R squared) of the variance in disorganized attachment status, and correctly identified 72.7% of cases. As shown in Table 2, only one of the three predictor variables, maternal depressive symptom levels during pregnancy, made a unique statistically significant contribution to the model. The interaction between prenatal and postnatal depression was not significant in this model, and thus the second hypothesis was not supported.

In order to test for potential mediation, post hoc analyses were conducted that estimated the indirect effect of prenatal depressive symptoms on infant attachment disorganization through postpartum depressive symptoms. This was calculated using a macro developed by Preacher and Hayes (2004) that provides a test of direct and indirect effects on a dichotomous outcome using the Sobel test, as well as a percentile-based bootstrap confidence interval for estimating indirect effects. In this test the bootstrap resamples were set at 5000. The indirect effect of $-.03$ was not found to be significant ($p = .38$). This was supported by the fact that the bootstrapped estimates of the 95% confidence interval $[-.13, .05]$ contained the value zero. Thus, there was no evidence that the association between maternal antenatal depressive symptoms and infant disorganized attachment was mediated by maternal postpartum depressive symptoms.

To test the third hypothesis, that the association between maternal antenatal depression and infant disorganization would be stronger for infants also exposed to less optimal parenting during the early infancy period, a second logistic regression equation was tested. This model assessed the impact of mean depressive symptoms during pregnancy, maternal parenting quality at 3 months, and the interaction between maternal prenatal depressive symptoms and maternal parenting quality on the likelihood that infants would be classified as disorganized at 12 months. In addition, infant gender and number of BDI-II scores assessed during pregnancy were entered as control variables. The full model containing the three predictors and the two control variables was statistically significant, $\chi^2(5, N = 79) = 16.54, p < .01$, indicating that the model was able to distinguish between infants classified as disorganized and infants classified as organized. The model as a whole explained between 21.0% (Cox and Snell R square) and 29.3% (Nagelkerke R squared) of the variance in disorganized attachment status, and correctly identified 74.3% of cases. As shown in Table 3, all three predictor variables (maternal prenatal depressive symptoms, maternal parenting quality, and the interaction between the two) made unique statistically significant contributions to the model.

In order to explore the nature of this significant interaction, the maternal parenting quality variable was recoded into a dichotomous variable. Mothers with mean standardized parenting quality scores below zero ($n = 26$) were categorized as displaying less optimal parenting (i.e., lower levels of warmth and positive regard toward the infant) and mothers with mean standardized parenting quality scores above zero ($n = 49$) were categorized as displaying more optimal parenting (i.e., higher levels of warmth and positive regard toward the infant). This cutoff was chosen in an attempt to identify clinically relevant levels of less optimal parenting. Independent logistic regressions were then calculated to examine associations between maternal antenatal depression and child disorganized attachment for the two parenting groups (less optimal and more optimal parenting). Consistent with the third hypothesis, results revealed that exposure to higher levels of maternal depressive symptoms during pregnancy was only associated with higher rates of infant disorganized attachment when maternal parenting at 3 months was less optimal ($B = .316, p > .05$). For children who experienced more optimal parenting at 3 months, exposure to maternal

depressive symptoms during the prenatal period was not associated with higher rates of disorganized attachment at 12 months ($B = .010, p = .869$). Examining these results in a different way, maternal depressive symptom levels during the antenatal period were significantly higher for disorganized infants whose mothers displayed less optimal parenting behaviors relative to disorganized infants of mothers with more optimal parenting and relative to infants who were not disorganized, regardless of mothers' parenting quality (see Figure 1 for a depiction of these results).

Discussion

The primary aim of this study was to examine associations between maternal antenatal depressive symptoms and infant disorganized attachment at 12 months. The first hypothesis, that infants classified as disorganized would have mothers with higher levels of depressive symptoms during pregnancy compared to infants classified as organized, was supported. To our knowledge, this was among the first studies to examine longitudinal pathways between antenatal maternal depression and infant attachment disorganization. These findings lend support to the fetal programming theory, which posits that the environment in utero can alter the development of the fetus during sensitive periods, with prolonged effects on the phenotype of the infant (Barker et al., 2002; Gluckman & Hanson, 2005). In this case, maternal depression during pregnancy appears to set infants on a course for attachment disorganization after birth. Although not tested in this study, one possible explanation for this finding is that developing fetal neuroregulatory systems are altered in some way through exposure to maternal depression in utero, resulting in behaviors associated with attachment disorganization. Taken together with Tharner et al.'s (2012) null findings in a low-risk, population-based sample, the results of this study also suggest that maternal depressive symptoms during pregnancy may be associated with infant attachment disorganization only when they are at least moderate in severity and perhaps when they are a recurrence of prior depressive episodes. Given that previous depression is one of the strongest predictors of antenatal depression (Rich-Edwards et al., 2006), pregnant women with histories of depression, such as those studied here, are an important population to consider in evaluating risk of disorganized attachment,

A secondary aim of this study was to examine the roles of two qualities of the postpartum environment as potential moderators of the predicted association between antenatal maternal depression and infant attachment disorganization. The early postnatal period has been recognized as a critical window for exacerbating or ameliorating the effects of prenatal stress on infant development (Glover, 2011). Thus, the second hypothesis tested was that the association between maternal antenatal depressive symptoms and infant attachment disorganization would be stronger for infants also exposed to high levels of maternal depression in the first year postpartum. This hypothesis was not supported; instead, maternal antenatal depressive symptoms predicted infant attachment disorganization regardless of maternal levels of postpartum depressive symptoms.

Furthermore, results of this study revealed that, in contrast to antenatal depressive symptoms, there was no direct association between maternal postpartum depressive symptoms and infant attachment disorganization. Although previous meta-analyses found associations between maternal postpartum depression and infant disorganized attachment, these associations were strongest when maternal depression was severe and chronic (Martins & Gaffan, 2000). Prior studies also did not take into account antenatal levels of depressive symptoms, which are a known risk factor for postnatal depression (O'Hara & Swain, 1996). In this sample, women reported a moderate level of depressive symptoms, on average, during the postpartum period. Consistent with the Martins and Gaffan (2000) findings, our results suggest that moderate levels of postpartum depression are not significantly associated

with infant disorganized attachment. A key finding from our study, however, is that even in the presence of moderate levels of postpartum depression, maternal antenatal depression significantly predicted infant attachment disorganization.

The third hypothesis tested in this study was that the association between maternal antenatal depressive symptoms and infant attachment disorganization would be stronger for infants exposed to less optimal parenting. This hypothesis was supported. As expected, even in light of its non-significant associations with maternal depression, parenting quality was found to play a role in infant attachment disorganization. For infants who had experienced more optimal parenting at 3 months, exposure to maternal depressive symptoms during the prenatal period was not significantly associated with higher rates of disorganized attachment at 12 months. In contrast, for infants who had experienced less optimal parenting at 3 months, exposure to antenatal maternal depressive symptoms was significantly associated with higher rates of disorganized attachment. These results highlight the early postnatal period, and specifically early maternal parenting quality, as an opportunity to ameliorate the negative effects of prenatal maternal depression on infant attachment disorganization. These results also lend support to previous findings that the quality of early mothering can either attenuate the effects of prenatal stress on infant development (Kaplan, Evans, & Monk, 2008) or else exacerbate them (Bergman, Sarkar, Glover, & O'Connor, 2008). The fact that maternal parenting quality at 3 months moderated the association between maternal prenatal depressive symptoms and infant disorganization suggests that this stage in early infancy may be particularly important in development. During this phase, infant regulatory systems are highly influenced by experience, including positive interactions with the mother.

Future Research, Strengths, and Limitations

Two notes of caution have been raised when interpreting findings that prenatal risk factors are associated with adverse consequences on fetal development (Thapar & Rutter, 2009). First, it has been recognized that prenatal risks tend to be associated with postnatal risks, and that postnatal risk may actually mediate associations between prenatal risk and infant outcomes. One of the primary strengths of this study was that it included measures of both antenatal and postnatal maternal depression. In post-hoc analyses for this study, postnatal maternal depression was tested as a mediator of the association between prenatal maternal depression and infant attachment disorganization and no evidence of mediation was found.

Second, it has been suggested that associations between prenatal risk factors and offspring outcomes arise because of unmeasured confounders, including maternally transmitted inherited factors (Thapar & Rutter, 2009). In the largest molecular genetics study on attachment to date, Luijk et al. (2011) tested main and interaction effects of several candidate genes (DRD4, DRD2, COMT, 5-HTT, OXTR) on attachment security and disorganization and found no replicable main effects. However, they did find evidence for a trace molecular effect for the codominant risk model for COMT Val158Met, as children with the Val/Met genotype showed somewhat higher disorganization scores. Although not included in the current study, future research could test the effects of prenatal maternal depression on infant disorganized attachment independent of the relationship between maternal and offspring genomes using genetically sensitive designs.

Another strength of this study was that all of the mothers had lifetime histories of depression, and thus were at elevated risk for perinatal depression relative to general population samples (O'Hara & Swain, 1996). An additional strength of this study was that, aside from mothers' risk for perinatal depression, this sample of mothers was selected to be low-risk based on socio-demographic factors. This eliminated the possibility that the stressors known to be associated with poverty or single- or teenaged-parenting, for example, might partially account for significant findings. At the same time, the sample was ethnically

diverse (30% of the women were African-American, commensurate with their representation in the geographic region from which we sampled). A final strength was in the longitudinal design of the study; maternal depression was measured prospectively through pregnancy, parenting quality was measured at a critical period in early infancy, and attachment disorganization was measured at 12 months postpartum.

One potential limitation of this study was that a larger proportion of males were classified as disorganized compared to females in this sample. Although this is consistent with several research studies, including that of Lyons-Ruth et al. (1997), it is not consistent with results of meta-analyses that failed to find a significant association between sex and attachment disorganization (van IJzendoorn et al., 1999). It is possible that this association differs in at risk samples; thus, the results of this study may not be generalizable to other samples, including those who are at low risk based on maternal depression history. Furthermore, because all women in this study had a lifetime history of depression and were not at risk based on socio-demographic variables, data from this study should not be generalized to samples of women at lower risk for developing perinatal depression or at high socio-demographic risk. It should be noted, however, that there was a high degree of variability in all study variables, including that of maternal depressive symptoms.

An additional limitation is that this study did not include the examination of mechanisms that may help explain the association found between maternal antenatal depression and infant disorganization. Potential mechanisms that could be tested in future research include maternal cortisol levels during pregnancy, infant cortisol levels during the first year of life, and additional measures of maternal parenting quality. It may also be important to consider the role of maternal representations and expectations in the link between antenatal depression and child outcomes (via parenting behavior). For example, Berlin et al. (2011) found that the effects of Early Head Start on positive parenting outcomes were moderated by maternal attachment avoidance and anxiety, such that more positive program effects were found for mothers with lower baseline avoidance and anxiety. The finding that mothers with positive thoughts and feelings about close relationships are more likely to benefit from positive parenting interventions may be particularly important to take into account when designing programs to enhance parenting quality in families at risk for infant disorganization due to maternal history of depression.

Finally, although these findings suggest that sensitive parenting during the first few months postpartum has the potential to buffer the effects of maternal antenatal depression on infant attachment disorganization, future research must be conducted to specifically test whether this period serves as a critical window in development during which sensitive parenting is able to protect children of antenatally depressed mothers from the development of attachment disorganization.

Summary and Conclusions

In summary, these results support an association between maternal antenatal depression and infant attachment disorganization at 12 months, suggesting a role of antenatal depression in initiating a developmental pathway toward disorganized attachment. However, exposure to warm, positive parenting early in infant life was found to reduce the likelihood of enduring negative outcomes for infants, specifically in regards to organization of attachment. Results of this study offer a number of clinical implications. First, as the antenatal period appears to be one important stage of development in regards to disorganized attachment, a continued focus of obstetricians and clinicians must be to alleviate depressive symptoms in pregnant women, with a special focus on women with histories of depression. Moreover, researchers and clinicians should consider that low or moderate levels of postpartum depression may mask the risks posed to infant development by prenatal depression. Second, these results

underscore the importance of intervening in the early postnatal period for mothers who had experienced high levels of depressive symptoms or depressive diagnoses during pregnancy. Specifically, the parenting behaviors of antenatally depressed mothers should be targeted during the first few months postpartum, when neuroplasticity is greatest and infants may have the greatest potential for gain (Johnson, 2005; Shonkoff, Boyce, & McEwen, 2009). Overall, the results of this study suggest that enhancing maternal parenting behaviors during this early period in development has the potential to alter pathways to disorganized attachment among infants exposed to antenatal maternal depressive symptoms, which could have enduring consequences for child wellbeing.

Acknowledgments

This research was supported by National Institute of Mental Health grant number 1P50MH58922-01A1.

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Figure 1.

Maternal depressive symptoms levels during the antenatal period were found to be significantly higher for disorganized infants whose mothers displayed less optimal parenting behaviors at 3 months postpartum relative to disorganized infants of mothers with more optimal parenting and relative to infants who were not disorganized, regardless of mothers' parenting quality.

Table 1

Correlations between Study Variables

	2	3	4
1. Maternal antenatal depressive symptoms	.55***	-.16	.31**
2. Maternal postpartum depressive symptoms		.01	.18
3. Parenting quality			-.08
4. Attachment disorganization			

Table 2

Summary of Logistic Regression Analysis Predicting Attachment Disorganization (N = 79)

	B	SE B	e^B
Control Variables			
Infant Gender	1.07	.54	2.93 *
Number of BDI-II Scores in Pregnancy	.14	.20	1.15
Predictor Variables			
Maternal Antenatal Depressive Symptoms	.21	.09	1.23 *
Maternal Postpartum Depressive Symptoms	.00	.12	.99
Antenatal X Postpartum Depressive Symptoms	-.01	.01	.99
Constant	-4.75	1.74	.01 **

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

Table 3

Summary of Logistic Regression Analysis Predicting Attachment Disorganization (N = 79)

	B	SE B	e^B
Control Variables			
Infant Gender	1.23	.60	3.41 *
Number of BDI-II Scores in Pregnancy	.20	.22	1.22
Predictor Variables			
Maternal Antenatal Depressive Symptoms	.14	.07	1.15 *
Maternal Parenting Quality	2.27	1.13	9.67 *
Antenatal Depression X Parenting Quality	-.21	.10	.81 *
Constant	-5.19	1.92	.01 **

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