Fall 12-20-2013

The Interaction of Post-Partum Depression and Maternal Knowledge of Infant Development on Change in Sensitive and Responsive Parenting during Early Infancy

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A Thesis

Submitted to the Graduate Faculty of the
University of New Orleans
in partial fulfillment of the
requirements of the degree of

Master of Science
in
Psychology

By

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B.A. University of Tampa 2006

December 2013

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Abstract

Sensitive and responsive parenting during early infancy is highly understudied, particularly in families with a low socioeconomic status. Longitudinal data from 41 mothers and their 4 to 16 week old infants found that accurate maternal knowledge of infant development positively affected parenting contemporaneously and over time while depression did not affect parenting in this sample. Implications for intervention and research are discussed.

Parenting, sensitive and responsive, early infancy, depression, knowledge, low-income, intervention, infants, sensitive parenting

The Interaction of Post-Partum Depression and Maternal Knowledge of Infant Development on Change in Sensitive and Responsive Parenting during Early Infancy

Theoretically, the quality of mother-infant interactions observed during the infancy period has profound effects on children's adjustment during infancy and into childhood (Ainsworth, 1979). Importantly, emerging relationship quality is highly dependent on mothers' ability to sensitively respond to the needs of their developing infants. Infants who are cared for by warm, engaged mothers who are stimulating and responsive have been found to be more securely attached to their mothers, more social infants and children, and more successful in future challenges such as school achievement and extracurricular activities (Combs-Orme, Wilson, Cain, Page & Kirby, 2003). In contrast, infants with disengaged, non-responsive or inconsistent parents have higher rates of behavioral and emotional problems in childhood that are often associated with a lack of emotional control and social and cognitive disturbances (Green & Goldwyn, 2002; Wakschlag & Hans, 1999). Thus, sensitive/responsive parenting, defined as mothers' ability to respond to infant cues in a timely and developmentally appropriate manner (Wakschlag & Hans, 1999), has emerged as the parenting 'gold-standard' which promotes optimal development during infancy and places mothers and infants on trajectories of increasing competence during the early childhood period (Landry, Smith, Swank, Assel, & Vellet, 2001).

One critical limitation with research considering the quality of early mother-infant interactions is that very few, if any, have focused on the early infancy period or the period from birth to 6 months of age. The lack of research considering the early infancy period is concerning for a number of reasons. First, theoretically, mothers' ability to respond to infants' needs in a timely, accurate, and effective manner affects the developing mother-infant relationship quality

and infant attachment (e.g., Ainsworth, 1979). Second, socioeconomic status (e.g. Eamon, 2000), lack of knowledge of infant development (e.g. Reich, 2005) and post-partum depression (e.g., Sohr-Preston & Scaramella, 2006) measured during the early infancy period have been found to negatively impact children's social, emotional, and cognitive adjustment during later developmental periods. Finally, in all likelihood low socioeconomic status, poor understanding of infant development, and elevated symptoms of maternal post-partum depression also negatively impact mothers' ability to read infants' cues and to sensitively respond to infants' needs. Given the preponderance of theoretical and empirical research highlighting the importance of responsive parenting during early infancy (e.g. Combs-Orme et al., 2003), a more thorough understanding of the interpersonal and environmental characteristics that may affect mothers' ability to engage in sensitive and responsive parenting during this critical developmental period is needed.

Although factors that may interfere with mothers' ability to sensitively respond to their infants needs are potentially limitless, the current research study considers the role of mothers' post-partum depression and knowledge of infant development on change in sensitive and responsive parenting during the early infancy period, or from infant age 4 to 16 weeks. Specifically, elevated and sustained levels of post-partum depression and a lack of understanding of the timing of infant skill acquisition (poor maternal knowledge) are expected to be associated with lower levels of sensitive and responsive parenting. The following sections will discuss the importance of sensitive and responsive parenting during the infancy period and then will describe how post-partum depression and inaccurate knowledge of infant development may interfere with the emergence of sensitive and responsive parenting. Finally, virtually no research considers the development of sensitive and responsive parenting among socioeconomically

impoverished families. The importance of better understanding processes related to the development of sensitive and responsive parenting among this social group will be discussed.

The developmental significance of sensitive/responsive parenting during early infancy

Sensitive/responsive parenting has been defined as mothers' ability to attend to their children's needs and emotions in ways that are developmentally appropriate in emotion, type, timing and intensity (Wakschlag & Hans, 1999). Sensitive responding can include giving and communicating affection, accurately interpreting and addressing the source of infants' distress, and being accepting and empathetic during distress bouts (Keller, Lohaus, Volker, Elben & Ball, 2003; Weis & Toolis, 2010). Additionally, sensitivity is characterized by parental responses that are well-timed developmentally, such that mothers respond quickly to very young infants' cries but may give older infants more time to attempt to self soothe. Importantly, sensitive/responsive parenting promotes infants' emerging autonomy by allowing infants periods of disengagement (e.g., gaze aversion) and engagement during social interactions (Tronick, Als & Brazelton, 1977).

Although sensitive parenting during the infancy period has been linked to more positive social adjustment during infancy and childhood (e.g. Landry et al., 2001), engaging in sensitive parenting is not easy for parents. By not matching infants' distress with distress, sensitive parents may need to regulate their own emotional arousal. That is, sensitive parents typically sooth their distressed infants' with calmness and warmth while managing the source of their babies' distress (LaGasse, Neal & Lester, 2005). However, even the most sensitive parents often experience difficulty calming their babies and experience times in which the source of their infants' distress cannot be identified. Importantly, while sensitive responding often is effective in reducing infants' distress, effectiveness is not part of the definition of sensitive parenting. Instead,

sensitive/responsive parents manage their infants' needs and cues, rather than their own (Smith, Landry & Swank, 2005). Taken together, sensitive/responsive parenting is a complex parenting style requiring well-timed and often soothing (i.e., calm and warm) responses to infants' distress while, potentially, also managing parents' own emotional arousal.

Adding to the complexity of the sensitive/responsive parenting construct is that sensitive parenting changes in response to infants' development. During the newborn period (0-3 months) parenting responses that quickly and accurately identify the source of infants' distress are rated as higher in sensitivity (Keller et al., 2003). During this early infancy period, infants' memory is limited so that delayed periods of waiting for a caregiver response can be even more distressing than during later developmental periods (Keller et al., 2003). Theoretically, timely and accurate parental responses to infants' distress enhances infants' development of self-regulation by increasing infants' trust in their caregiver (Kopp, 1982; Landry, Smith & Swank, 2006). That is, the more contingent and appropriate parents' responses are to infants' signaling, the sooner regular routines, parent-infant reciprocal interactions, and infants' self-regulatory abilities will emerge (Kopp, 1982).

Compared to later developmental periods, sensitive/responsive caregiving is perhaps most challenging and least rewarding during the early infancy period; very young infants do not have the ability to socially smile in response to caregivers' activities and are not an active participant in dyadic interactions (Spitz, 1949). Thus, the amount of positive feedback caregivers receive from infants for their efforts is limited. Increases in infants' ability to socially engage their parents from 4 to 12 months makes sensitive responding more rewarding, but ironically, sensitivity requires a gradual reduction in responsivity with age. During this middle infancy period, sensitive parenting involves gradual reductions in prompt responding with the intention

of encouraging and promoting infants' autonomy (Bayer, Sanson & Hemphill, 2006). Reflecting the dynamic and changing nature of sensitive parenting, parents' contingent responses to infants' cues are no longer enough to define sensitive and responsive parenting. The middle infancy period is associated with fewer feedings with more time in between feedings, increasingly longer periods of wake time, and increases in the length of sleep overnight. In addition, middle infants are able to smile socially, show pleasure during dyadic interactions, are able to focus and sustain attention for longer periods of time, and demonstrate significant increases their activity level (e.g., crawling; Kopp, 1982). While these physical, social and cognitive changes are positively received by parents, such infant advances also require increasingly more attention and stimulation from caregivers which can be as demanding as the constant caregiving needs of the early infancy period (Kopp, 1982). Characteristically, sensitive parenting during the middle infancy period promotes and encourages exploration of their environments, while simultaneously monitoring the safety of the environment (Landry et al., 2006).

Thus, sensitive parenting requires a frequent re-calibration of how and when to respond to infants' cues based on parents' expectations and perceptions of their infants' ability to autonomously regulate or manage their own emotions or behaviors. In other words, sensitive parents may become less responsive to their babies in order to provide babies with an opportunity to 'try it on their own'. Such delays in responding to their babies' cries may reflect an expectation that their infants can manage their distress independently. What distinguishes sensitive from unresponsive parents is that sensitive parents continue to monitor infants' distress. If infants are unable to self-soothe, sensitive parents will intervene where unresponsive parents will not. Theoretically, sensitive/responsive parenting during the early infancy period sets the tone for parents' pattern of responding to infants' cues over time and has important implications

on the quality of infants' physical, social, cognitive and motor development. Quite surprisingly, very few studies examine parenting during early infancy and how parents come to adopt sensitive responding. The lack of parenting research during early infancy may be due to a general expectation that the transition to parenthood is stressful and that new mothers have little time or energy to participate in research. Alternatively, since the primary parenting duties in early infancy involve feeding, diapering and sleep, few measurable parenting experiences may exist, limiting the variability in responsive parenting. Despite the challenges for researchers, the early infancy period does pose a number of new parenting challenges for mothers. Mothers must balance the caregiving demands inherent to the newborn period while developing a sensitive and responsive parenting style. Research that clarifies barriers impeding the development of sensitive and responsive parenting is clearly needed. One such barrier to using more sensitivity may be a lack of knowledge of infant development.

The relationship between maternal knowledge of infant development and sensitive/responsive parenting

Parents with little or no knowledge of infant developmental abilities or infant social, emotional and cognitive development may experience more difficulties adapting to the changing demands of infant development. For instance, mothers who expect their infants to sleep through the night or increase feeding intervals before their infants are developmentally able to do so may become increasingly frustrated with these caregiving demands (Reich, 2005). Presumably, mothers whose knowledge of infant developmental abilities coincides with actual abilities should be more tolerant of the early infancy period in which demands on caregivers is high and caregiver rewards are minimal. In other words, mothers who expect their newborn infants to need to eat, sleep, and have diaper changes on a frequent and irregular basis throughout the day

and night should become less frustrated with infant cries, inconsistent sleep patterns and feeding routines and be will be more tolerant of the demands associated with early infant caregiving.

Closely tied to knowledge of infant development are expectations for infants' behavior. In all likelihood, a positive association between knowledge of infant development and expectations of infant behavior exists. For instance, mothers who are more knowledgeable about infant developmental processes also tend to have more realistic expectations of their infants' abilities (Reis, 1988). However, this association is far from absolute. Quite possibly, mothers may have unrealistic expectations for their own infants' behavior even though they have generally accurate understanding of how infants develop. That is, even if mothers are aware that infants do not sleep through the night at three months of age, mothers may still expect such behavior from their own babies. Mothers' expectations for the timing of their infants' skill development is likely to be more subjective than actual knowledge of the timing of infant skill development. Moreover, given the paucity of empirical research even focusing on the role of knowledge of infant development on sensitive parenting, the proposed study will consider only how maternal knowledge of infant development is related to sensitive and responsive parenting and will not focus on maternal expectations for skill development.

Quite surprisingly, mothers generally seem to be poor estimators of the timing of infants' developmental abilities. Using a sample of 203 low-income mothers recruited from pediatric waiting rooms, mothers were asked to complete questionnaires regarding infant abilities at varying stages of development as well as appropriate parenting practices for each of these stages. Mothers were found to overestimate the abilities of their 6 month old infants' sleep, feeding and physical abilities by as many as three months or more (Reich, 2005). This mismatch between what mothers' think their infants should be able to do and what their infants' are actually capable

of doing may be associated with less sensitive and responsive parenting. That is, mothers may become overly frustrated with normal infant behaviors when mothers' knowledge of infant developmental milestones is inaccurate (Fox et al, 1995). Consistent with this idea, more accurate knowledge of infant development has been associated with higher levels of sensitive, stimulatory and flexible child-rearing behaviors (Knoche et al., 2007). For example, adolescent mothers who rated themselves as more capable and more knowledgeable had 9.5 month old infants who scored higher on the Bayley Scales of Infant Development (Knoche et al., 2007), suggesting that more competent and knowledgeable mothers provide more effective infant stimulation. Similarly, using a sample of 254 mothers and their 20 month old toddlers, Bornstein and colleagues (2007) found that the mothers who scored the highest on observer ratings of positive parenting practices including warmth and sensitivity had a better understanding of normative developmental social and cognitive progression (e.g. language competence and sociability) and were more aware of how the environment influences infant development. In the current study, more accurate knowledge of infant development at 1 month of age was hypothesized to predict increases in sensitive and responsive parenting from 1 to 4 months of age (see Figure 1).

Post-partum depression undermines sensitive/responsive parenting

While research evaluating the links between accurate knowledge of infant development and parenting is limited, an abundance of evidence has linked depression with reductions in sensitive parenting. Post-partum depression has been found to affect approximately 20% of new mothers with symptoms beginning as early as the eighteenth week of pregnancy (Sohr-Preston & Scaramella, 2006). Up to 80% of post-natal women experience depressive symptoms that largely impact their social and cognitive functioning and increases risk that the symptomology may

develop into post-partum depression (Livingood, Daen & Smith, 1983; Sohr-Preston & Scaramella, 2006). Although elevated symptoms of depression are normative immediately following childbirth, very little is known regarding the impact of change in depressive symptoms for the emerging mother-infant relationship or the quality of mothers' parenting. One possibility is that depressive symptoms during the weeks immediately following childbirth have no effect on the emerging parenting quality. Alternatively, as early depressive symptoms dissipate during the post-partum period, mothers become increasingly more sensitive and responsive to their babies' needs; again, no lasting negative effects may occur. However, if depressive symptoms are slow to wane, mothers may be placed on a trajectory of decreasing parenting sensitivity (e.g. Sohr-Preston & Scaramella, 2006).

Compared to mild or transient depressive symptoms, depressive symptoms that persist may negatively impact the quality of mothers' parenting. For instance, depressed mothers have been found to be more irritable, hostile, uninvolved and unaffectionate during interactions with their infants than non-depressed mothers (e.g. Albright & Tamis-LeMonda, 2002; Dodge, 1990; Livingood et al., 1983). New mothers with elevated levels of depressive symptoms also seem to have problems using appropriate levels of stimulation with their babies during dyadic exchanges and have been found to either over or under stimulate their babies (Livingood et al., 1983; Sohr-Preston & Scaramella, 2006). Perhaps most concerning, beyond the newborn period, depressed mothers have been found to look at their children less, speak to them less frequently, are more easily frustrated and overwhelmed by typical infant demands, and are less able to meet the demands of their children (Knoche, Givens & Sheridan, 2007; Livingood et al., 1983; Mantymaa, Puura, Luoma, Salemelin & Tamminen, 2006). Consistent with previous research and as illustrated in Figure 1, mothers' levels of depressive symptoms measured 1 month post-

partum is expected to be associated with less sensitive and responsive parenting observed at 4 months, even after controlling for earlier sensitivity.

Placing sensitive/responsive parenting within a social context of risk

Regardless of socioeconomic status, most mothers experience some stress when caring for a newborn infant. However, the stress associated with caring for a newborn can be amplified by the presence of other children, household chores, work demands, a lack of sleep, and the mothers' physical recovery to childbirth. While increases in stress related to increased caregiving demands are common, low income status may exacerbate such stress. Low socioeconomic status is typically defined as low income (e.g., incomes at or below 200% of the poverty line), hourly work status with little or no maternity leave, and fewer years of educational attainment (e.g., Conger & Donnellan, 2007). The financial burden of caring for a newborn will be significantly greater for families making less money because all infants require the same level of basic care (e.g., diapers, formula). In other words, low-income families may choose to purchase cheaper diapers, but not have much flexibility in how many diapers are used.

Compared to more affluent mothers, low SES families cope with more daily stressors and, over time, these daily stressors can undermine parents' abilities to handle subsequent stress including the demands of caring for children (Klebanov, Brooks-Gunn & Duncan, 1994). Not surprisingly, low-income at-risk mothers have been found to be less responsive to their babies, perhaps because of the stress associated with low SES and household chaos (Wachs, 1999; Wakschlag & Hans, 1999). During later developmental periods, economically impoverished mothers have been found to convey fewer positive feelings towards their preschool-aged children, to be less affectionate with their children, and to speak less frequently to their children as compared to middle class families (Eamon, 2000). In addition, mothers with less educational

attainment, disproportionately found in among low SES individuals, have been found to score lower on measures of nurturance and warmth than mothers with higher education (Fox et al., 1995).

Despite recognizing the additional stressors that low-SES mothers face on a daily basis, very little research has considered the impact of economic disadvantage on parenting during the early infancy period. Not surprisingly, mothers who display little affection, sensitivity, warmth and responsiveness towards their infants have infants who are at a higher risk for developing social, emotional or cognitive problems (Bayer et al., 2010; Wakschlag & Hans, 1999; Weis & Toolis, 2010). However, few, if any, studies have considered the increased risk for post-partum depression that low SES women face and virtually no research has considered how maternal knowledge of infant development would affect mothers' sensitivity among economically impoverished mothers.

Infant temperament, maternal age and sensitive and responsive parenting

While little is known about how maternal knowledge and low SES may affect sensitive parenting during infancy, infant temperament repeatedly has been found to affect parenting style. In other words, some infants are simply easier to sensitively parent than others (i.e. Seifer, Schiller, Sameroff, Resnick & Riordan, 1996). Seifer and colleagues (1996) highlight that infant behavior (i.e. soothability) is typically the sole indicator of mothers' sensitivity, but infant temperament may affect how easy babies are to soothe (Seifer et al., 1996). Given the established link between more reactive infant temperament and less responsive parenting (Koenig, Barry & Kochanska, 2010), in the current study, infant distress was controlled statistically in all analyses.

Like temperament, mothers' age also has been positively associated with more sensitive caregiving. Specifically, older mothers are generally found to be more sensitive and responsive

than younger, particularly adolescent-aged, mothers. In reports comparing first time adolescent mothers with first time adult-aged mothers, adolescent mothers report greater feelings of stress, depression and feeling 'out of control' than older mothers (Barratt, Roach, Morgan & Colbert, 1996). Quite possibly, younger mothers are less cognitively ready to parent when compared to older mothers (Miller, Miceli, Whitman & Borkowski, 1996). Mothers' age, in addition to infant distress reactivity, also was controlled in all analyses.

Study Goals

This study addresses critical research gaps by considering the role of maternal knowledge of infant development and levels of post-partum depression on the emergence of sensitive/responsive parenting during the early infancy period. First, stability in sensitive parenting from 1 to 4 months post-partum was examined. Next, maternal knowledge and levels of depression measured when infants were 1 month of age were expected to predict change in sensitive parenting from 1 to 4 months of age. Finally, more maternal depression was expected to diminish the positive impact of elevated maternal knowledge, measured at 1 month of age, on increases in sensitive parenting from 1 to 4 months. Importantly, a sample of socioeconomically at risk women, an understudied population in terms of risk for post-partum depression, maternal knowledge of development and parenting during infancy, was included. Specifically, the current study tested the following hypotheses:

Hypothesis 1: Maternal sensitivity will demonstrate modest stability over time, reflecting within sample variability in the amount of change in sensitivity (either increasing sensitivity or decreasing sensitivity) during the early infancy period.

Hypothesis 2: Higher levels of maternal depression measured at 1 month of age will predict decreases in sensitive/responsive parenting from 1 to 4 months of age.

Hypothesis 3: Elevated levels of depression and low levels of maternal knowledge measured at 1 or 4 months of age will interactively predict change in sensitive/responsive parenting from 1 to 4 months of age. Specifically, under conditions of high maternal depression, maternal knowledge will have little effect on responsive parenting. Under conditions of low maternal depression, maternal knowledge will predict increases in responsive parenting.

Methods

Participants

Forty-one mothers with infants aged 0 - 4 weeks participated in the current study. All mothers were recruited from a clinic targeting serving economically disadvantaged families in the New Orleans area (i.e. Daughters of Charity). Mother's averaged 25 years of age (SD = 6.25) at the first assessment. Participants were predominately African American (83%) with an average annual income of $14,900. Since income alone does not take into account family size, an income-to-needs ratio was computed. The income-to-needs ratio converts annual household income to a score reflecting the distance from poverty. Scores of 1 reflect incomes that are at the poverty line, with scores below 1 reflecting incomes below poverty and values greater than 1 representing the distance from the poverty line. Income-to-needs ratio is calculated dividing total annual income by the 2012 poverty guideline for the comparably sized family. In the current investigation, the average income-to-needs ratio was .65 indicating that the majority of families had incomes that were 35% below the poverty level. Eighty-three percent of mothers graduated from high school, although only approximately 10% completed any post high school education. Almost half (49%) of mothers reported being single, never married and not living with a romantic partner at the time of the 4 week assessment.

Participants were first recruited during visits to the health clinic. Clinical caseworkers affiliated with the Daughters of Charity explained the study to pregnant women and women who had recently delivered a healthy baby and whose baby was younger than 4 weeks of age. Mothers who were interested in learning more information about the study gave the clinical caseworker permission for their name and contact number to be provided to project staff. Twice a week, clinic staff sent the names and phone numbers of interested participants to the Project Manager. The Project Manager contacted interested mothers, explained the study, and reviewed eligibility requirements. Women were eligible if they received health care through Daughters of Charity, had a baby who was not less than 36 weeks gestational age at birth, and who did not have any severe medical conditions. Interested women who were still pregnant were re-contacted shortly after the birth of their baby and screened for eligibility.

While 41 mothers completed the 4 week assessment, only 26 mothers participated in the 16 week assessment (retention = 63%). A number of reasons for not participating emerged, none of which seemed directly tied to the activities of the interview. The 16 week time point seemed to be a particularly challenging developmental period for mothers, especially if mothers were returning to work. Other mothers did not have working telephone numbers, even though they had been contacted a few weeks prior to the 16 week interview date. Some mothers were not home when interviewers arrived for the pre-scheduled meeting. A set of paired t-tests were computed to compare participating mothers with nonparticipating mothers at 16 weeks on critical study constructs; no statistically significant differences emerged.

Procedures

All study procedures were approved by the Institutional Review Board at the University of New Orleans. Mothers' completed assessments with their babies at 4, 10, and 16 weeks of

age. Both the 4 and 16 week visits included an in-home feeding assessment and videotaped mother-infant behavior. To decrease participant burden, the 10 week assessment was a brief assessment, with no in home observations that could be completed in home or over the phone. Interviews were scheduled in the participants' homes or at the University of New Orleans to occur within 3 days of the infants' 4 week (1 month), 10 week, and 16 week (4 months) birthday. Only data from the 1 and 4 month assessments were used in the current study. Mothers were compensated $25 for the initial 1-month assessment and $35 for the 4-month assessment.

Upon arrival to the home, interviewers first reviewed the consent form with mothers (all assessments) and obtained her signed consent (only at 4 weeks). Next, interviewers set up the interview and brought an infant carrier, camera and tripod to the home. The entire interview was videotaped. Mothers were asked to sit in a comfortable place with their babies and the interviewer reviewed the activities for the assessment. Mothers completed three activities: feeding her baby, completing questionnaires, and participating in a structured activity which involved swaddling her baby. At the 16 week assessment, mothers also completed a still face activity with their babies, but this activity was not used in the current report. Mothers selected the order in which they wanted to complete the feeding, the questionnaire interviews, and the swaddling activity based on their babies' expected sleeping and feeding schedule.

The questionnaire portion of the interview involved interviewers reading a series of questions to the mothers and recording their answers. Mothers followed along in a blank questionnaire booklet. The only exception was when interviewers asked mothers about their feelings of depression. At this time, mothers and interviewers traded questionnaires. Interviewers read the items to mothers and mothers recorded their answers privately. As part of the consenting process, mothers were informed that their levels of depression were measured and

if they had high levels of depression, their interviewers would contact them and contact the Clinical Caseworker at Daughters of Charity. Mothers' depression answers were scored within 48 hours of completing the interview. The Principal Investigator of the study was notified of all mothers scoring in the clinically significant range for depression (i.e., over 30); interviewers contacted mothers and then notified the Clinical Caseworker. Three mothers had scores in the range which required them and their Clinical Caseworker to be contacted.

Interviewers helped mothers complete a sleep/feeding/crying diary for themselves and their babies that recorded both mothers' and babies' eating and sleeping schedule during the past 24 hours and marked any instance of crying during the previous 24 hours. Mothers were taught how to use the schedule and asked to record the sleep/feeding/crying diary for themselves and their infant for 3 days immediately following the 1 and 4 month assessment. After 3 days the interviewer called mothers and recorded the information over the phone. In the present study, only the diary data collected at the time of the initial assessment was used.

Two observational procedures were used to measure mothers' sensitive and responsive parenting at the 1 and 4 month assessments. First, mothers' were videotaped feeding their infants and their feeding behaviors were later coded using the NCAST feeding coding system. Next, mothers were videotaped swaddling their babies in a large receiving blanket. Interviewers demonstrated the swaddling procedure using a baby doll and mothers then practiced swaddling their babies. This activity was expected to generate variation in mothers' sensitive handling and manipulation of their babies, but initial pilot coding indicated little to no variability in sensitivity and the activity was not included in the present report.

Measures

Maternal Knowledge. Two measures were used to assess maternal knowledge of infant development. The 20-item Concepts of Development Questionnaire (CODQ; Sameroff & Feil, 1985; Gutierrez & Sameroff, 1988; Benasich & Brooks-Gunn, 1996) is a measure of mothers' understanding of infant development. Mothers respond on a 4-point scale (1 = strongly disagree, 4 = strongly agree). Items assess mothers' understanding of infant characteristics (e.g. "girls tend to be easier babies to take care of than boys") as well as mothers' perspective regarding infant development (e.g. "the mischief that 2 year olds get into is part of a passing stage they will grow out of"). Based on the scoring procedures developed by Sameroff and Feil (1985), items for the perspective scale and categorical scale are summed and divided by 10. A composite score is computed by subtracting the categorical scale from the perspective scale and adding 3. Next, the total score is computed by dividing the score by 2. The possible range of the CODQ was 0-4. Average scores at the 4 and 16 week assessments were 1.81 indicating that mothers had only modest understanding of infant development.

Mothers also completed the 45-item Opinions about Babies questionnaire (OAB; Reich, 2005) which measures mothers' understanding of typical child developmental milestones and abilities. Developed from the American Pediatric Association recommendations, mothers indicated whether or not they agreed (1) or disagreed (0) with each statement; a 'no opinion' category (2) also was included when mothers were unaware of the milestone described. Sample questions include "baby food and cereal should be given when a baby is 3 months old" and "babies learn from watching what their mothers do". Scores were computed by summing the total number of correct responses; scores can range from 0 to 75 with higher scores indicating more accurate knowledge of infant milestones. Scores on the OAB increased slightly from 4

weeks (M = 50.54) to 16 weeks (M = 53.94). Mothers' scores again indicated modest levels of knowledge of the American Pediatric Association recommendations of infant achievements. Not surprisingly, the two indexes of maternal knowledge were moderately correlated (4 weeks: r = .42, $p < .01$; 16 weeks: r = .52, $p < .01$). An overall index of maternal knowledge was computed by standardizing the two scores, one derived from the CODQ composite score and the other derived from the OAB, and averaging the scores separately for each point in time.

Symptoms of depression. Mothers' levels of depressive symptoms were measured at 1 and 4 months post-partum using the Beck Depression Inventory (BDI; Beck, Steer & Garbin, 1988; Da Silva, Vieria, Pinheiro, Horta, Pinheiro, Di Silva, 2008). The BDI is a widely used 21-item depression measure that requires individuals to rate constructs on a 0 (no feelings of this nature) to 3 (strong feelings of this nature). Items include assessment for failures, pessimism, crying, self-dislike and feelings of worthlessness and guilt. As requested by the Institutional Review Board, the suicidality item was eliminated from the questionnaire. A final score was computed by averaging across the 20 items and multiplying this score by 21. Since the BDI has a metric for converting scores to a likelihood of reaching clinical levels of depression, converting the scale to the 21 item distribution allows for a more accurate interpretation of the severity of the depressive symptoms.

Sensitive/responsive parenting. Mothers' sensitivity during interactions with their infants was measured in two ways. First, mothers' were observed feeding their infants and qualitative characteristics of the feeding interaction were live coded using the NCAST Feeding Scale. The NCAST Feeding Scale is widely used observational rating system designed to measure parental sensitivity and responsiveness during infant feeding situations. Importantly, the NCAST Feeding Scale has been demonstrated to be highly reliable and valid for assessing parent-child

interactional strengths and weaknesses (Byrne & Keefe, 2003). Although the NCAST system can be used with fathers, reliability and validity has primarily been conducted with mother-infant feedings.

The NCAST system is comprised of 76-items which create 6 subscales, sensitivity to cues (i.e., caregiver allows child to suck/chew without interruption), response to distress (i.e., caregiver changes voice volume to softer or higher pitch [while infant is distressed]), social-emotional growth fostering (i.e., caregiver engages in social forms of interaction at least once during the feeding), cognitive growth fostering (i.e., caregiver talks to child using two words at least three times during the feeding), clarity of cues (i.e., child signals readiness to eat) and responsiveness to caregiver (i.e., child explores caregiver or reaches out to touch caregiver during feeding). For each item that occurred during the feeding, the response of "yes" (1) is recorded. If the item does not occur during the feeding, response of "no" (0) is recorded. In general, higher scores indicate more sensitive parenting. In the present investigation, sensitive/responsive parenting was comprised of the summing scores from the sensitivity to cues, response to distress, social-emotional growth fostering, and cognitive growth fostering subscales. These four subscales (50 items) were used to create the Caregiver Total scale and higher total scores indicated more sensitive/responsive parenting. To date, the NCAST is the only assessment of maternal sensitivity that has been validated for early infancy (NCAST Programs, 1994).

Given the lack of well validated measures assessing the quality of mothers' responsiveness during early infancy, a second coding procedure was developed to rate mothers' attentiveness towards babies during the first 30 minutes of the in home interview. Specifically, mothers' level of attentiveness/involvement with babies was rated using 5 codes: mother looks, mother touches, mother holds, mother bounces, and mother talks to the baby. Coders scored each

consecutive 30 seconds of the first 30 minutes of the interview, resulting in a total of 60 coded epochs. In each epoch, coders marked a 1 if the behavior occurred during that epoch and a 0 if the behavior did not occur. Scores were created by summing each of the 60 epochs separately for each code. Each behavioral code/indicator could range from 0 to 60. A maternal involvement score was created by summing across the 5 involvement codes (possible range 0-300). Twenty-five percent of the maternal involvement videos were double-coded with an average inter-rater reliability of .90.

Since both maternal caregiving during the feeding (caregiver total) and maternal involvement were expected to be indicators of an overall sensitivity construct, the next step was to correlate the caregiver total score from the NCAST feeding scale with the maternal involvement score. Maternal involvement and the caregiver total score were more strongly correlated at 16 weeks ($r = .51$, $p < .05$) than at 4 weeks ($r = .39$, $p < .05$). One possible reason for the variation in the magnitude of the bivariate association could actually be the increased validity of the NCAST feeding scale. Although the NCAST has been validated on infants as young as 4 weeks old, many of the items in the feeding assessment may be "too old" for a one month old infant. For example, one-month-old infants rarely smile, laugh, coo or initiate contact with their mothers; however, multiple NCAST items require these behaviors from infants in order to be scored positively. Conversely, at 16 weeks infants were much more active and engaged during feeding so that more of the categories could be coded.

An overall sensitive parenting score was computed by standardizing and averaging the maternal involvement and caregiver total scores at 4 and 16 weeks. Since the maternal involvement score represents a newly created construct, analyses also were replicated using each of the sensitive/responsivity indicators separately.

Infant demandingness. Finally, an Infant Demandingness score was created to control for variability in infant characteristics. Demanding infants were defined as those who require more attention from caregivers. For example, fussy infants who do not sleep well require more attention from mothers than infants who are quietly watchful and sleep with regularity. Five indicators were used to measure infant demandingness: infant reactivity, poor feeding cues, sleep and eating regularity, and number of overnight awakenings. Each indicator will be described in turn.

First, using the videotaped mother-infant behavior during the first 30 minutes of the assessments coders rated infants' level of reactivity, specifically their vocalizations and distress. Vocalizations included any non-distress sounds which babies made; such vocalizations do not solicit help from mothers and were not included. In contrast, distress vocalizations included any whines, cries, or clear distress cues. These vocalizations are more demanding and are used to get mothers' attention. The summed infant distress code was used to measure the frequency of distress vocalizations during the first 30 minutes of the assessment. Possible scores ranged from 0-60. The mean level of distress in the current sample was 14. Using this cutoff, infants with levels of distress below 14 were scored no risk (0) and infants at or above 14 were scored as risk (1).

A second indicator of demandingness was infants' abilities to provide clear feeding cues. Infants' ability to signal or interact with their caregiver throughout a feeding provides the caregiver with cues of their feeling states (i.e. satiation, pleasure, frustration; Sumner & Speitz, 1994). Infants who do not signal regularly throughout the feeding were considered more difficult to interpret their satiation cues (Sumner & Speitz, 1994). A total of 14 items measure the clarity of infant cues. These included: child actively resists food offered, child initiates contact with

caregiver's face or eyes at least once during the feeding, and child demonstrates satiation at the end of the feeding. Infants are coded as 1 if they display a cue at least once and 0 if no evidence of the cue is present. The 14 codes were summed to create an overall clarity of cues score. Higher scores indicated less demandingness and more clarity of cues. The mean infant clarify of cues score was 11. Infants with scores at or below 11 were coded as more difficult/demanding(1) all other infants received scores of 0.

Next, indicators of sleeping and feeding regularity were coded to measure demandingness. The work of Chess and Thomas (1979) suggests that more biological regularity (e.g., sleep, eating) is associated with an easier and less demanding temperament (see also Rothbart & Ahadi, 1994). Based on pediatric recommended norms, 1-month-old infants should sleep on average 15.5-16.5 hours per day and eat 10 times; 4-month-old infants should sleep on average 15 hours per day and eat 8 times (American Pediatric Association, 2012). A regularity score was computed by calculating the difference between the total hours infants slept during a day from the expected norm (16 at 1 month; 15 at 4 months). Positive scores indicate that infants received more than the recommended number of sleep hours, while negative values indicates the number of hours less than the expected norm. The same procedure was used to compute an infant feeding score, and scores were computed to reflect the total number of feedings that infants differed from the recommended norms for their age. Using these values, infants who slept more than and ate less than the pediatric recommended norms were coded as less demanding (0) and infants sleeping or feeding below recommended levels were coded as considered more demanding and coded as 1.

Lastly, the total number of infant awakenings between 10pm and 6am were used as a final indicator of demandingness. Infants who wake frequently during the night not only evoke

more attention from caregivers, they also interrupt caregivers' sleep and may leave caregivers more fatigued the next day (and potentially less responsive). Using the sleep/eat/cry diary, the total number of over-night awakenings was recorded. The typical number of overnight awakenings for infants less than 16 weeks of age is 3 (American Pediatric Association, 2012). Infants who woke up 3 or fewer times per night were coded as not demanding (0) and infants who woke more than 3 times per night were coded as demanding (1).

To create an overall demandingness score, the 5 indicators of demandingness were summed. Scores were created separately at 4 and 16 weeks. On average, 4 week old infants slept 13.5 hours per day, ate 9 times per day, awoke twice between 10pm and 6am, had 17 instances of distress during the 30 minute questionnaire paradigm and cued mom 14 times during a feeding. At 16 weeks, the average infant slept 13 hours per day, ate 8 times per day, awoke 1.5 times between 10pm and 6am, had 4 instances of distress during the questionnaire paradigm and cued mom 17 times during the feeding. Not surprisingly, at 4 and 16 weeks infant sleep and infant feedings were negatively and significantly correlated (4 weeks: r = -.42; 16 weeks: r = -.43), indicating that infants who slept more ate less. No other demandingness indicators were significantly correlated. At 16 weeks, more of the indicators were correlated. In addition to the sleep and feeding scores, infant total sleep and infant distress (r = .42), infant distress and overnight awakenings (r = .46), and overnight awakenings and total feedings (r = .44) were positively and significantly correlated. Not surprisingly, infants who wake up more frequently during the night, probably cry more and are fed more in response to this awakening.

Analyses

Prior to testing study hypotheses, the means, standard deviations, and distributions for each score were evaluated for skewness and kurtosis. Constructs were correlated to ensure the

measures were related in theoretically consistent ways. Finally, hierarchical linear regression equations were computed to evaluate the extent to which maternal knowledge conditioned the association between maternal depression and sensitive/ responsive parenting within both points in time.

Because of sample size restrictions, regression equations were computed including the statistical controls of infant demandingness and maternal age and then re-computed without the controls. As a general rule, at least 10 participants are needed for every variable included in a regression equation (Tabachnick & Fidell, 2007). With a sample of 41, only 4 variables can be included and with the sample of 26, only 2 variables can be included in the regression equations. For the 4 week models, the two main effects and the 1 interaction term fit within this requirement, but the 16 week model and the change from 4 to 16 week model do not have a sufficiently sized sample for the planned analyses. While the statistical controls were significant in some models and not others, the pattern of theoretical significance among the study constructs did not change and results are reported without including the statistical controls. Since any analyses involving the 16 week data (hypotheses 2 and 3) violated sample size requirements, partial correlations also were estimated and are summarized. Like a standardized beta, partial correlation coefficients essentially estimate the bivariate association between an independent and dependent variable controlling for the other study variables. However, the interpretation of the partial correlation and standardized beta coefficients are different. The partial correlation reflects the magnitude of the relationship between two constructs, keeping other variables constant (e.g., controls), while the standardized beta reflects relative unit of increase in the dependent variable given a 1 unit increase in the independent variable. Concordance between two analyses, the

partial correlation and the standardized beta coefficient, increases confidence in the robustness of the association particularly when sample size violations have occurred.

Two sets of contemporaneous models were estimated, at 4 and 16 weeks, and one longitudinal model was computed examining change from 4 to 16 weeks. All independent variables were centered by subtracting the mean from the score. In the first step of the regression equation, maternal age and infant demandingness were entered as statistical controls. In the next step, the main effects of post-partum depression and maternal knowledge at infant age 4 or 16 weeks, respectively, were entered. In the third step, the interaction between maternal knowledge and post-partum depression was entered. Consistent with expectations, maternal knowledge was expected to be associated with more sensitive parenting at low but not high levels of maternal depression.

Results

Prior to testing study hypotheses, the distributional properties of the study constructs were examined. Skewness and kurtosis values were in the acceptable range (i.e., below 3.0) and no transformations were performed. Means and standard deviations of study constructs are summarized in Table 1. Quite surprisingly, mothers reported very low levels of depression at both time points. However, results of a paired t-test indicate a significant decrease in depression scores from 4 weeks (M = 7.49, SD = 7.13) to 16 weeks (M = 5.81, SD = 6.93). Since, maternal knowledge scores were a composite of two standardized indicators, change could not be evaluated. The means and standard deviation of the overall sensitivity score and the two indicators of sensitivity also were examined. Regarding the individual indicators, the NCAST guidelines for classifying risk status indicates that scores at or below 35 fall within the lowest 10^{th} percentile (Sumner & Spietz, 1994).

Table 1 – Summary of the means, standard deviations and bivariate correlations of study constructs by infant age[1].

	1	2	3	4	5	6	7	Means (4 wks)	SD (4 wks)
1. Maternal Age	----	.05	.21	.11	.09	.35*	-.22	25.54	6.25
2. Infant Demandingness	.10	__	.14	.30+	.21	.07	.28+	1.46	1.32
3. Maternal Depression	.18	.01	__	.11	.02	-.03	.08	7.49	7.13
4. Maternal Knowledge	.23	-.20	.25	__	.27+	.24	.21	.00	.84
5. Sensitive /Responsive Parenting	.33	-.04	.01	.47*	__	.84**	.83**	.00	.82
6. Caregiver Total (NCAST)	.62**	.05	-.01	.52*	.88**	__	.39*	34.37	6.14
7. Maternal Involvement	.02	-.22	.42*	.33	.89**	.51*	__	115.38	57.52
Means (16 wks)	25.54	.65	5.81	.00	.01	37.24	116.68		
SD (16 wks)	6.25	.98	6.93	.90	.87	6.44	57.54		

Note: [1] Scores above the diagonal represent 4 week means, standard deviations, and correlations. Sixteen week scores are below the diagonal; scores on the diagonal represent the value of the across time correlation.

$+ p < .10$; * $p < .05$; ** $p < .01$.

At 4 weeks the average caregiver total score was below 35 (M = 34.23, SD = 6.26) and 50 percent of mothers had scores in the 'risk' range. Means were slightly higher at 16 weeks (M = 37.24, SD = 6.44), with 11 of the 26 participating mothers scoring in the 'risk' range. Regarding the observational ratings of mothers' attentiveness or involvement to infants, mothers' scores remained fairly stable at both points of time (4 weeks, M = 115.38. SD = 57.52; 16 weeks, 116.68, SD = 57.54). Mothers verbally or visually attended to their babies about 39 percent of the first 30 minutes of the interview.

Next, correlations were computed to evaluate the extent to which study constructs were related in theoretically consistent ways (see Table 1). Maternal knowledge and depression scores were not statistically and significantly correlated. Importantly, for moderation to occur, a statistically significant correlation is not required. Maternal knowledge was marginally statistically and significantly correlated with sensitive/responsive (SR) parenting at 4 weeks (r = .27, $p < .10$) and significantly correlated at 16 weeks (r = .47, $p < .05$), indicating that more knowledge was associated with more sensitive and responsive parenting. In contrast, depression was not significantly correlated with parenting at either point in time (see Table 1). A less consistent pattern of associations emerged with knowledge and depression among the indicators of sensitivity, perhaps because these correlations were computed using a very small sample size.

Considering the statistical associations among maternal age and infant demandingness with the study constructs, both maternal age and infant demandingness were statistically and significantly correlated with indicators of sensitive parenting, but not the composited score. Mother's age was significantly correlated with the caregiver total score at 4 (r = .35, $p <$. 05) and 16 (r = .62, $p < .01$) weeks, but not with observed involvement at either points in time. In contrast, a trend towards statistical significance emerged for infant demandingness maternal involvement at 4 weeks only (r = .28; $p < .10$).

Finally, correlations were computed to examine the relationship between maternal knowledge and depression measured at 4 weeks with sensitive parenting measured at 16 weeks (See Table 2). Maternal knowledge measured at 4 weeks was significantly associated with 16 week sensitive parenting (r = .50, $p < .05$) and the indicators of sensitive parenting, caregiver total (r = .48, $p < .05$) and maternal involvement (r = .44, $p < .05$).

Table 2 – Summary of the longitudinal means, standard deviations and bivariate correlations of study constructs from infant age 4 to 16 weeks[1]

		16 week					
4 week	1	2	3	4	5	6	7
1. Maternal Age	**-**	.10	.18	.23	.33	.62*	.02
2. Infant Demandingness		**.23**	.13	.25	.40*	.41+	.40+
3. Maternal Depression			**.62****	.14	-.03	-.07	.19
4. Maternal Knowledge				**.88****	.50*	.48*	.44*
5. Sensitive /Responsive Parenting					**.62****	.53*	.63**
6. Caregiver Total (NCAST)						**.72****	.60**
7. Maternal Involvement							**.52***

Note: [1] Scores on the left represent 4 week constructs; Sixteen week constructs are along the top; scores on the diagonal represent the value of the across time correlation.

$+ p < .10$; * $p < .05$; ** $p < .01$.

In contrast, depression levels measured at 4 weeks were not significantly associated with the sensitive parenting composite or with the indicators of sensitivity. The results of the correlational analyses indicated some support for the study hypotheses. The next step was to formally test the hypotheses using regression analyses.

Hypothesis 1 and 2: Maternal depression and maternal knowledge predict sensitive and responsive parenting contemporaneously at 4 and 16 weeks

Considering the within time effects of depression and knowledge on sensitive parenting measured at 4 weeks of age, maternal knowledge and depression scores were entered in the first step and the interaction term in the second step of the regression equation. None of the beta coefficients associated with maternal knowledge, maternal depression, or their interaction

accounted for statistically significant portions of the variance associated with 4 week SR parenting (see Table 3).

Table 3 – Summary of contemporaneous hierarchical regression equations estimating the extent to which maternal knowledge of infant development moderates the within time association of maternal depression and sensitive and responsive parenting at infant ages 4 and 16 weeks

	4 weeks				16 weeks			
	ΔR^2 (Fchange)	**β**	***r***	**Semi-Partial**	**ΔR^2 (Fchange)**	**β**	***r***	**Semi-Partial**
Step 1	**.07(.25)**				**.23(.06)+**			
Maternal Knowledge		.25	.27*	.24		.47*	.47*	.43*
Maternal Depression		-.00	.02	-.00		-.07	.01	-.07
Step 2	**.00(.68)**				**.00(.73)**			
Knowledge x Depression		-.07		-.07		-.08		-.08

Note: +$p < .10$; *$p < .05$; **$p < .01$

Upon examination of the partial correlations, the same pattern of non-significance emerged. Although not presented in Table 3, the same pattern of statistical non-significance emerged even after considering each indicator of sensitive parenting separately.

Regarding 16-week associations, in the first step of the equation the beta coefficient associated with maternal knowledge was statistically significant (β = .47, $p < .05$; see Table 3). The partial correlation term of maternal knowledge was significant as well ($r = .43$), increasing the statistical confidence of the significant effect of knowledge on sensitive parenting. Specifically, more knowledge of infant development was associated with more parenting sensitivity. Like the 4-week model, however, no statistically significant change in R-square emerged upon entry of the knowledge x depression interaction term. The models were then re-

estimated for each indicator of sensitive parenting (i.e., caregiver total and maternal involvement). Considering the specific dimensions of parenting, the beta coefficient associated with maternal knowledge was statistically significant in the caregiver total model, indicating more knowledge was associated with a higher caregiver total score (see Table 5). In contrast, more maternal depression was marginally associated with lower ratings of maternal involvement (see Table 5). In both instances, the partial correlation term also was significant (r = .45; r = -.38). The knowledge x depression interaction term was not significant in either the caregiver total or the maternal involvement models.

Table 5 – Summary of contemporaneous hierarchical regression equations estimating the extent to which maternal knowledge of infant development moderates the within time association of maternal depression and caregiver total and maternal involvement parenting scores at infant age 16 weeks

N=26	**Caregiver Total**				**Maternal Involvement**			
	ΔR^2 (Fchange)	**β**	***r***	**Semi-Partial**	**ΔR^2 (Fchange)**	**β**	***r***	**Semi-Partial**
Step 1	**.29(3.67)***				**.22(2.74)+**			
Maternal Knowledge		.48+	.52*	.45*		.15	.33	.14
Maternal Depression		-.05	-.01	-.05		-.42+	.42*	-.38*
Step 2	**.03(.70)**				**.02(.37)**			
Knowledge x Depression		-.20		-.20		-.15		-.14

Note: +p < .10; *p < .05; **p < .01

Hypothesis 3: Estimating the direct and interactive effects of maternal knowledge and depression on change in parenting sensitivity from infant age 4 to 16 weeks.

The final set of analyses considered the direct and interactive effect of maternal knowledge and depression, measured at 4 weeks post-partum, on change in observed sensitive parenting from 4 to 16 weeks. As shown in Table 4, a marginally significant R-square emerged after estimating the impact of maternal depression and knowledge. Examining the beta coefficients indicated that only maternal knowledge contributed to the explained variance in sensitive parenting ($\beta = .39$, $p < .05$; see Table 4). Examining the partial correlations confirmed these findings ($r = .37$). Specifically, more knowledge at 4 weeks post-partum was associated with more parenting sensitivity at 16 weeks, adjusted for 4 week levels of parenting sensitivity. The depression x knowledge interaction term did not explain statistically significant portions of the variance associated with sensitive parenting.

Next, the components of sensitive parenting were considered. Results were consistent with the correlational analyses. That is, when predicting change in sensitive parenting using only the caregiver total score, only maternal knowledge accounted for unique portions of the variance associated with the 16 week caregiver total score, controlling for 4 week scores. When predicting change in maternal involvement from 4 to 16 weeks, a trend towards statistical significance emerged only for maternal depression. Taken together, results suggest that depression and knowledge may affect different components of parenting sensitivity.

Table 4 – Summary of the hierarchical regression equation estimating maternal knowledge of infant development as a moderator of the of maternal depression on change in sensitive and responsive parenting from infant ages 4 to 16 weeks

		16 weeks		
4 week	**ΔR^2 (Fchange)**	**β**	***r***	**Semi-Partial**
Step 1 (Control)	**.38(.00)****			
SR Parenting (4 weeks)		.54**	.62**	.52*
Step 2	**.14(.07)+**			
Maternal Knowledge		.39*	.50*	.37*
Maternal Depression		-.06	-.03	-.06
Step 3	**.00(.83)**			
Knowledge x Depression		.04		.03

Note: $+p < .10$; $*p < .05$; $**p < .01$

Discussion

Sensitive and responsive parenting during early infancy, specifically in a low-income population, greatly lacks research and understanding. While was comprises sensitive and responsive parenting during early infancy is relatively defined, what allows one parent able to be sensitive whereas others are not has been given little attention in current research. Using longitudinal data from low-income mothers and infants, the current study addresses maternal depression and maternal knowledge of infant development as two possible components of sensitive and responsive parenting. Results indicate that maternal knowledge of infant development has a positive relationship with sensitive and responsive parenting from infant ages

4 to 16 weeks as well as contemporaneously at 16 weeks. Maternal depression, however, did not have a significant effect on sensitive and responsive parenting during the course of this study. The following sections will first describe the methodological challenges associated with measuring sensitive parenting during the early infancy period. Next, the importance of maternal knowledge for parenting and infant development and the impact of maternal depression on sensitive/responsive parenting will be discussed. Finally, the strengths and limitations of the current study will be outlined, concluding with implications for future work in this area.

An interesting pattern of statistical associations emerged regarding maternal knowledge and depression. No statistical association emerged between levels of maternal depression and indicators of sensitivity at 4 or 16 weeks of age or when considering change in sensitivity from 4 to 16 weeks of age. While statistically significant correlations between constructs are not required for moderation to occur, the finding that depression and knowledge were not associated with sensitive parenting at the bivariate level was surprising. First considering depression, mean depression scores were lower in the current sample than in other studies (i.e. Chung, McCullom, Elo, Lee & Culhane, 2004). Limited variability in the depression and sensitivity scores and limited power to detect associations with such a small sample may have distorted the magnitude of this association. Alternatively, depression may be less prevalent among some demographic subgroups than others. Additional research clarifying the prevalence of post-partum depression among low income mothers is clearly needed. Second, maternal knowledge was not correlated with sensitive parenting, but once the effects of maternal depression were considered, a statistically significant association emerged. Specifically, more knowledge of infant development was associated with increases observed sensitivity. When considering the separate indicators of sensitivity, knowledge was only associated with the caregiver total score and not the maternal

involvement score. While the maternal involvement score mainly requires mothers to notice and attend to their infants over an extended period of time, the caregiver total score requires mothers to have an understanding of how to: play with an infant (i.e. finger play, allowing the infant to explore mother), talk to an infant (i.e. speaks to infant using two or more words three or more times, talks to infant about something other than feeding), and read infant cues (i.e. stops feeding when satiation or a potent disengagement cue occurs, only offers food when infant is attending). More knowledge may reflect mothers' who have a better understanding of infancy in general, thereby increasing their ability to be sensitive to infant needs.

Measuring Sensitive Parenting during Early Infancy

Central to the current study was the concept of sensitive parenting. Sensitive parenting is one of the few constructs in which scientists are generally in agreement regarding the definition. The most commonly agreed upon component of sensitive parenting definitions is that sensitivity involves prompt responses to distress cues from infants (i.e., Keller et al., 2003). Unique to early infancy, the range of typical causes of infant distress is generally limited to feeding, diapering, sleep and stimulation needs. Thus, as compared to later developmental periods, a clear set of parental responses constitute sensitive parenting exists during the newborn period (i.e., Sumner & Speitz, 1994).

Despite this relative restricted range of sensitive caregiving behaviors, few empirical studies have measured sensitive parenting during the newborn period, or 1-month post-partum. Procedures for measuring sensitivity have been established. For instance, one of the most widely used observational measures of sensitive parenting is the NCAST feeding system. This measure has been well validated as a measure of sensitivity (i.e. Farel, Freeman, Keenan & Huber, 1991); however, many of the items lack face validity for 4-week-old infants. For example, mothers'

abilities to read infant cues are important markers of sensitivity, yet scoring these dimensions of sensitivity depend on infants abilities to provide mothers with social cues (e.g., smiling, cooing or talking, and initiating eye contact or touch; Sumner & Speitz, 1994). Developmentally, four-week-old infants have limited social interaction skills and often feed in a drowsy state rather than an alert state needed for social interaction (Lavelli & Poli, 1998). In later developmental periods, feedings become much more social and infants are likely to exhibit some, if not all, of the social and disengagement cues. Importantly, scoring mothers' sensitivity in responding to infants depended on infants' demonstration of social or disengagement cues. If infants are incapable of providing social cues to mothers, as in the newborn period, then scores may not accurately represent mothers' ability to read babies' cues. Alternatively, since babies tend not to exhibit many social or disengagement cues during early infancy, this skill may be less critical for sensitive parenting during early infancy.

Similarly, the maternal involvement observational coding system may not be a good indicator of mothers' monitoring and attentional focusing of their babies because babies were positioned next to mothers and most slept through a good portion of the interview. Sensitive parenting has less variability during the early infancy period, and therefore is quite difficult to assess. Alternatively, most mothers are capable of being attentive to their infants during low stress situations like when their only requirement is to answer questions from an interviewer and their baby has likely just been fed and is asleep. What is still untapped is how sensitively mothers can manage competing attentional demands.

In addition to assessing parenting sensitivity during high stress times, measures of parenting sensitivity may be improved by supplementing these procedures with indirect measures of sensitivity. For instance, measures of infant sleep duration are not typically included

in measures of parenting sensitivity. Surprisingly, on average the infants in the current study slept 2.5 hours less than recommended hours of sleep at 4 weeks and 2 hours less than recommended at 16 weeks (American Pediatric Association, 2012). Some mothers may miss important sleep cues from babies and are less able to create an environment that supports healthy sleep habits. Such indirect measures of maternal sensitivity may improve the validity of sensitivity during this developmental period.

Maternal Knowledge and its Changing Effect on Sensitive and Responsive Parenting

A general understanding of how and when infants develop may provide mothers with a framework from which to interpret their babies' behavior and respond more sensitively (Reich, 2005). Elevated levels of depression were expected to disrupt and negate the benefits of knowledge of infant development on emerging parenting sensitivity. In general, results were somewhat inconsistent with expectations. That is, while levels of maternal knowledge measured at 4 and 16 week were associated with parenting sensitivity at 16 weeks, depression did not moderate these associations.

Although maternal knowledge did not interact with depression as expected, the findings do have interesting implications for the role of maternal knowledge and depression on emerging parenting quality. Maternal knowledge is a vastly understudied paradigm in developmental psychology. Understanding infant needs and developmental abilities may be a critical precursor to sensitive parenting. Knoche and colleagues (2007) found that mothers with more accurate knowledge of infant development demonstrated more sensitive and flexible child rearing practices engaged in a play activity with their child. Studies of toddler-aged children also demonstrated a similar link between maternal knowledge and sensitive parenting (e.g., Bornstein, et al., 2007). Since the parenting demands associated with the newborn period may

demonstrate less variability and be universally higher than later developmental periods, maternal knowledge may be more critical during developmental transition periods than during early infancy. For instance, with increases in infants' age, mothers' expectations for infant autonomy begin to increase (e.g., Kopp, 1989). That is, mothers increasingly begin to expect that their babies to self soothe, play unattended, sleep longer periods, sleep through the night, or hold a bottle. Mothers' who expect their babies to be able to master these tasks before their babies are actually capable of mastering the tasks may be less responsive to their infants before infants are ready for such autonomy. Thus, accuracy of knowledge may help maintain levels of sensitivity, or insensitivity, throughout the infancy period but the periods in which there is the greatest mismatch between mothers' expectations and infants' abilities also may be characterized by the least parenting sensitivity. Future research which more carefully examines the impact of developmental variability in knowledge on sensitivity is clearly needed.

Like sensitive parenting, however, measuring knowledge in newborns proved quite challenging. While dramatic changes in infant needs and abilities occur during the early infancy period (Kopp, 1982), at 4 weeks infants have not achieved any developmental milestones and are extremely limited in their ability to engage in autonomous activity (Kopp, 1982; Reich, 2005). Only a few questions actually infants' abilities at 4 weeks old and these items generally focused on naptime and bedtime routines. Quite possibly, the measures used missed critical components of newborn knowledge such as how much sleep babies need or how much babies should eat. Directly measuring knowledge of infant development also is impacted by the lack of clear consensus of infant development. Considerable variability in the timing of when babies reach developmental milestones exists. Given the lack of consistency within and across families in when babies master new skills, parents understanding of how parenting may need to adapt to

developmental transitions, like babies' acquisition of new skills (e.g., social smile, crawling, walking, talking), may be more critical.

Currently, only a handful of studies attempt to address the impact of knowledge on parenting during infancy and none considered early infants. For example, Hess, Teti and Hussey-Gardner (2004) found that maternal knowledge of infant development was unrelated to parenting efficacy among a high-risk sample of 10-month old infants. In addition, Huang, Caughy, Genevro & Miller (2005) considered how knowledge of infant development at infant age 4 months affected the quality of parent-child interactions during the toddler years (16-18 months) and found that mothers who underestimated children's abilities at 4 months were observed to be less sensitive during a teaching task during the toddler years. Importantly, parenting quality measured at 4 months did not predict parenting quality during the toddler years (Huang et al., 2005). Taken together, our understanding of what maternal knowledge is and how it impacts parenting is severely limited.

Maternal Depression and Sensitive/responsive Parenting

Surprisingly, maternal depression did not interact to predict sensitive parenting contemporaneously or over time. One reason why maternal depression may not have affected sensitive/responsive parenting at 4 weeks could be that symptoms of depression are very common in the first few weeks post-partum and, if alleviated, may not have lasting effects on parenting style or child outcomes (Sohr-Preston & Scaramella, 2006). Mothers may be able to meet the basic caregiving demands of a 4-week-old infant despite the presence of depressive symptoms. Prolonged depression, as opposed to fleeting symptoms, has increasingly detrimental effects on parenting sensitivity (i.e. Albright & Tamis-LeMonda, 2002). However, the participants in the current study reported very low levels of depressive symptoms. Empirical

research indicates that women living in a low SES household are typically at an elevated risk of depression, including post-partum depression (i.e. Wakschlag & Hans, 1999), yet research is emerging to suggest that while negative emotionality may be increased in high-risk samples, low-income women may manifest their sadness with anger (Sterling, Fowles, Sunghun, Latimer & Walker, 2011). Along with this, while the BDI is a widely used depression measure, current research has shown that minority women, specifically African Americans, view and feel depression differently than Caucasian women (Sterling et al., 2011). For example, the BDI assesses depression using 'typical' symptoms such as feelings of worthlessness, under or overeating and loss of pleasure in everyday activities (Beck, Steer & Garbin, 1988). However, using a sample of over 4,000 minority women, including post-partum women, Sterling and colleagues (2011) found that African American women, specifically, conceptualize depression as a feeling that their lives are 'out of control', feeling taken for granted by family and friends and feeling 'attacked' by external sources in the world. Additional studies on depression have found that African American women are more likely to display somatic and/or neuro-vegetative symptoms of depression as opposed to mood or cognitive symptoms (Das, Olfson, McCurtis & Weissman, 2006). None of these symptoms are well-captured by the BDI. While these studies are not specifically focused on post-partum depression, they are focused on minority samples and the different manifestations of depressive symptoms among cultures.

Given that the women in the present study are predominately African American or Hispanic, the lack of statistical association between depressive symptoms and other study constructs may be a result of the lack of validity of the depression measure for the sample characteristics. In addition, while the current study involves post-partum women, a screening measure assessing specifically post-partum symptoms was not used. Research comparing the

BDI to the Edinburgh Postnatal Depression Scale (EPDS, 1987) has indicated that when using DSM-determined cutoff scores, the EPDS is markedly more sensitive in detecting depressive symptoms in post-partum women than the BDI (Harris, Huckle, Thomas, Johns & Fung, 1989). It is possible that increased levels of depression would have been found had a different depression assessment tool been used.

Limitations, Strengths, and Future Directions

The current study is not without limitations. First, adequately measuring parenting knowledge during the newborn period proved quite challenging. Very few measures of maternal knowledge exist and these measures are rarely used during the early infancy period. Moreover, maternal knowledge may vary with infants' development and measures targeting unique needs of each developmental period may also be necessary. Assessing knowledge of infant development will remain challenging until a better understanding of what comprises knowledge at different points of infancy exists. Second, sensitive caregiving during the newborn period may involve a restricted range of behaviors and evidence for such behaviors may be limited because infants typically are asleep more than they are awake. Third, the Beck Depression Inventory may not be the best measure of post-partum depression or depression among less economically affluent women. Using a measure more targeted towards post-partum depression (e.g., Edinburg post-partum depression inventory), or a measure targeted more towards ethnic minorities, may have resulted in better variability in depressive symptoms. Fourth, the sample was very small to begin with and even smaller at 16 weeks. Although attrition analyses revealed no group differences on constructs measured at 4 weeks, the power to detect interactional effects was substantially reduced. Caregiving demands associated with early infancy may have reduced mothers' willingness to participate. The interview was long (1.5 hours) and the compensation was very

small ($35). With more compensation, better retention may have been observed. Future studies may want to increase the amount of contact with the mothers through follow-up phone calls or function as a resource for mothers providing assistance with baby needs (e.g., diapers or formula) may help with retention.

Despite these limitations this study adds to the paucity of work focusing on the early infancy period. Clear strengths include the use of observational data from low-income, post-partum mothers. While the specific components of knowledge necessary at each developmental period need further evaluation, the clear link displayed between knowledge and sensitive parenting in the current sample indicates that on some level, whether it is knowledge of milestones or more knowledge in general, mother's with an increased understanding of their infants at 16-weeks were more sensitive contemporaneously, and having a better base of knowledge at 4-weeks effected sensitive parenting over time. Presently, few, if any, studies focus on the type of knowledge mothers need to best care for their infants. The current study not only highlights the need for additional research in this area, but draws attention to the type of measures that need to be developed to appropriately assess maternal knowledge during the newborn period such as sleeping and feeding regularities. Future work is clearly needed to develop valid measures of sensitive caregiving and maternal knowledge. An additional focus on better measures and sample retention will allow for continued evidence of the importance of maternal knowledge and maternal depression on sensitive/responsive parenting during early infancy.

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