Published in final edited form as:

Child Dev. 2018 November ; 89(6): 2118–2135. doi:10.1111/cdev.12895.

Family Context Moderates the Association of Maternal Postpartum Depression and Stability of Infant Temperament

Stephanie H. Parade^a, Laura Marie Armstrong^b, Susan Dickstein^a, and Ronald Seifer^a

^aE. P. Bradley Hospital and the Warren Alpert Medical School of Brown University

^bThe University of North Carolina at Charlotte

Abstract

Maternal postpartum depression, maternal sensitivity, and family functioning were examined as predictors of the stability of observed infant temperament over the first 30 months of life (N = 147 families). Eight observations at 8, 15, and 30 months postpartum were used to assess infant temperament. Structured clinical interviews were used to assess maternal depression, and observational assessments were used to assess family functioning and maternal sensitivity. Family context moderated the effect of maternal depression on change in infant temperament. Maternal depression was associated with change in infant temperament when maternal sensitivity was low, but not when maternal sensitivity was high. Family functioning similarly moderated these links. Results underscore the centrality of the family context in shaping child behavior over time.

Keywords

temperament; postpartum depression; family context; longitudinal; infancy

Recent work has defined temperament as a child's basic disposition in the areas of attention, activity, affectivity, and self-regulation that emerges early in life and is shaped by the complex interactions among genetics, biology, and the environment (Shiner, Buss, McGlowry, Putnam, Saudino, & Zentner, 2012). Although there has been much debate over how to characterize temperament, it is well-established that individual differences in infant temperament are associated with children's later social-emotional and behavioral functioning, and have clear implications for children's mental health (see Sanson, Hemphill, & Smart, 2004 for a review). A child's temperament is thought to develop as a result of biological maturation and in response to transactions between the child and her environment, particularly within the caregiving context. However, what remains unclear is how different contextual factors work in concert to contribute to stability and change in temperament across development. This study seeks to address these issues utilizing a longitudinal design to determine how maternal postpartum depression, maternal sensitivity, and family functioning jointly influence observed infant temperament from infancy to toddlerhood.

Conceptualization of Temperament

Historically, the two main approaches to operationalizing temperament have been based on behavioral style (Thomas, Chess, Birch, Hertzog, & Korn, 1963) or the expression and regulation of primary emotions (Goldsmith & Campos, 1982). Behavioral style refers to the way in which the infant responds to a variety of everyday activities. In this approach, the primary concern is understanding how the infant generally behaves across multiple settings within the natural environment, including within the caregiving context. Aspects related to the situational context in which the behavior is observed are generally of less concern. This is in contrast with a more emotion-focused approach to temperament. When the expression of emotion is considered, temperament behaviors are interpreted within a conditional framework whereby behavior is understood within the context of environmental constraints. The assessment of temperament using the emotion expression framework often involves the activation of an emotion system, such as fear, distress, or anger, and the observation of behavior in response to the selected emotion-eliciting situation.

More recent theoretical approaches to temperament derive from the behavioral style and emotion focused perspectives. For example, Rothbart and colleagues integrate biological and environmental influences on temperament in order to understand a child's biological reactivity and self-regulation (Rothbart & Derryberry, 1981). This work has led to the hierarchical organization of the various aspects of temperament into three broad dimensions, negative affect, effortful control, and surgency (Rothbart & Bates, 2006). Effortful control is one of the most studied dimensions, and this work has contributed to a particular emphasis on the maturation of executive attention systems as one of the mechanisms by which temperament develops (Posner & Rothbart, 2000). In addition, inhibition to novelty has emerged as a robust predictor of childhood outcomes that is tightly linked to physiology (Garcia Coll, Kagan, & Reznick, 1984). Children are classified as behaviorally inhibited based on motor activity, distress, and wariness in response to novel situations (Fox, Henderson, Marshall, Nichols & Ghera, 2005). In contrast, children who show high levels of positive affect, sociability, and bold behavior are classified as uninhibited or exuberant (Putnam & Stifter, 2005). A key issue across these approaches is the way in which the caregiving context impacts stability and change in child temperament over time.

We utilize a behavioral style approach for this study and focus on understanding mean-level stability and change in temperamental difficulty within the caregiving context over infancy and toddlerhood. We are interested in infant temperament behaviors across different naturalistic settings, including settings in which the infant is alone, in close proximity to mother, and during caretaking situations. We did not attempt to activate any particular emotion or determine the content or motivation of the temperament behaviors. Recent work drawing from the behavioral style approach and using person-centered analytic techniques have found support for the construct of temperamental difficulty, although it may be labeled as "undercontrolled" (Caspi & Shiner, 2006), "resistant to control" (Bates, Pettit, Dodge, & Ridge, 1998), or "high maintenance" (McClowry, 2002). By using dimensional indicators of multiple temperament traits to form a meaningful construct, we also account for the co-occurrence among temperament dimensions. Temperamental difficulty is composed of a constellation of temperament traits, such as high activity, negative mood, low approach, and

high distractibility, and is associated with a host of negative outcomes, including internalizing and externalizing problems and poor social competence (Sanson et al., 2004).

Differences in the Stability and Trajectory of Temperament

Although stability of child behavior has traditionally been considered a hallmark of temperament, prior research examining both rank-order stability (stability or change of an individual's ranking within a group over time) and mean-level stability (stability or change of the average score for a group over time) has demonstrated changes in temperament across development. Rank-order stability estimates of temperament over infancy and early childhood are low to moderate in magnitude, with estimates ranging from .34 to .52 (Parade, Dickstein, Schiller, Hayden, & Seifer, 2015; Roberts & DelVecchio, 2000). This suggests that approximately 75% of the developmental variance in infant temperament remains unexplained and that there is meaningful change in temperament over time. Emerging biological mechanisms (e.g., executive attention and control processes) and contextual influences are proposed explanations of such change (Posner, Rothbart, Sheese, & Voelker, 2012). For example, across studies using a variety of approaches to temperament, both fear and anger reactivity increase between 4 to 16 months of age, but the rate of increase for fear slows between 12 and 16 months and anger reactivity decreases between 19 and 30 months (Braungart-Rieker, Hill-Soderlund, & Karrass, 2010; Denham, Lehman, Moser, & Reeves, 1995). Similarly, other work examining mean-level change in temperament over time suggests normative increases in parent reported negative emotionality throughout infancy followed by declines in early childhood (Bridgett et al., 2009; Lipscomb et al., 2011; Partridge & Lerner, 2007). This suggests that normative developmental processes contribute to change in child behavior across early development.

Although change in temperament across infancy and early childhood may in part reflect biological processes, the caregiving context is salient as well. Infants have rudimentary capacities for managing their physical and emotional states, but they are largely dependent on caregivers to modulate their internal states (Kopp, 1982). Behavioral style is not yet entrenched in infancy, and temperament appears to be less stable in infancy compared to the preschool years and beyond (Roberts & DelVecchio, 2000). Therefore, infancy may be a time when we would expect to see the greatest change in temperament as a function of the caregiving context.

Work supporting the view that contextual factors contribute to the stability of infant temperament is characterized by important limitations. First, much of the research relies on mother reports of temperament, which may inflate estimates of temperament stability due to the mother's own reporter bias (Seifer, Sameroff, Dickstein, Schiller, & Hayden, 2004). While maternal perceptions of one's own infant are important, they are influenced by personal biases, emotional dispositions, and parental expectations, which may explain why there are inconsistent levels of agreement between mother and observer ratings of infant temperament (Seifer, Sameroff, Barrett, & Krafchuk, 1994; Seifer et al., 2004). Consistent with this view, mothers with more depressive symptoms and those who are more sensitive in responding to infant cues are less concordant with trained observers (Leerkes & Crockenberg, 2003). Furthermore, mothers have access to unique information about their

child and may attribute meaning to their infant's behavioral tendencies based on a shared history of experiences, cultural values, and maternal characteristics. Maternal reports of temperament also require implicit aggregation of the child's temperament behaviors, placing a demand on mothers' observational and memory capacities. Thus, observational approaches to assessing temperament allow us to understand the influence of the caregiving context while eliminating the potential informant confound due to maternal report.

Second, even when temperament is assessed using observation, it is typically observed at a single point in time (on a single day) within each wave of assessment. This can result in error in measurement due to situational factors like hunger, fatigue, or illness. Although steps are often taken to minimize these situational factors by scheduling observations at times during which infants are well rested, fed, and otherwise healthy, situational factors still have the capacity to impact infant behavior. Indeed, recent work from our group has shown that single time point observations of temperament are less stable than aggregate observations (Parade et al., 2015).

Third, although much work has considered maternal behavior as a predictor of the stability of infant temperament, few studies have considered the impact of family functioning. The mother-infant relationship is embedded within and shaped by the family context, and therefore a focus only on mothers may lead us to overlook important contributors to infant development (Hayden et al., 1998). Infants rely on the warmth, structure, and health of the family unit, not just the mother, in order to feel safe and secure and to learn to regulate their distress. Furthermore, family functioning is likely a more proximal predictor of infant temperament than indicators of family risk that are typically considered to understand change in temperament over time such as socioeconomic status, poverty-related risk, and household conditions (Lemery-Chalfant, Kao, Swann, & Goldsmith, 2013; Li-Grining, 2007). Importantly, the family unit may have an even greater impact on infants in the context of parental risk factors such as maternal depression. Related to this, we know little about how contextual factors work together to moderate developmental stability and change in infant temperament over time (but see Bridgett, Burt, Laake, & Oddi, 2013 for an exception). Most prior work has considered only main effects of contextual factors on temperament stability, and we extend this work to consider interaction effects, focusing on maternal sensitivity and family functioning as moderators of the influence of maternal depression on change in temperament over time.

Maternal Postpartum Depression

Maternal depression is prevalent among women in the postpartum period with estimates suggesting that approximately 10–20% of women experience postpartum depression (Gavin et al., 2005; Verreault et al., 2014). Maternal depression is associated with negative and unrealistic expectations and beliefs about the self and others, and it is well-established that maternal depression is associated with maternal perceptions of infant temperament. Mothers who are depressed rate their infants as higher in negative emotionality (Huot, Brennan, Stowe, Plotsky, & Walker, 2004) as well as more temperamentally difficult (Britton, 2011). In addition, mothers who report more severe depressive symptoms between infant age 4 and 6 months also report sharper increases in their infant's negative emotionality (Bridgett et al.,

2009) and temperamental difficulty (Hanington, Ramchandani, & Stein, 2010) over infancy. However, links between maternal depression and infant temperament are less clear when observational assessments of temperament are used. Some research has shown that depressed mothers have infants who exhibit more negative emotionality and less mature regulatory behaviors (Feldman et al., 2009) as well as sharper increases in fearfulness over time (Gartstein et al., 2010). Other research has not found an association between maternal depression and infant negative emotionality (but has demonstrated links with fearfulness; Pauli-Pott, Mertesacker, & Beckmann, 2004). This inconsistency in the literature may reflect methodological differences in the use of parent versus observer report of temperament but also suggests that certain factors may moderate the effect of maternal postpartum depression on infant temperament over time.

Caregiving Context May Moderate the Impact of Maternal Depression on Temperament

Parenting behavior is often conceptualized as a mechanism by which maternal factors impact child outcomes, and maternal caregiving behaviors are often examined as mediators of the association between maternal depression and infant behavioral outcomes (Coyl, Roggman, & Newland, 2002). Yet the relations between maternal depression and observed infant temperament are not consistently supported in the literature as reviewed above, suggesting the relation holds in some contexts but not others. The caregiving context including maternal sensitivity and the overall functioning of the family unit may mitigate the impact of maternal depression on infant temperament. It is now well understood that although maternal depression is a risk factor for impairments in parenting and other interpersonal family processes, not all mothers who experience depression exhibit difficulties with parenting and their close relationships (Campbell, et al., 2004). Several studies have demonstrated that some mothers diagnosed with depression exhibit similar parenting behaviors as healthy mothers, and effect sizes between maternal depression and parenting are small to moderate in magnitude (Lovejoy, Graczyk, O'Hare, & Neuman, 2000). In fact, when parenting behavior is divided into positive, negative, and disengaged behaviors, maternal depression is only weakly associated with positive parenting behaviors, like warmth and engagement (Lovejoy et al., 2000). Taken together, this suggests that the caregiving context may promote resilience in the face of maternal depression. Sensitive maternal behavior and a highly functioning family unit may buffer infants from the negative consequences of maternal depression. Understanding why some depressed mothers but not others contribute to child adaptation is critical for developing effective interventions with families at risk.

Maternal Sensitivity

Maternal sensitivity contributes to positive developmental outcomes throughout childhood, including attachment security (Ainsworth, Blehar, Waters, & Wall, 1978), social-emotional functioning (Leerkes, Blankson, & O'Brien, 2009), and cognitive development (Stams, Juffer, & van IJzendoorn, 2002). When mothers are attuned to their infant's needs, accurately interpret their infant's cues, and contingently respond to their infants in ways that are warm and appropriate, they have the opportunity to foster infant affective tolerance and

regulatory capacities. In addition, infants come to learn that their distress will be attended to and managed by caregivers, thus decreasing the need for infants to exhibit prolonged or intense negative emotional reactions. Consequently, infants with a more difficult temperament likely function better when they experience sensitive caregiving that includes structured, predictable routines and a caregiver that can help the infant manage distress in developmentally appropriate ways (Leerkes et al., 2009). As described above, depressed women are at heightened risk for impairments in parenting, yet not all mothers with depression exhibit parenting difficulties (Lovejoy et al., 2000). Therefore, maternal sensitivity has the potential to affect change in temperament over the course of development and to buffer infants from maternal postpartum depression. Indeed, when maternal depression and maternal parenting behaviors are examined together, parenting (i.e., sensitivity and rejection) moderates the relation between maternal depression and a variety of child characteristics, including social engagement (Feldman et al., 2009), cortisol reactivity (Kaplan, Evans, & Monk, 2008), and internalizing problems (Zalewski, Thompson, & Lengua, 2015). Thus, maternal sensitivity may moderate the relation between maternal depression and change in infant temperament over time.

To our knowledge, no prior work has examined maternal sensitivity as a moderator of the effect of postpartum depression on change in infant temperament. However, work demonstrating main effects of sensitivity on temperament support this proposition. Mothers rated higher in sensitivity have infants who are less fearful and exhibit less negative emotionality (Pauli-Pott et al., 2004; Seifer, Schiller, Sameroff, Resnick, & Riordan, 1996). With respect to change in temperament, mothers who are more sensitive have infants who show slower increases in fearfulness (Braungart-Rieker et al., 2010) as well as greater declines in negative emotionality (Belsky, Fish, & Isabella, 1991). Taken together, these findings suggest that sensitive parenting benefits infants who have a more difficult temperament, and that maternal sensitivity has the potential to buffer infants from the deleterious effects of maternal depression.

Family Functioning

Though most research on infant temperament has focused on characteristics of the mother-infant dyad, there has been growing interest in understanding the role of the larger family context. Evidence from main effect models suggests that other family relationships shape infant temperament and therefore potentially moderate effects of maternal postpartum depression on temperament over time. Mothers who reported a higher quality marital relationship prenatally had infants who declined in negative emotionality between 3 and 9 months (Belsky et al., 1991), greater marital adjustment at 4 months postpartum was associated with lower infant negative emotionality at six months (Bridgett, Burt, Laake, & Oddi, 2013), and a supportive coparenting relationship at 3.5 months postpartum was associated with parent-reported decreases in infant difficulty between 3.5 and 13 months (Davis, Schoppe-Sullivan, Mangelsdorf, & Brown, 2009). On the other hand, mothers who reported higher amounts of marital stress rated their infants higher in negative emotionality at 4 months (Bridgett et al., 2009), prenatal marital aggression was associated with greater infant withdrawal from novelty at six months (Crockenberg, Leerkes, & Lekka, 2007), and fathers that were less positive about their marriage prenatally had infants who showed

increases in negative emotionality between 3 and 9 months (Belsky et al., 1991). Likewise, greater home chaos at 4 months postpartum was associated with greater infant negative emotionality at six months (Bridgett et al., 2013). We extend this work to consider family functioning, a correlate of inter-parental relationship functioning and parenting behavior (Hayden et al., 1998), as a predictor of infant temperament over time. We draw upon the McMaster Model of Family Functioning (Miller, Ryan, Keitner, Bishop, & Epstein, 2000), which is grounded in a family systems approach to understand family functioning in six interrelated domains including problem solving, communication, roles, affective responsiveness, affective involvement, and behavioral control. Overall family functioning is considered to be high when appropriateness and effectiveness is demonstrated across each of these domains. To our knowledge, no prior work has examined family functioning conceptualized from this theoretical perspective as a moderator of the effect of maternal depression on change in observed infant temperament over time.

The Current Study

The current study builds upon prior work to examine the joint influence of maternal postpartum depression, maternal sensitivity, and family functioning on mean-level stability of observed infant temperamental difficulty over the first 30 months of life utilizing a behavioral style approach. Given prior work suggesting that aggregated observational assessments of infant temperament within a single developmental period produce more reliable and stable estimates of infant temperament over time than do single observations within each developmental period (Parade et al., 2015), we drew upon eight videotaped observations of infant temperament at 8, 15, and 30 months postpartum to examine predictors of temperament over time. We hypothesized that:

1. Maternal depression is associated with linear increases in infant temperamental difficulty over time.
2. Maternal sensitivity buffers infants from the effect of maternal depression on increases in infant temperamental difficulty over time.
3. Family functioning buffers infants from the effect of maternal depression on increases in infant temperamental difficulty over time.

Method

Participants

One hundred and forty-seven families from the Goodness of Fit (GOF) study comprise the sample for the current report. Families were recruited prenatally from the main obstetrics hospital in a metropolitan area in the northeastern United States that accounted for approximately 90% of the births in the region. Families were approached during childbirth education classes, given a brief presentation about the study, and interested families were contacted by telephone to arrange a prenatal enrollment visit. Families were followed longitudinally through 30 months postpartum with assessments at prenatal, 4 months, 8 months, 15 months, and 30 months of age. Data were collected between 1996 and 2004. At the time of the infant's birth 160 families were enrolled in the GOF study. At 8 months of

age temperament observations were available from 147 families, at 15 months of age 133 families, and at 30 months of age 126 families. Little's Missing Completely at Random test (Little, 1988) demonstrated that these data were missing completely at random ($\chi^2(96) = 100.71, ns$).

For the 147 families who were enrolled at 8 months of age and comprise the sample for data analysis, their infants included 78 (53%) boys and 69 (47%) girls. Seven of the infants were Black, 10 Hispanic, 1 Asian, 1 Native American, and 7 mixed race. The remaining 121 infants were White, non-Hispanic. The majority of mothers ($n = 115$) were married and living with their spouse, an additional 21 were single, divorced, or separated and living with a partner, and 11 were divorced or single and not living with a partner. Most of the sample was middle or upper SES: 134 had Hollingshead (1975) SES of 1–3. Seven mothers had less than a high school education, 16 were high school graduates, 42 had some college, and 82 had a 4-year college degree. Families were oversampled for maternal depression: Slightly more than half of mothers ($n = 80$) had a lifetime history of major depression assessed using the Structured Clinical Interview for DSM-III-R (Spitzer, Williams, Gibbon, & First, 1990) in the prenatal period and the Longitudinal Interval Follow-up Evaluation (LIFE; Keller et al., 1987) in the postpartum period. Sixty-eight of the mothers with a lifetime history were depressed prior to pregnancy, 23 were depressed during pregnancy, and 47 were depressed in the first 30 months postpartum (38 with postpartum depression in the first 12 months).

Infant Temperament - Observed

A series of 8 videotaped observations of the mother and her infant in the home were scheduled at 8, 15, and 30 months of age. The 8 observations were typically completed within a 4-week period around the assessment age (some families completed fewer than 8 observations, see details below). Assessments were scheduled for times that the infant was expected to be awake, alert, and interactive, thus visits typically occurred mid-day following a nap. A single research assistant was assigned to each family for the duration of the study and was responsible for videotaping all of the assessments. Each observation at 8 months and 15 months included at least 10 minutes of three situations: mothers in close proximity with infant, infant alone, and mother caretaking behavior. At 30 months, there was no mandatory caretaking situation, only mothers in close proximity and infant alone, because the caregiving activities typically captured in the prior assessments (primary feeding and diapering) were no longer relevant at this age as determined in early pilot work.

The activities during which the mothers were in close proximity with the infant were intentionally mother driven activities (predominantly play activities across all 3 waves of assessment), rather than experimenter driven activities, to capture infant behavior during naturally occurring mother-infant interactions in the home. Likewise, the activities when the infant was alone were intentionally infant driven activities and were also predominantly play activities across all 3 waves of assessment. Efforts were made to capture these different situations during naturally occurring interaction, if these situations did not naturally occur during the observation mothers were prompted to engage in one of the three types of interaction so that all dyads engaged in all three types of interaction. The video recording lasted approximately 45 minutes per session. The timing of our three temperament

assessment waves (8, 15, and 30 months) was intended to capture child behavior across developmental milestones within the constraints of our study. Temperament was assessed at 8 months to capture child behavior prior to the time at which infants typically begin walking and talking, and at 15 months to capture behavior when infants have typically achieved these milestones. Temperament was again assessed at 30 months as that was the oldest age at which we could assess behavior within the constraints of our 5-year research grant period. Given our interest in understanding how a child's behavioral style naturally develops in context, we intentionally designed our observational assessment to occur in the home rather than a laboratory setting.

Infant behavior during each of the video recordings was scored using the Temperament Adjective Triad Assessment (Seifer et al., 1994), which includes 14 bipolar items defined by a triad of adjectives at each pole (see Table 1). Research assistants who did not conduct the home visits with the family scored the 14 temperament items on a five-point scale. Rater reliability was .80 or above (intraclass correlation) and was established on four sets of 10 videotapes per set that were double coded by a lead rater and the rater in training. The mean of the 14 Temperament Adjective Triad Assessment items was used to derive a Total Difficulty score for each videotaped observation. Scores for the total session (temperament across the 3 situations including mother-infant, infant alone, and caretaking) were used. Alpha coefficients for the Total Difficulty Score from the 14 items was .86 at 8 months, .85 at 15 months, and .89 at 30 months. Total Difficulty scores for each videotaped observation were then averaged across the set of 8 observations to compute an 8-observation aggregate score within each wave of assessment. Aggregate scores were not computed for those families with less than 4 observations. All of the families in the current report completed enough observations to compute an aggregate score and most families completed all 8 observations at each wave of assessment (92% at 8 months, 90% at 15 months, 86% at 30 months). As demonstrated in our previously published work (Parade et al., 2015), internal consistency reliability estimates of the 8-observation aggregates were high (.81 at 8 months, .78 at 15 months, and .75 at 30 months), and the stability of temperament between waves of assessment increased when the 8-observation aggregates rather than single timepoint assessments were considered.

Maternal Depression Status and Symptoms

Mothers completed the Structured Clinical Interview for DSM-III-R (Spitzer et al., 1990) prenatally and the Longitudinal Interval Follow-up Evaluation (LIFE; Keller et al., 1987) every six months postpartum to capture symptoms and diagnostic criteria for major depression on a month by month basis. At the time of each LIFE interview, a psychiatric symptom rating (PSR) was assigned for each month considered in the interview to capture the severity of depressive symptoms. A score of 1 indicates no symptoms, scores of 2–4 indicate sub-syndromal symptoms of increasing severity and impairment, and scores of 5 and 6 indicate that criteria for DSM disorder are met with the higher score indicating extreme impairment. The mean PSR score was computed for the severity of maternal depressive symptoms in the first 12 months postpartum. Although DSM-IV was available at the time of this study, a desire to compare and/or combine this sample with other samples previously collected in our laboratory led us to use clinical interviews designed for DSM-

IIIR. Depression criteria in the DSM, as well as in the SCID interview instrument, were not changed in any meaningful way from version IIIR to version IV. This choice also maximized compatibility with the LIFE instrument to capture symptoms and diagnostic criteria beyond the initial clinical interview. Clinical interviewers received centralized SCID training by the DSM-IV depression workgroup, and achieved the reliability standard (.80 or above). All diagnoses were made using group consensus. Of the 147 mothers considered in the current report, 80 had a lifetime history of major depression including 68 (46%) who were depressed prior to pregnancy, 23 (16%) who were depressed during pregnancy, and 47 (32%) who were depressed in the first 30 months postpartum. For data analysis, mothers who were depressed in the first 12 months postpartum comprise the group of women who were considered to have postpartum depression ($n = 38$; 26%).

Maternal Sensitivity

Following the series of 8 home visits that included observations of mother and infant behavior at 15 months postpartum, the research assistant who conducted the home visits with the family completed the Maternal Behavior Q-Sort (Pederson & Moran, 1995). This Q-sort procedure measures maternal sensitivity by comparing a sort of the mother's behavior with a criterion sort of the behavior of a prototypically sensitive mother using 90 items that reflect maternal sensitivity as described by Ainsworth and colleagues (1978). Research assistants were trained to reliability criterion of .80 or above (q-correlation with experienced rater). To establish reliability the research assistant observed the series of 8 home visits with the experienced rater and then completed the Q-Sort procedure. Research assistants engaged in refresher trainings throughout the study to minimize rater drift. The research assistant who conducted the home visits with the family at 15 months completed the Q-sort based on their knowledge and experience with the family, and intentionally did not have access to the videos while completing the Q-sort to minimize rater bias between the temperament observation and Q-sort scoring. Lower scores indicate less sensitive maternal behavior. In this sample, Q-sort sensitivity scores are highly correlated ($r = .65$, $p < .001$) with sensitivity ratings from the Biringen, Robinson, and Emde (1988) Emotional Availability Scales, which is based on Ainsworth et al.'s (1978) work. We focus on Q-sort sensitivity scores rather than sensitivity ratings from the Emotional Availability Scales, because sensitivity ratings from the Emotional Availability Scales in this study were derived from the videotapes of the temperament observations described above, and we wished to minimize inflation of the association of temperament and maternal sensitivity due to shared methodology.

Family Functioning

Family functioning was assessed from a videotaped observation of a family meal at 15 months postpartum. We chose to assess family functioning in the context of a mealtime interaction in an effort to capture naturally occurring interactions between members of the family system during everyday events. Each family was asked to select a convenient time when all family members would be available and eating together, and an unobtrusive camera was arranged by the research assistant so all family members were visible for the observation. The research assistant then instructed the family to turn the camera on when they were ready to eat and left the home for the duration of the meal. Following the meal but on that same evening, the research assistant returned to the home to pick up the camera. At

the time of the camera retrieval, the majority of families (86%) reported that the meal was either pretty typical or very typical, with only 14% who reported the meal as somewhat typical or not at all typical.

Videotapes of the family meal were coded using the Mealtime Interaction Coding System (MICS; Dickstein, Hayden, Schiller, Seifer, & San Antonio, 1994) to assess family functioning. The MICS was closely adapted from the McMaster Structured Interview of Family Functioning Clinical Rating Scale (Miller, Kabacoff, Bishop, Epstein, & Keitner, 1994), with adjustments for the unstructured and naturalistic observation. Raters coded 6 specific domains of family functioning (task accomplishment, affect management, interpersonal involvement, behavioral control, communication, and roles), and also rated Overall Family Functioning which was a single rating that was an integration of the 6 domains, on a 7-point scale with higher scores reflecting higher quality family functioning. The Overall Family Functioning rating was used for data analysis. High levels of overall family functioning represent highly appropriate and effective behaviors and affect in each of the six domains using the McMaster model criteria. Rater reliability was .80 or above (intraclass correlation) and was established based on four reliability sets of 10 videotapes in each set that were double coded by the research assistant and the lead rater (a total of 40 videotapes).

Socioeconomic Status

Hollingshead (1975) 4-factor SES scores were computed from the education and occupation scores of the two adults in the household at study entry. For those families where only the mother was in the household, her education and occupation determined the SES classification. Lower scores indicate higher SES.

Data Analysis

SPSS 20 was used to examine descriptive statistics and correlations between the substantive variables of interest and potential covariates (family SES, maternal age, infant sex). Two variables (maternal sensitivity and postpartum depressive symptoms) were log transformed prior to data analysis to adjust for skewed distributions. Latent growth curve modeling in MPlus 6 was used to examine predictors of mean-level stability of infant temperament over time. First, an unconditional growth curve model was tested to determine if there was significant mean-level change in infant temperament prior to inclusion of family context variables. Second, conditional growth curve models were tested to determine if maternal postpartum depression predicted subgroup mean-level change in infant temperament over time, and if maternal sensitivity and family functioning moderated these links. In all growth curve models, time was centered at 15 months postpartum, so that the intercept represented infant temperament at 15 months of age and was temporally concurrent with the moderator variables. Prenatal depression was included as an a-priori covariate in all models for hypothesis testing to account for potential prenatal programming effects on temperament (e.g. Davis et al., 2007). Less than 4% of the data were missing overall, and as described above Little's Missing Completely at Random test (Little, 1988) demonstrated that the data were missing completely at random ($\chi^2(96) = 100.71, ns$); therefore full information maximum likelihood procedures were used to account for missing data. Significant

interaction terms were probed using procedures outlined by Aiken and West (1991), and simple slopes within the latent growth curve modeling framework were calculated at low (< 1 SD) and high (> 1 SD) levels of the moderator.

Results

Preliminary Analyses

Descriptive statistics and correlations among the variables of interest are displayed in Table 2. Prenatal depression, postpartum depression status, and postpartum depressive symptoms were significantly associated with one another. Maternal sensitivity was associated with prenatal depression, postpartum depression status, and postpartum depressive symptoms. Family functioning was associated with postpartum depression status, postpartum depressive symptoms, and maternal sensitivity, but not prenatal depression. None of the family context variables (depression, maternal sensitivity, family functioning) were associated with infant temperament at any of the individual time points.

Examination of Potential Covariates

Examination of potential covariates revealed that family SES, maternal age, infant sex, and prenatal depression were not associated with infant temperament at any time point. Likewise, infant sex was not associated with postpartum depression or maternal sensitivity, but family functioning was lower among families with boys ($p = .026$). Family SES was associated with postpartum depression status ($p = .038$), postpartum depressive symptoms ($p = .021$), maternal sensitivity ($p < .001$), and family functioning ($p = .001$). Maternal age was associated with postpartum depression status ($p = .017$), and both maternal sensitivity and family functioning (both $p < .001$). Women who were depressed in pregnancy were more likely to be depressed and to have greater depressive symptoms in the postpartum period (both $p < .001$), and to have lower maternal sensitivity ($p = .002$). Therefore, family SES, maternal age, infant sex, and prenatal depression were included as covariates in hypothesis testing.

Unconditional Growth Curve Model

The unconditional linear growth curve model examining change in infant temperament over time with no family context variables included as predictors demonstrated excellent fit to the data (Chi-Square = 3.16(3), *ns*; RMSEA = .019; CFI = .998; SRMR = .031). The intercept and slope for change in infant temperament over time were both significant ($B = 66.49$, $SE = .34$ and $B = -1.62$, $SE = .26$ respectively, both $p < .001$) and indicated that on average, infant temperament became less difficult over time. Likewise, the variance component was significant for both the intercept and slope ($B = 11.94$, $SE = 1.96$, $p < .001$ and $B = 3.29$, $SE = 1.36$, $p = .016$, respectively).

Substantive Analyses

H1: Maternal depression is associated with linear increases in infant temperamental difficulty over time—Results of the conditional latent growth model testing maternal postpartum depression status as a predictor of change in infant temperament is displayed in Model 1 of Table 3. Maternal depression was not a significant predictor of

either the intercept or slope indicating change in temperament. Likewise, results of the conditional latent growth model testing maternal postpartum depressive symptoms as a predictor of change in infant temperament is displayed in Model 2 of Table 3. Contrary to expectations, maternal depressive symptoms was not a significant predictor of either the intercept or slope indicating change in temperament.

H2: Maternal sensitivity buffers infants from the effect of maternal depression on increases in infant temperamental difficulty over time—Results of the

conditional latent growth models testing maternal sensitivity as a moderator of the influence of maternal depression on change in infant temperament over time are displayed in Models 3 through 5 of Table 3. As illustrated in Model 3, maternal sensitivity did not exert a significant independent main effect on change in infant temperament over time, however as illustrated in Model 4, there was an interaction of maternal depression status and maternal sensitivity in the prediction of change in temperament over time. As hypothesized, examination of simple slopes revealed that maternal depression status was associated with the slope for change in infant temperament when sensitivity was low ($B = 2.45$, $SE = .84$, $p = .003$) but not when sensitivity was high ($B = .16$, $SE = 1.00$, $p = .870$). Likewise, as illustrated in Model 5, there was an interaction of maternal depressive symptoms and maternal sensitivity in the prediction of change in temperament over time. Examination of simple slopes revealed that maternal depressive symptoms was associated with the slope for change in infant temperament when sensitivity was low ($B = 5.83$, $SE = 2.33$, $p = .012$) but not when sensitivity was high ($B = -1.98$, $SE = 2.80$, $p = .479$). To better understand infant temperament when maternal sensitivity was low, we examined the group of infants whose mothers were rated below the median sensitivity score. As illustrated in Figure 1, when sensitivity was low infants whose mothers were depressed were consistently observed to be highly difficult, whereas infants whose mothers were not depressed were observed to be less difficult over time.

H3: Family functioning buffers infants from the effect of maternal depression on increases in infant temperamental difficulty over time—Results of the

conditional latent growth models testing family functioning as a moderator of the influence of maternal depression on change in infant temperament over time are displayed in Models 6 through 8 of Table 3. As illustrated in Model 6, family functioning did not exert a significant independent main effect on change in infant temperament over time, however as illustrated in Model 7, there was an interaction of maternal depression status and family functioning in the prediction of the slope for change in temperament over time. Examination of simple slopes revealed that maternal depression status was associated with change in infant temperament when family functioning was low ($B = 2.50$, $SE = .79$, $p = .002$) but not when family functioning was high ($B = -.14$, $SE = .95$, $p = .884$). Likewise, as illustrated in Model 8, there was an interaction of maternal depressive symptoms and family functioning in the prediction of change in temperament over time. Examination of simple slopes revealed that maternal depressive symptoms was associated with the slope for change in infant temperament when family functioning was low ($B = 4.25$, $SE = 2.11$, $p = .044$) but not when family functioning was high ($B = -1.98$, $SE = 2.68$, $p = .459$). To better understand infant temperament when family functioning was low, we examined the group of infants whose

families were rated below the median family functioning score. As illustrated in Figure 2 and consistent with the interaction effect of maternal sensitivity, when family functioning was low infants whose mothers were depressed were consistently observed to be highly difficult, whereas infants whose mothers were not depressed were observed to be less difficult over time. Therefore, hypothesis three was supported.

Discussion

Temperament has long been recognized as a predisposition towards a set of stable behavioral tendencies with both biological determination and shaping by the child's environment (Shiner et al., 2012). Stability estimates of infant temperament, however, are generally small to moderate in magnitude. We examined the joint effects of maternal postpartum depression, maternal sensitivity, and family functioning on mean-level stability of observed infant temperament over the first 30 months of life drawing upon a behavioral style approach. Results suggest that infant temperament tends to become less difficult over time, yet the co-occurrence of maternal depression and other family risk factors contributes to heightened temperamental difficulty beyond the first year of life. Infants whose mothers were depressed in the postpartum period, and also exhibited low maternal sensitivity or low family functioning, were rated by independent observers as consistently difficult over time. This work suggests that family factors play a critical role in shaping the trajectory of an infant's behavioral style as it unfolds over development.

Results of the current study support the growing perspective that in addition to any biological determinants of temperament, the family and caregiving context also shapes the development of an infant's behavioral style. In the current report, infant temperament tended to become less difficult over time, perhaps due to emerging biological processes such as executive attention and control processes (Posner et al., 2012), yet this trajectory was shaped by the family environment. The mechanisms underlying the impact of the family environment on change in temperament over time are not fully understood, but prior work suggests that the caregiving context may alter the longitudinal course of temperament through both behavioral and physiological mechanisms. A more optimal caregiving context may support the development of effective emotion regulation strategies as well as adaptive physiological responses to stress among children (Leerkes & Parade, 2015). Indeed, in the current study infant temperament tended to become less difficult over time, but this pattern was not observed among infants who experienced multiple contextual risks.

The presence of multiple contextual risk factors appears to contribute to heightened temperamental difficulty among infants over the first 30 months of life. In the current study, both maternal depression status and maternal depressive symptoms were associated with greater temperament difficulty, but only in conjunction with low maternal sensitivity or low family functioning. Maternal sensitivity and a highly functioning family unit moderated the effect of depression on trajectories of temperamental difficulty over time. These results are consistent with prior work suggesting that maternal sensitivity interacts with maternal depression in affecting infant social engagement (Feldman et al., 2009), as well as work suggesting that the presence of multiple family risk factors is more highly predictive of infant social competence than is maternal psychopathology alone (Seifer, Sameroff et al.,

1996). Taken together, this work supports the perspective that the effects of maternal psychopathology and family processes are best understood in conjunction with one another. Mothers who consistently and appropriately respond to their infants' needs, hallmarks of sensitive parenting, may more effectively teach their infants how to regulate their negative emotions, contributing to declines in infant difficulty over time even in the context of maternal depression. In contrast, depressed mothers who respond less sensitively to the infant may not transmit effective emotion regulation strategies, maintaining a difficult infant behavioral style.

Family functioning moderated links between maternal depression and infant temperamental difficulty as well. A highly functioning family unit characterized by clarity in roles, effective communication, and high interpersonal involvement among family members may support the infant's emotion regulation and contribute to declines in temperamental difficulty over time by conveying a sense of interpersonal safety and security to the infant even when the mother is depressed. Maternal depression in conjunction with family dysfunction may disrupt the infant's sense of safety and security, and interfere in the development of effective regulation strategies, maintaining a difficult temperamental style over time. That none of the caregiving context variables (maternal depression, maternal sensitivity, family functioning) were associated with infant temperament at any of the individual time points further underscores the view that contextual risk factors exert the strongest influence in conjunction with one another.

An independent main effect of maternal postpartum depression on change in infant temperament over time was not observed in the current study. As discussed above, maternal depression exerted influence on change in observed temperament only in conjunction with other family risks. These findings are in contrast to prior work demonstrating that maternal depression is associated with increases in observed infant fear between 8 and 12 months of age (Gartstein et al., 2010). An important distinction between the current study that found only moderated effects of maternal depression on observed temperament and Gartstein et al.'s work that demonstrated main effects is that we considered change in temperament from 8 to 30 months of age whereas Gartstein focused on the period of 8 to 12 months. Maternal depression may exert a significant effect on change in infant temperament over a short period of time, but family contextual factors appear moderate these effects as they extend over longer time intervals. Furthermore, Gartstein's study focused on temperamental fear whereas the current report considered infant temperamental difficulty more broadly from a behavioral style approach. Future work should consider family factors that moderate the impact of maternal depression on specific temperament dimensions associated with the emotion expression approach. Likewise, consideration of child behavioral style in contexts other than those considered in the current report (infant with mother, infant alone, caretaking) including more emotionally evocative contexts is an important next step. Perhaps of most interest, future work should integrate the behavioral style approach with emotion expression approaches to better understand temperament as it develops within naturally occurring relational contexts while biological processes such as executive attention and control come online.

An important strength of the current study is the use of repeated observations of infant temperament within 3 waves of assessment (up to 8 observational assessments at 8, 15, and 30 months of age). The majority of prior work that has considered infant and contextual factors that influence the stability of temperament over time has drawn upon parent reports of temperament, which have the potential to be biased by the parents' emotional dispositions, relationship status, and states of mind. This is particularly problematic in the consideration of parental depression as a predictor of the stability of temperament over time as it is difficult to discern whether stability estimates are due to consistency in the mother's own bias or the infant's actual behavior. Our study is further strengthened by the use of clinical assessments of maternal depression as well as independent observer ratings of family functioning and maternal behavior. That we controlled for prenatal depression in our examination of links between maternal postpartum depression and temperament is a strength as well given evidence suggesting that maternal depression in pregnancy has the potential to "prenatally program" infant behavior in the postpartum (Davis et al., 2007). Given the nuance in the pattern of results found, this work underscores the utility of observational assessments of infant, parental, and family behavior when considering the role of parental psychopathology in the development of an infant's behavioral style.

Despite these strengths, the current study is characterized by a number of important limitations that pose important directions for future research. The current sample is relatively homogenous in that mothers were predominantly white and of middle to upper socioeconomic status. Although many families in the study were considered to be at risk by virtue of maternal depression, the sample overall was not otherwise impoverished. It will be important for future work to examine the role of maternal depression and other family factors as predictors of change in observed temperament over time in more heterogeneous and more at risk samples. Furthermore, prior work underscores the potential for infant temperament to shape parental behavior and sensitivity, yet these links are often inconsistent and appear to be dependent on other parental and family risk factors (Leerkes & Crockenberg, 2002; Paulussen-Hoogeboom, Stams, Hermanns, & Peetsma, 2007). Future work should consider repeated observations of maternal sensitivity to understand potential bidirectional links between infant temperament and family context across the first 30 months. Related to this, our observation of infant temperament included three situations: mother in close proximity with infant, infant alone, and caretaking. Infant temperament during the mother in close proximity situation was likely influenced by maternal behavior during the observational assessment, potentially inflating stability of infant temperament over time due to stability of the mother's own behavior. Future work examining transactional relations between maternal and infant behavior should consider if maternal and infant behavior are jointly stable over time. Likewise, the current study did not test 3-way interactions of maternal depression, maternal sensitivity, and family functioning. It is difficult to test these types of higher-order interactions in behavioral studies with relatively small sample sizes given issues with power and difficulty replicating results. Future work with a larger sample of families as well as a replication sample would be more ideally suited to test these higher-order effects. Related to this, because we captured temperament at 3 waves of assessment we examined linear change in temperament over time. Future work should utilize additional waves of assessment to examine the potential for non-linear change

in temperament over time. Finally, although it is well established that not all women who are depressed demonstrate impairments in sensitivity (Lovejoy et al., 2000), the factors that promote sensitive maternal behavior and adaptive family functioning in the face of maternal depression are not well understood. Although consideration of family factors in conjunction with maternal depression is a strength of the current study, more work is needed in this area to understand the processes underlying pathways to resilient functioning within families at risk.

In sum, we found that the caregiving context moderates the association between maternal postpartum depression and the mean-level stability of infant temperament across the first 30 months of life. Should these results replicate in additional samples, these findings have clinical implications for families with young children. It would seem beneficial to consider family interaction and maternal sensitivity when supporting families with maternal depression. An effective way to support healthy child outcomes in families with a depressed mother might be to implement targeted interventions that jointly address the depressive symptoms and family relationships. Interventions that enhance the overall functioning of the family unit and maternal sensitivity may more effectively promote adaptive child outcomes instead of a singular focus on maternal depression alone (Forman et al., 2007). Related to this, if mothers are not ready or able to engage in treatment for depression, then intervention programs focused on the family unit may be advantageous. Although maternal depression may impair overall family functioning, families can also be a source of strength and resilience for its members and a context in which health and well-being are supported. Given that parenting behaviors occur within the context of multiple relationships, narrowly focusing on the mother-infant dyad might minimize the influence of the whole family unit on supporting healthy child outcomes. In fact, children may rely on the warmth, structure, and consistency of the family unit especially during times of a parent or family member's illness. Taken together, this work highlights the centrality of the caregiving context in shaping the development of an infant's behavioral style as it unfolds over development.

Acknowledgments

This research was supported by a grant from the National Institute of Mental Health, Grant # R01-MH51301, R. Seifer Principal Investigator. We thank the many research assistants who contributed to this project, including Maryann Lynch, Renee Belair, and Michaela Hermann. We also thank Women & Infant's Hospital and Gail Steffy for assisting in recruitment of study participants.

References

- Aiken L, West S. Multiple regression: Testing and interpreting interactions. Newbury Park, CA: Sage; 1991.
- Ainsworth MDS, Blehar MC, Waters E, Wall S. Patterns of Attachment: A Psychological Study of the Strange Situation. Hillsdale: Lawrence Erlbaum Associates; 1978.
- Bates JE, Pettit GS, Dodge KA, Ridge B. Interaction of temperamental resistance to control and restrictive parenting in the development of externalising behaviour. *Developmental Psychology*. 1998; 34:982–995. DOI: 10.1037/0012-1649.34.5.982 [PubMed: 9779744]
- Belsky J, Fish M, Isabella RA. Continuity and discontinuity in infant negative and positive emotionality: Family antecedents and attachment consequences. *Developmental Psychology*. 1991; 27:421.doi: 10.1037/0012-1649.27.3.421

- Biringen Z, Robinson J, Emde RN. Emotional availability scales. Denver: University of Colorado Health Sciences Center; 1988.
- Braungart-Rieker JM, Hill-Soderlund AL, Karrass J. Fear and anger reactivity trajectories from 4 to 16 months: the roles of temperament, regulation, and maternal sensitivity. *Developmental Psychology*. 2010; 46:791.doi: 10.1037/a0019673 [PubMed: 20604602]
- Bridgett DJ, Burt NM, Laake LM, Oddi KB. Maternal self-regulation, relationship adjustment, and home chaos: Contributions to infant negative emotionality. *Infant Behavior & Development*. 2013; 36(4):534–547. DOI: 10.1016/j.infbeh.2013.04.004 [PubMed: 23748168]
- Bridgett DJ, Gartstein MA, Putnam SP, McKay T, Iddins E, Robertson C, Rittmueller A. Maternal and contextual influences and the effect of temperament development during infancy on parenting in toddlerhood. *Infant Behavior and Development*. 2009; 32:103–116. DOI: 10.1016/j.infbeh.2008.10.007 [PubMed: 19111913]
- Britton JR. Infant temperament and maternal anxiety and depressed mood in the early postpartum period. *Women & Health*. 2011; 51:55–71. DOI: 10.1080/03630242.2011.540741 [PubMed: 21391161]
- Campbell SB, Brownell CA, Hungerford A, Spieker SJ, Mohan R, Blessing JS. The course of maternal depressive symptoms and maternal sensitivity as predictors of attachment security at 36 months. *Development and Psychopathology*. 2004; 16:231–252. DOI: 10.1017/S0954579404044499 [PubMed: 15487594]
- Caspi A, Shiner RL. Personality development. In: Damon W, Lerner R, Eisenberg N, editors *Handbook of child psychology: Vol 3. Social, emotional, and personality development*. 6th. New York: Wiley; 2006. 300–365.
- Coyl DD, Roggman LA, Newland LA. Stress, maternal depression, and negative mother-infant interactions in relation to infant attachment. *Infant Mental Health Journal*. 2002; 23:145–163. DOI: 10.1002/imhj.10009
- Crockenberg SC, Leerkes EM, Lekka SK. Pathways from marital aggression to infant emotion regulation: The development of withdrawal in infancy. *Infant Behavior & Development*. 2007; 30:97–113. DOI: 10.1016/j.infbeh.2006.11.009 [PubMed: 17292783]
- Davis EP, Glynn LM, Schetter CD, Hobel C, Chicx-Demet A, Sandman CA. Prenatal exposure to maternal depression and cortisol influences infant temperament. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2007; 46:737–746. DOI: 10.1097/chi.0b013e318047b775 [PubMed: 17513986]
- Davis EF, Schoppe-Sullivan SJ, Mangelsdorf SC, Brown GL. The role of infant temperament in stability and change in coparenting across the first year of life. *Parenting: Science and Practice*. 2009; 9:143–159. DOI: 10.1080/15295190802656836
- Denham SA, Lehman EB, Moser MH, Reeves SL. Continuity and change in emotional components of infant temperament. *Child Study Journal*. 1995; 25:289–308.
- Dickstein S, Hayden LC, Schiller M, Seifer R, San Antonio W. Providence Family Study mealtime family interaction coding system. East Providence, RI: 1994.
- Feldman R, Granat A, Pariente C, Kanety H, Kuint J, Gilboa-Schechtman E. Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation, and stress reactivity. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2009; 48:919–927. DOI: 10.1097/CHI.0b013e3181b21651 [PubMed: 19625979]
- Forman DR, O'hara MW, Stuart S, Gorman LL, Larsen KE, Coy KC. Effective treatment for postpartum depression is not sufficient to improve the developing mother–child relationship. *Development and Psychopathology*. 2007; 19:585–602. DOI: 10.1017/S0954579407070289 [PubMed: 17459185]
- Fox NA, Henderson HA, Marshall PJ, Nichols KE, Ghera MM. Behavioral inhibition: Linking biology and behavior within a developmental framework. *Annual Review of Psychology*. 2005; 56:235–262. DOI: 10.1146/annurev.psych.55.090902.141532
- Garcia Coll C, Kagan J, Reznick JS. Behavioral inhibition in young children. *Child Development*. 1984; 55:1005–1019. DOI: 10.2307/1130152
- Gartstein MA, Bridgett DJ, Rothbart MK, Robertson C, Iddins E, Ramsay K, Schlect S. A latent growth examination of fear development in infancy: contributions of maternal depression and the

risk for toddler anxiety. *Developmental Psychology*. 2010; 46:651.doi: 10.1037/a0018898 [PubMed: 20438177]

Gavin NI, Gaynes BN, Lohr KN, Meltzer-Brody S, Gartlehner G, Swinson T. Perinatal depression: A systematic review of prevalence and incidence. *Obstetrics & Gynecology*. 2005; 106:1071–1083. DOI: 10.1097/01.AOG.0000183597.31630.db [PubMed: 16260528]

Goldsmith HH, Campos JJ. Toward a theory of infant temperament. In: Emde RN, Harmon R, editors *The development of attachment and affiliative systems*. New York: Plenum; 1982. 161–212.

Hanington L, Ramchandani P, Stein A. Parental depression and child temperament: Assessing child to parent effects in a longitudinal population study. *Infant Behavior and Development*. 2010; 33:88–95. DOI: 10.1016/j.infbeh.2009.11.004 [PubMed: 20056283]

Hayden LC, Schiller M, Dickstein S, Seifer R, Sameroff S, Miller I, Rasmussen S. Levels of family assessment: I. Family, marital, and parent–child interaction. *Journal of Family Psychology*. 1998; 12:7.doi: 10.1037/0893-3200.12.1.7

Hollingshead AB. Four factor index of social status, unpublished manuscript, available from the author. Yale University; New Haven, CT: 1975.

Huot RL, Brennan PA, Stowe ZN, Plotsky PM, Walker EF. Negative affect in offspring of depressed mothers is predicted by infant cortisol levels at 6 months and maternal depression during pregnancy, but not postpartum. *Annals of the New York Academy of Sciences*. 2004; 1032:234–236. DOI: 10.1196/annals.1314.028 [PubMed: 15677418]

Kaplan LA, Evans L, Monk C. Effects of mothers' prenatal psychiatric status and postnatal caregiving on infant biobehavioral regulation: can prenatal programming be modified? *Early Human Development*. 2008; 84:249–256. DOI: 10.1016/j.earlhumdev.2007.06.004 [PubMed: 17761394]

Keller MB, Lavori PW, Friedman B, Nielson E, Endicott J, McDonald-Scott P, Andreasen NC. The Longitudinal Interval Follow-Up Evaluation: A comprehensive method for assessing outcome in prospective longitudinal studies. *Archives of General Psychiatry*. 1987; 44:540–548. DOI: 10.1001/archpsyc.1987.01800180050009 [PubMed: 3579500]

Kopp CB. Antecedents of self-regulation: A developmental perspective. *Developmental Psychology*. 1982; 18:199–214. DOI: 10.1037/0012-1649.18.2.199

Leerkes EM, Blankson AN, O'Brien M. Differential Effects of Maternal Sensitivity to Infant Distress and Nondistress on Social-Emotional Functioning. *Child Development*. 2009; 80:762–775. DOI: 10.1111/j.1467-8624.2009.01296.x [PubMed: 19489902]

Leerkes EM, Crockenberg SC. The development of maternal self-efficacy and its influence on maternal behavior. *Infancy*. 2002; 3:227–247. DOI: 10.1207/S15327078IN0302_7

Leerkes EM, Crockenberg SC. The impact of maternal characteristics and sensitivity on the concordance between maternal reports and laboratory observations of infant negative emotionality. *Infancy*. 2003; 4:517–539. DOI: 10.1207/S15327078IN0404_07

Leerkes EM, Parade SH. A psychobiological perspective on emotional development within the family context. In: Calkins SD, editor *Handbook of Infant Development: Biopsychosocial Perspectives*. New York: Guilford; 2015.

Lemery-Chalfant K, Kao K, Swann G, Goldsmith HH. Childhood temperament: Passive gene–environment correlation, gene–environment interaction, and the hidden importance of the family environment. *Development and Psychopathology*. 2013; 25:51–63. DOI: 10.1017/S0954579412000892 [PubMed: 23398752]

Li-Grining CP. Effortful control among low-income preschoolers in three cities: Stability, change, and individual differences. *Developmental Psychology*. 2007; 43:208.doi: 10.1037/0012-1649.43.1.208 [PubMed: 17201520]

Lipscomb ST, Leve LD, Harold GT, Neiderhiser JM, Shaw DS, Ge X, Reiss D. Trajectories of parenting and child negative emotionality during infancy and toddlerhood: A longitudinal analysis. *Child Development*. 2011; 82:1661–1675. DOI: 10.1111/j.1467-8624.2011.01639.x [PubMed: 21883160]

Little RJ. A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*. 1988; 83:1198–1202. DOI: 10.1080/01621459.1988.10478722K

- Lovejoy MC, Graczyk PA, O'Hare E, Neuman G. Maternal depression and parenting behavior: A meta-analytic review. *Clinical Psychology Review*. 2000; 20:561–592. DOI: 10.1016/S0272-7358(98)00100-7 [PubMed: 10860167]
- McClowry SG. The temperament profiles of school-age children. *Journal of Pediatric Nursing*. 2002; 17:3–10. DOI: 10.1053/jpdn.2002.30929 [PubMed: 11891489]
- Miller I, Kabacoff R, Epstein N, Bishop D, Keitner G, Baldwin L, van der Spuy H. The development of a clinical rating scale for the McMaster model of family functioning. *Family Process*. 1994; 33:53–69. DOI: 10.1111/j.1545-5300.1994.00053.x [PubMed: 8039568]
- Miller IW, Ryan CE, Keitner GI, Bishop DS, Epstein NB. The McMaster approach to families: Theory, assessment, treatment and research. *Journal of Family Therapy*. 2000; 22:168–189. DOI: 10.1111/1467-6427.00145
- Parade SH, Dickstein S, Schiller M, Hayden L, Seifer R. Stability of child behavioral style in the first 30 months of life Single timepoint and aggregated measures. *International Journal of Behavioral Development*. 2015; 39:121–129. DOI: 10.1177/0165025414538555
- Partridge T, Lerner JV. A latent growth-curve approach to difficult temperament. *Infant and Child Development*. 2007; 16:255–265. DOI: 10.1002/icd.465
- Pauli-Pott U, Mertesacker B, Beckmann D. Predicting the development of infant emotionality from maternal characteristics. *Development and Psychopathology*. 2004; 16:19–42. DOI: 10.1017/S0954579404044396 [PubMed: 15115063]
- Paulussen-Hoogbeem MC, Stams GJJ, Hermanns J, Peetsma TT. Child negative emotionality and parenting from infancy to preschool: A meta-analytic review. *Developmental Psychology*. 2007; 43:438.doi: 10.1037/0012-1649.43.2.438 [PubMed: 17352551]
- Pederson DR, Moran G. Appendix B. Maternal Behavior Q-set. In: Waters E, Vaughn BE, Posada G, Kondo-Ikemura K, editors *Caregiving, cultural, and cognitive perspectives on secure-base behavior and working models: New Growing Points of Attachment Theory and Research*. Vol. 60. 1995. 247–254. Monographs of the Society for Research in Child Development
- Posner MI, Rothbart MK. Developing mechanisms of self-regulation. *Development and Psychopathology*. 2000; 12:427–441. DOI: 10.1017/S0954579400003096 [PubMed: 11014746]
- Posner MI, Rothbart MK, Sheese BE, Voelker P. Control networks and neuromodulators of early development. *Developmental Psychology*. 2012; 48:827.doi: 10.1037/a0025530 [PubMed: 21942663]
- Putnam SP, Stifter CA. Behavioral approach–inhibition in toddlers: Prediction from infancy, positive and negative affective components, and relations with behavior problems. *Child Development*. 2005; 76:212–226. DOI: 10.1111/j.1467-8624.2005.00840.x [PubMed: 15693768]
- Roberts BW, DelVecchio WF. The rank-order consistency of personality traits from childhood to old age: A quantitative review of longitudinal studies. *Psychological Bulletin*. 2000; 126:3–25. DOI: 10.1037/0033-2909.126.1.3 [PubMed: 10668348]
- Rothbart MK, Bates JE. Temperament. In: Eisenberg N, Damon W, Lerner RM, editors *Handbook of child psychology: Vol 3, Social, emotional, and personality development*. 6th. Hoboken, NJ US: John Wiley & Sons Inc; 2006. 99–166.
- Rothbart MK, Derryberry D. Development of individual differences in temperament. In: Lamb ME, Brown AL, editors *Advances in developmental psychology*. Hillsdale, NJ: Erlbaum; 1981. 37–86.
- Sanson A, Hemphill SA, Smart D. Connections between temperament and social development: A review. *Social Development*. 2004; 13:142–170. DOI: 10.1046/j.1467-9507.2004.00261.x
- Seifer R, Sameroff AJ, Barrett LC, Krafchuk E. Infant temperament measured by multiple observations and mother report. *Child Development*. 1994; 65:1478–1490. DOI: 10.1111/j.1467-8624.1994.tb00830.x [PubMed: 7982363]
- Seifer R, Sameroff AJ, Dickstein S, Gitner G, Miller I, Rasmussen S, Hayden LC. Parental psychopathology, multiple contextual risks, and one-year outcomes in children. *Journal of Clinical Child Psychology*. 1996; 25:423–435. DOI: 10.1207/s15374424jccp2504_7
- Seifer R, Sameroff A, Dickstein S, Schiller M, Hayden LC. Your own children are special: Clues to the sources of reporting bias in temperament assessments. *Infant Behavior and Development*. 2004; 27:323–341. DOI: 10.1016/j.infbeh.2003.12.005

- Seifer R, Schiller M, Sameroff AJ, Resnick S, Riordan K. Attachment, maternal sensitivity, and infant temperament during the first year of life. *Developmental Psychology*. 1996; 32:12.doi: 10.1037/0012-1649.32.1.12
- Shiner RL, Buss KA, McClowry SG, Putnam SP, Saudino KJ, Zentner M. What Is Temperament Now? Assessing Progress in Temperament Research on the Twenty-Fifth Anniversary of Goldsmith et al. (1987). *Child Development Perspectives*. 2012; 6:436–444. DOI: 10.1111/j.1750-8606.2012.00254.x
- Spitzer R, Williams J, Gibbon M, First MB. *Structured Clinical Interview for DSM-III-R*. Washington, DC: American Psychiatric Press; 1990.
- Stams GJJ, Juffer F, van IJzendoorn MH. Maternal sensitivity, infant attachment, and temperament in early childhood predict adjustment in middle childhood: the case of adopted children and their biologically unrelated parents. *Developmental Psychology*. 2002; 38:806.doi: 10.1037/0012-1649.38.5.806 [PubMed: 12220057]
- Thomas A, Chess S, Birch HG, Hertzog ME, Korn S. *Behavioral Individuality in Early Childhood*. New York: New York University Press; 1963.
- Verreault N, Da Costa D, Marchand A, Ireland K, Dritsa M, Khalifé S. Rates and risk factors associated with depressive symptoms during pregnancy and with postpartum onset. *Journal of Psychosomatic Obstetrics & Gynecology*. 2014; 35:84–91. DOI: 10.3109/0167482X.2014.947953 [PubMed: 25123985]
- Zalewski M, Thompson SF, Lengua LJ. Parenting as a Moderator of the Effects of Maternal Depressive Symptoms on Preadolescent Adjustment. *Journal of Clinical Child & Adolescent Psychology*. 2015; Advance online publication. doi: 10.1080/15374416.2015.1030752

Figure 1. Maternal postpartum depression is associated with change in infant temperament when maternal sensitivity is low

Figure 2.
Maternal postpartum depression is associated with change in infant temperament when family functioning is low

Table 1**Temperament Adjective Triad Assessment Items**

<u>Mood Subscale</u>	
Happy/Jubilant/Cheerful	Sad/Blue/Unhappy
Effective/Successful/Achieving	Frustrated/Limited/Blocked
Content/Satisfied/Comfortable	Fussy/Upset/Cranky
Alert/Bright-eyed/Attentive	Bored/Inert/Unattentive
<u>Approach Subscale</u>	
Exploring/Seeking/Investigating	Reserved/Inhibited/Shy
Approaching/Moves Toward/Contacting	Withdrawing/Avoidant/Ignoring
<u>Activity Subscale</u>	
Vocal/Babbling/Noisy	Silent/Hushed/Quiet
Fast-paced/Up-tempo/Quick	Deliberate/Steady/Slow-paced
Energetic/Lively/Animated	Exhausted/Tired/Worn out
Active/Busy/Moving	Still/Idle/Passive
<u>Intensity Subscale</u>	
Intense/Vigorous/Strong	Mild/Moderate/Low-key
Involved/Enthusiastic/Engaged	Uninvolved/Neutral/Detached
Reactive/Aware/Sensitive	Serene/Placid/Unreactive
<u>Distractibility Item</u>	
Distractible/Fleeting/Transient	Persistent/Focused/Lasting

Note: The mean of the 14 Temperament Adjective Triad Assessment items was used to derive a Total Difficulty score. Alpha coefficients for the Total Difficulty Score was .86 at 8 months, .85 at 15 months, and .89 at 30 months.

Table 2

Descriptive Statistics and Correlations Among Substantive Variables of Interest

	1	2	3	4	5	6	7	8	9	10	11
1. Prenatal Depression	–										
2. Postpartum Depression Status	.56**	–									
3. Postpartum Depressive Symptoms	.56**	.75**	–								
4. Socioeconomic Status	.21*	.17*	.19*	–							
5. Maternal Age	–.15	–.20*	–.08	–.44**	–						
6. Infant Sex	–.24**	–.09	–.11	–.08	.11	–					
7. Maternal Sensitivity (15 mo)	–.26**	–.33**	–.42**	–.43**	.38**	.12	–				
8. Family Functioning (15 mo)	–.09	–.25**	–.26**	–.29**	.37**	.19*	.44**	–			
9. Infant temperament (8 mo)	–.06	–.03	.05	–.10	.08	.05	–.10	–.03	–		
10. Infant temperament (15 mo)	–.13	–.02	–.07	–.08	.03	.05	–.15	.03	.49**	–	
11. Infant temperament (30 mo)	–.03	.17 ^t	.15 ^t	–.07	–.06	–.01	–.06	–.05	.34**	.49**	–
Frequency	n=23 (16%)	n=38 (26%)	–	–	–	69 girls (47%)	–	–	–	–	–
Mean	–	–	2.02	2.14	29.11	–	.58	4.81	68.30	65.96	65.02
SD	–	–	1.33	.89	5.46	–	.38	1.10	5.34	4.84	5.11

Note: N = 147. Statistics presented are those prior to imputation of missing data.

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

Latent Growth Curve Models Predicting Change in Infant Temperament over Time

Table 3

	Model 1: Depression Status B(SE)	Model 2: Depressive Symptoms B(SE)	Model 3: Maternal Sensitivity B(SE)	Model 4: Depression Status X Sensitivity B(SE)	Model 5: Depressive Symptoms X Sensitivity B(SE)	Model 6: Family Functioning B(SE)	Model 7: Depression Status X Family Functioning B(SE)	Model 8: Depressive Symptoms X Family Functioning B(SE)
Predicting Intercept								
Infant sex	.15 (.69)	.16 (.68)	.11 (.70)	.09 (.70)	.11 (.70)	.29 (.71)	.19 (.69)	.14 (.69)
Family SES	-.44 (.42)	-.48 (.42)	-.81 (.44)	-.77 (.44)	-.77 (.44)	-.56 (.43)	-.53 (.42)	-.59 (.41)
Maternal age	-.02 (.07)	-.03 (.07)	.03 (.07)	.03 (.07)	.02 (.07)	.00 (.07)	.00 (.07)	-.01 (.07)
Prenatal depression	-.95 (1.18)	-1.14 (1.14)	-.90 (1.00)	-1.49 (1.18)	-1.39 (1.16)	.02 (1.01)	-.74 (1.19)	-.86 (1.17)
Postpartum depression	.86 (.93)	3.54 (2.55)		.84 (.98)	1.59 (2.78)		.87 (.96)	2.16 (2.65)
Maternal sensitivity			-3.83** (1.33)	-2.83 (1.71)	-3.01* (1.46)			
Family Functioning						-.30 (.34)	.30 (.42)	-.03 (.34)
PPD × Sensitivity				-1.21 (2.47)	-6.34 (6.95)			
PPD × Family Functioning							-1.24* (.63)	-4.24* (1.69)
Predicting Slope								
Infant sex	-.25 (.51)	-.20 (.51)	.05 (.53)	-.02 (.51)	.04 (.51)	-.13 (.52)	-.26 (.50)	-.25 (.51)
Family SES	-.14 (.31)	-.15 (.31)	-.14 (.33)	-.04 (.32)	-.06 (.33)	-.07 (.31)	-.04 (.30)	-.08 (.31)
Maternal age	-.06 (.05)	-.07 (.05)	-.09 (.05)	-.09 (.05)	-.10 (.05)	-.08 (.05)	-.07 (.05)	-.08 (.05)
Prenatal depression	-.76 (.90)	-.22 (.88)	.43 (.76)	-.61 (.90)	-.35 (.87)	.01 (.76)	-1.00 (.90)	-.59 (.89)
Postpartum depression	1.36 (.70)	1.98 (1.90)		1.31 (.73)	1.92 (2.05)		1.18 (.71)	1.13 (1.98)
Maternal sensitivity			.28 (1.03)	2.62* (1.33)	1.63 (1.12)			
Family Functioning						.02 (.25)	.63* (.31)	.19 (.25)
PPD × Sensitivity				-3.82* (1.86)	-13.02* (5.21)			
PPD × Family functioning							-1.21* (.46)	-2.86* (1.26)
Model Fit								
Chi-Square	5.83 (8), ns	10.85 (8), ns	5.38 (8), ns	8.80 (10), ns	16.41 (10), ns	5.77 (8), ns	7.63 (10), ns	11.58 (10), ns
SRMR	.027	.033	.033	.025	.033	.032	.027	.032

Note: N = 147. PPD = Postpartum depression.
* p < .05.
** p < .01.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript