Antecedents of maternal sensitivity during distressing tasks: Integrating attachment, social information processing, and psychobiological perspectives

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Abstract:

Predictors of maternal sensitivity to infant distress were examined among 259 primiparous mothers. The Adult Attachment Interview, self-reports of personality and emotional functioning, and measures of physiological, emotional, and cognitive responses to videotapes of crying infants were administered prenatally. Maternal sensitivity was observed during three distress-eliciting tasks when infants were 6 months old. Coherence of mind was directly associated with higher maternal sensitivity to distress. Mothers' heightened emotional risk was indirectly associated with lower sensitivity via mothers' self-focused and negative processing of infant cry cues. Likewise, high physiological arousal accompanied by poor physiological regulation in response to infant crying was indirectly associated with lower maternal sensitivity to distress through mothers' self-focused and negative processing of infant cry cues.

Keywords: autonomic nervous system | adult attachment | maternal sensitivity | sympathetic arousal | parasympathetic regulation

Article:

Maternal sensitivity to infant distress cues or during potentially distressing activities has been demonstrated to be predictive of infants' subsequent social-emotional adjustment, as indexed by infant–mother attachment security, better affective and physiological regulation, social competence, and the absence of behavioral problems, more so than has maternal sensitivity to infant nondistress (Conradt & Ablow, 2010; del Carmen, Pedersen, Huffman, & Bryan, 1993; Leerkes, 2011; Leerkes, Blankson, & O'Brien, 2009; McElwain & Booth-LaForce, 2006). Thus, identifying the factors that promote maternal sensitivity to infant distress has important implications for interventions aimed at enhancing infant well-being. Prior research based on attachment theory and a psychobiological perspective has demonstrated links between adult attachment and maternal sensitivity in a distress context (Ablow, Marks, Feldman, & Huffman, 2013) and between physiological regulation and maternal sensitivity in a distress context (Ablow et al., 2013; Hill-Soderlund et al., 2008; Moore et al., 2009). Other research, informed by a social information processing (SIP) perspective, has demonstrated that mothers' adaptive emotional (e.g., empathetic) and cognitive responses (e.g., positive beliefs) to infant cry cues predict their degree of sensitivity in situations when infants are distressed (Leerkes, 2010). The goal of this article is both to replicate these findings in a larger and more diverse sample and to extend them by testing a more comprehensive conceptual model that integrates attachment, SIP, and psychobiological perspectives to identify the origins of maternal sensitivity to infant distress and to elucidate the pathways by which such effects occur.

The Integrated Model

According to the SIP perspective (Crick & Dodge, 1994), individuals enter a social situation with knowledge, experiences, and capabilities (i.e., the database) that they draw upon as they process and interpret the cues of a social partner. This database influences whether or not the individual notices social cues, how they interpret those cues, and how they prioritize personal and social goals in the moment; all of these influence a person's response. In an adaptation of the classic SIP model, Lemerise and Arsenio (2000) highlighted the role of affective processes in SIP. They asserted that affect–event linkages are an important aspect of the database and that emotionality and regulatory ability, both general (i.e., mood that day) and specific to the situation, influence how an individual processes and responds to social cues. For example, a person with a tendency toward negative emotionality may experience greater arousal when presented with a difficult social signal, and both may contribute to more negative interpretations of the social partner's behavior and greater difficulty generating appropriate responses. They also called for greater attention to affective processes, including empathy, within each stage of the SIP model (e.g., cue encoding, goal clarification).

Drawing from this perspective, we propose that adult attachment representations inform aspects of the SIP database, such as affect–event linkages and social schema, and along with general emotional characteristics predict individual differences in expectant mothers' physiological arousal and regulation in response to infant cry cues as well as their cognitive and emotional processing of infant cry cues. Further, specific patterns of arousal and regulation, particularly high arousal accompanied by poor regulation, lend to more negative cognitive and emotional processing of cry cues. In turn, cognitive and emotional processing of infant cry cues predict individual differences in sensitive responding to their own infants in distressing situations. Our effort to combine the attachment and SIP perspectives is consistent with Dykas and Cassidy's (2011) call for more direct efforts to test social cognitive processes as mediators of associations between attachment classifications and social behavior, including parenting, and to consider physiological processes as a mediator of links between attachment and SIP. Next we review theory and evidence relevant to each of the proposed pathways.

Adult Attachment Representations

Bowlby (1980) theorized that children develop internal working models, or a sense of self in relation to the world, based on early interactions with caregivers. A secure working model was thought to stem from positive caregiving experiences and be reflected by a positive sense of self and trust in others. In contrast, an insecure working model was believed to result from experiences of harsh, withdrawn, or inconsistent caregiving and to be reflected through a negative sense of self and distrust in others. Main, Kaplan, and Cassidy (1985) operationalized states of mind with respect to attachment in terms of mental representations of early attachment experiences as judged from the discourse of individuals during the course of the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1984–1996). Individuals with secure representations of early attachment experiences are characterized by high ratings of coherence of mind because they describe these experiences and their influence on current functioning in a consistent manner and without becoming emotionally overwrought during discussion of attachment experiences (Hesse, 2008). It has been argued that mothers with a secure representation of early attachment experiences, and hence high coherence of mind, are more likely than other mothers to notice infant cues, interpret them positively, and regulate their own affect and arousal adaptively—all of which promote maternal sensitivity (Main et al., 1985). Empirical work has supported this pattern (Ablow et al., 2013; Atkinson et al., 2005; van IJzendoorn, 1995; Whipple, Bernier, & Mageau, 2011), but few studies have directly tested the mechanisms purported to explain these associations.

The mechanism we propose is that mothers' adult attachment representation influences how they perceive, interpret, and react to infant distress cues. Consistent with this view, prior research has found adult attachment security to be linked with awareness and accurate labeling of infant emotions (Blokland & Goldberg, 1998; Deoliveira, Moran, & Pederson, 2005) and more positive and less negative personality attributions about distressed infants (Leerkes & Siepak, 2006; Zeanah et al., 1993). Likewise, adult attachment security has been linked with lower reported negative affect and better physiological regulation (Ablow et al., 2013), less physiological arousal (Groh & Roisman, 2009), and greater emotion mimicking in response to infant distress stimuli, which may reflect empathy (Spangler, Maier, Geserick, & von Wahlert, 2010).

One study has directly tested the proposed mediating effect of adult attachment on sensitivity via these processes. Using a prospective longitudinal design, Ablow et al. (2013) tested physiological regulation in response to infant cries as a mediator of the link between adult attachment and sensitivity to distress. They found adult attachment security to be linked with physiological regulation in response to cry videos and physiological regulation was linked with observed maternal sensitivity to infant distress, but the proposed mediating effect was not significant. Thus, additional work is needed to identify the processes that explain the association between adult attachment and maternal sensitivity to distress.

Emotional Risk

We also propose mothers' general emotional characteristics (i.e., depressive symptoms, trait positive and negative emotionality, global difficulties with emotion regulation, agreeableness, and neuroticism) pose risks for insensitive maternal behavior for two reasons. First, the idea that background moods and trait-like emotional characteristics inform the manner in which individuals become aroused by and process social cues is a core tenet of Lemerise and Arsenio's (2000) adaption of the SIP model as described above. Consistent with this view, adults who experience elevated symptoms of depression are less skilled at noticing infant signals, report that infant crying is less urgent and arousing, are less likely to say they would intervene, report more negative beliefs about crying, and demonstrate a blunted regulatory response when exposed to infant distress than nondepressed adults (Donovan, Leavitt, & Walsh, 1998; Leerkes, Parade, & Burney, 2010; Oppenheimer, Measelle, Laurent, & Ablow, 2013; Schuetze & Zeskind, 2001). Likewise, adults who are high on neuroticism and rely on avoidant coping strategies report more negative attributions about children, hold negative beliefs about infant crying, and perceive infant crying as more aversive (Leerkes, Parade, & Burney; Leung & Slep, 2006; Zeifman, 2003). These findings support the idea that emotional traits and mood are viable predictors of physiological, emotional, and cognitive reactions to infant cry cues.

Second, prior research has demonstrated that personality and emotional characteristics are linked with parenting. For example, depressive symptoms are linked with less sensitive maternal behavior (e.g., Musser, Ablow, & Measelle, 2012); low neuroticism, high agreeableness, and positive trait emotions are linked with responsive parenting (Adam, Gunnar, & Tanaka, 2004; Prinzie, Stams, Dekovic, Reijntjes, & Belsky, 2009); and adaptive emotion regulation is linked with the use of appropriate discipline practices (Lorber, 2012). Thus, it is important to note if effects of adult attachment, on mothers' physiological, cognitive, emotional, and sensitive responses to infant distress are independent of these factors (Dykas & Cassidy, 2011).

Physiological Arousal and Regulation

Mothers' physiological responses to infant crying relative to resting baseline reflect their context-specific arousal and regulation and are expected to influence the manner in which they respond to infant distress, both directly and indirectly through their effect on mothers' cry processing. In this study, we focus on mothers' skin conductance level (SCL) and vagal suppression, or respiratory sinus arrhythmia (RSA). Both measures capture immediate physiological responses to a stressor. SCL reflects arousal or activation of the sympathetic nervous system associated with emotional arousal and may reflect behavioral inhibition in aversive contexts (Gray, 1975), which is likely to be maladaptive in relation to parenting. Consistent with this view, increased electrodermal activity in response to aversive child behavior was more characteristic among child abusers than nonabusers (Frodi & Lamb, 1980; Wolfe, Fairbank, Kelly, & Bradlyn, 1983) and predicted more negative appraisals about children (Lorber & O'Leary, 2005).

In contrast, vagal withdrawal reflects vagal *regulation* of the heart when an organism is challenged, a parasympathetic response. Such regulation is indexed by decreases in RSA during situations where coping or regulation is required (Porges, 2007). During demanding tasks, this physiological process allows a person to shift focus from internal homeostatic demands to purposeful generation of coping strategies to control affective arousal. As such, it has been argued that vagal withdrawal reflects the behavioral activation system and promotes an approach orientation (Gray, 1975) that is adaptive in challenging parenting situations (Ablow et al., 2013; Hill-Soderlund et al., 2008; Mills-Koonce et al., 2007; Moore et al., 2009).

Importantly, although the sympathetic and parasympathetic systems have often been viewed as interdependent systems that act in an antagonistic fashion (i.e., if one is high the other is low), Berntson, Cacioppo, and Quigley (1993) have argued that the two systems can in fact operate independently, reciprocally (i.e., if one increases, the other decreases), or coactively (i.e., both can increase or decrease simultaneously). Interactions between levels of sympathetic arousal and parasympathetic regulation of the autonomic nervous system may ultimately prove most useful in predicting risk for psychopathology and maladaptive behavior because simultaneous patterns of arousal and regulation reflect different underlying physiological states (Beauchaine, 2001; Lonigan, Vasey, Phillips, & Hazen, 2004). For example, high arousal accompanied by high regulation reflects a regulated state in which both the behavioral inhibition and approach systems are active and may counterbalance one another. In contrast, high arousal accompanied by low regulation may be viewed as underregulation characterized by heightened behavioral inhibition and limited approach. In fact, prior research has demonstrated that high trait negative affect is only linked with anxiety and depression when effortful control is low (Lonigan et al., 2004). We propose that arousal and regulation in response to infant crying interact to predict mothers' social cognition and subsequent sensitivity. That is, arousal that is well regulated likely reflects awareness of the infant's state accompanied by the ability to cope (i.e., a tendency to inhibit tempered by an approach orientation); in this case, we would expect a mother to intervene sensitively on the infant's behalf. In contrast, a mother whose arousal is poorly regulated (i.e., a tendency to inhibit accompanied by a low approach orientation) may focus on making herself feel better rather than intervening on the infant's behalf. This view is consistent with Eisenberg and colleagues, contention that sympathy and subsequent prosocial responding are most likely when arousal is well regulated (Eisenberg et al., 1994) and that heightened personal distress, indexed in part by physiological arousal, likely undermines the cognitive abilities required to focus on the needs of others (Eisenberg & Eggum, 2008). Recent work by Mills-Koonce et al. (2009) provides some empirical support for an interaction effect between physiological arousal and regulation. In their study, mothers' vagal withdrawal attenuated the association between high resting cortisol (reflecting trait-level heightened reactivity to stress) and maternal negative intrusiveness. To our knowledge, the current study is the first to examine interaction effects between physiological arousal and regulation in response to infant cry cues in relation to maternal sensitivity to distress. Furthermore, we examine the pathways by which physiology is linked with maternal sensitivity.

Cry Processing

Leerkes (2010) demonstrated that expectant mothers who were skilled at identifying infant distress cues shown on video, who reported empathizing with those infants, and who endorsed positive beliefs about crying were observed to be more sensitive with their own infants 6 months later than were expectant mothers who reported feeling more self-focused anxiety or anger and endorsed more negative and self-focused beliefs about crying. An aspect of the SIP model not included in this study was mothers' attributional biases, or the extent to which they believe infants cry for hostile reasons (e.g., to manipulate mothers) or nonemotional internal reasons (i.e., because they are tired) versus external and benign reasons (e.g., some situations are distressing). Parents' negative attributions about infant behavior have been found to be related to harsh parenting (Berlin, Dodge, & Reznick, 2013; Lorber & O'Leary, 2005), and nonemotional attributions about crying may reflect a tendency to ignore or avoid emotion (Gottman, Katz, & Hooven, 1996). Thus, we predict both will be linked with lower maternal sensitivity.

One useful way to conceptualize SIP constructs related to infant distress is the extent to which mothers' processing reflects a focus on the infant's current state and needs versus a focus on her own state, needs, and preferences, a distinction Ainsworth, Blehar, Waters, and Wall (1978) argued differentiate between sensitive and insensitive mothers. In an earlier study mothers' accurate distress detection, empathy, and positive beliefs about crying loaded on a single dimension labeled *infant-oriented cry processing* and mothers' anger, anxiety, and negative beliefs about crying loaded on a single dimension labeled *mother-oriented cry processing*, each of which predicted maternal sensitivity during distress tasks (Leerkes, Weaver, & O'Brien, 2012). We anticipate a similar structure and pattern of findings in this study.

The Present Study

In sum, the goal of this study is to test a more comprehensive model of the origins of maternal sensitivity to infant distress that integrates SIP, attachment, and psychobiological perspectives. We test the following hypotheses: (H1) mothers' coherence of mind with respect to attachment and lower emotional risk will be linked with lower physiological arousal and mother-oriented cry processing and with higher physiological regulation and infant-oriented cry processing in response to infant crying, (H2) mothers' physiological arousal and regulation in response to infant crying will interact such that arousal will be associated with higher mother-oriented cry processing and lower infant-oriented cry processing when regulation is low, (H3) high infant-oriented cry processing and low mother-oriented cry processing will be linked with higher maternal sensitivity to distress, (H4) mothers' coherence of mind with respect to attachment and emotional risk will have indirect effects on sensitivity to infant distress via mothers' physiological reactions to crying and cry processing, and (H5) the interaction between physiological arousal and regulation in response to infant crying will have an indirect effect on maternal sensitivity to distress via mothers' infant-oriented and mother-oriented cry processing. Given the characteristics of our sample, and the importance of determining if antecedents of maternal sensitivity vary across racial groups, we also test race as a moderator of the proposed pathways. Based on prior research, we anticipated the structural model would be invariant across European American and African American mothers (Bakermans-Kranenburg, van IJzendoorn, & Kroonenberg, 2004; Mesman, van IJzendoorn, & Bakermans-Kranenburg, 2012).

Method

Participants

Participants in the current study were 259 primiparous mothers (128 European American, 123 African American, 8 multiracial) and their infants from the Southeastern United States. Mothers ranged in age from 18 to 44 years ($M = 25.1$). Twenty-seven percent had a high school diploma or less, 27% had attended but not completed college, and 46% had a 4-year college degree. A majority (57%) of mothers were married or living with their child's father, 24% were in a relationship but not living with their child's father, and 19% were single. Annual family income ranged from less than $2,000 to over $100,000; median income was $35,000. Although all mothers were primiparous, they varied in the extent to which they reported prior experience caring for infants: 22% reported no or little experience, 37% reported some, and 41% reported a lot of prior experience caring for infants. Of the initial 259 participants, 211 mother and infant dyads participated in the 6-month observation. Of the 48 who did not participate in the 6 month observation: 19 completed questionnaires only because they had moved from the area or were too busy, 5 withdrew from the study primarily because they were too busy, 2 were withdrawn because their infants died, and 22 could not be located or did not respond to attempts to contact them. All participating infants were full term and healthy; 51% were female.

Procedure

Expectant mothers were recruited at childbirth classes offered in the local hospital and public health department; breastfeeding classes offered through the Special Supplemental Nutrition Program for Women, Infants, and Children; obstetric practices; and word of mouth. Upon enrollment in the study, women were mailed consent forms and a packet of questionnaires including measures of demographics, personality, emotional functioning, and beliefs about infant crying. Women visited our laboratory for an interview 6–8 weeks prior to their due date. At this visit, mothers' electrodermal activity and heart rate were recorded while they viewed video clips of crying infants. Mothers and their infants visited our laboratory for a videotaped observation of mother–infant interaction within 2 weeks of the infant's 6-month birthday. Mothers received $50 and a gift at the completion of each visit.

Measures

Emotional Risk

Prior to the prenatal interview, mothers completed self-report measures to assess emotional and personality characteristics that pose risk for insensitive maternal behavior. The Center for Epidemiologic Studies–Depression Scale (Radloff, 1977) was administered to assess depressive symptoms. Items were summed such that high scores reflect higher depressive symptoms. The Difficulties in Emotion Regulation Scale (Gratz & Roemer, 2004) was administered to assess the extent to which mothers struggle in their awareness, clarity, acceptance, and regulation of their negative emotions. The average score was calculated such that higher scores reflect greater difficulties with emotion regulation. The Differential Emotions Scale (Izard, Libero, Putnam, & Haynes, 1993) was administered to assess the extent to which mothers typically experience positive and negative emotions in daily life; scores relevant to each emotion dimension were averaged. The NEO Five-Factor Inventory (Costa & McCrae, 1985/1992) was administered to assess agreeableness (the sum of 12 items that reflect the extent to which the mother is trusting, helpful, and forgiving) and neuroticism (the sum of 12 items that reflect the extent to which the mother is anxious, hostile, and depressed).

Adult Attachment Interview

At the prenatal visit, mothers were administered the AAI (George et al., 1984–1996), a semistructured interview in which participants are asked to describe their early childhood relationships with their primary caregivers and the influences they perceive those experiences have had on them. AAIs were transcribed verbatim and all identifying information was removed from the transcripts before they were coded by coders trained through and reliable with the lab of Dr. Mary Main using the AAI Scoring and Classification System (Main & Goldwyn, 1998). Interrater agreement for the three-way classification system was 82%, based on 50 double-coded cases. Among European American mothers, 99 (77%) were classified as secure/autonomous, 26 (20%) dismissing, and 3 (3%) preoccupied. Among African American mothers, 80 (61%) were classified as secure/autonomous, 41 (34%) dismissing, and 10 (8%) preoccupied. Although African American mothers were more likely to be classified in both nonsecure groups than European American mothers in this sample, $\chi^2(2) = 9.11$, $p < .05$, the largest proportion of both groups was classified as secure/autonomous, consistent with what has been reported in other nonclinical samples (Bakermans-Kranenburg & van IJzendoorn, 2009).

Given the complexity of our proposed model and the greater statistical power afforded by the use of continuous versus dichotomous variables, we selected the coherence of mind rating (1 = *not at all coherent* to 9 = *very coherent*), which is a summary measure of participants' ability to describe early attachment experiences and their influence on current functioning in an organized manner as our criterion measure of adult attachment security. Although the dichotomous secure–insecure classification has been typically used in work of this type, the coherence of mind rating is the rating that best distinguishes between secure and insecure adults on the AAI and has demonstrated associations with observed parenting in prior research (Bosquet & Egeland, 2001; Cowan, Cohn, Cowan, & Pearson, 1996). Interrater reliability on the coherence rating in this sample was good, intraclass correlation = .75, $p < .001$.

Emotion Interview

Following the AAI, electrodes were placed on the mothers' right collarbone and under each ribcage to record their heart rate, and two velcro strips were placed on the middle segments of two adjacent fingers of mothers' nondominant hand to record SCL. These were connected to the Biolog (UFI, Morro Bay, CA) which stored physiological data for subsequent download to a computer. Expectant mothers engaged in a 2-min baseline procedure during which they were asked to be calm for 2 min while the interviewer left the room. Next, mothers viewed four 1-min video clips of infants. The order of presentation was fixed. Each mother saw two clips of infants exhibiting anger followed by two clips of infants exhibiting fear, the first of each was European American and the second was African American. All infants were 6 months old, two were female and two were male, and all were dressed in gender-neutral clothing. These videos were recorded during standard temperament assessments: an arm restraint procedure for anger clips and a novel toy approach procedure for fear clips similar to those described below. Mothers watched these video clips while seated approximately 1.2 m away from a 20-in. television. The average fundamental frequency was 800.00 Hz (range = 650.17–950.33) for the anger clips and 691.67 Hz (range = 450.33–1,000.76) for the fear clips. The average sound pressure level was 78.70 deciBels adjusted (dBA) range = 65.00–89.9) for the anger clips and 71.85 dBA (range = 65.00–85.00) for the fear clips. As elaborated below, after viewing each clip, mothers were interviewed and completed rating forms.

Physiological Arousal

SCL was continuously recorded in microsiemens on the Biolog at a sampling rate of 100 Hz, and average SCL during each video was calculated. Difference scores were calculated for each of the four video clips by subtracting the baseline SCL score from the clip scores such that high scores indicate an increase in arousal from baseline to clip. Change scores for each clip were averaged to yield a single measure of physiological arousal.

Physiological Regulation

Mothers' electrocardiogram was recorded at a sampling rate of 1 kHz. A data file containing the interbeat intervals (IBI), or the time between R-waves, was transferred to a computer for artifact editing (resulting from movement) and analyzed using the CardioEdit software (Brain Body Center, University of Illinois at Chicago). Estimates of RSA were calculated using Porges's (1985) method. Heart period (HP) was derived from the IBI data, and then an algorithm was applied to the sequential HP data. A band-pass filter extracted the variance of HP within the frequency band of spontaneous respiration (.12–.40 Hz) in adults. RSA, in ms^2, was calculated for every 15-s epoch during baseline and during each of the video clips and was then averaged across epochs within a task of interest. Vagal withdrawal scores were calculated for each clip by subtracting the average RSA from the average RSA during baseline. Change scores for each clip were averaged to yield a single score. High scores indicate greater vagal withdrawal and better physiological regulation.

Emotional Reactions to Distress

After watching each of the four 1-min video clips, mothers rated how strongly they felt 17 emotions (e.g., sad, irritated, concerned) on a 4-point scale ranging from 1 (*not at all*) to 4 (*very strongly*) using a paper questionnaire. Then, mothers were asked to describe verbally why they felt each emotion. Each explanation was coded as infant oriented (i.e., concerns about the infant's welfare, a desire to help the infant, sympathy or empathy for the infant, or feeling pleasure or pride in the infant's behavior) or mother oriented (i.e., self-focused concerns, negative reactions about the infant, or responses that are of interest or importance to the mother but not the infant; Dix, Gershoff, Meunier, & Miller, 2004). Reliability for infant versus mother orientation on each of the distinct emotions was calculated based on 40 double-coded interview transcripts. Kappas ranged from .65 to 1.0 (mean $\kappa = .85$). Two emotional reaction scores were calculated for each clip by averaging mothers' intensity ratings for appropriate emotions: *empathy* (infant-oriented empathy, sympathy, sadness) and *mother-oriented negative emotions* (angry, irritated, frustrated, annoyed, disgusted, anxious, concerned, nervous, worried). Then, parallel scores were averaged across the four clips to yield composite scores of *empathy* and *mother-oriented negative emotions*.

Accurate Distress Detection

After viewing each video clip, mothers rated infant distress on a scale ranging from 1 (*high positive*) to 7 (*high negative*). Mothers were coded as *minimizing* or underrating distress if they gave a global rating of 1, 2, 3, or 4, indicating they did not recognize that the infant was distressed. The number of clips they minimized was summed for a possible range from 0 to 4 ($M = .50$, $SD = .77$). For each clip, mothers were asked to identify the infant's dominant emotion from a list of 20 emotion terms (e.g., interested, happy, sad, angry). Angry, frustrated, irritated, annoyed, and disgusted were coded as accurate for the anger clips. Afraid, scared, nervous, anxious, wary, or worried were coded as accurate for the fear clips. The number of times mothers *accurately identified the dominant negative emotion* were summed across clips for a possible range from 0 to 4 ($M = 2.59$, $SD = .99$). When mothers named an incorrect dominant emotion, the nature of their error was coded into one of three weighted categories: another negative (e.g., indicated angry for fear clip; coded 1), nonemotion (e.g., tired, hungry, or bored; coded 2), or positive emotion/state (e.g., happy; coded 3). A total weighted error score was computed by summing across the four clips, resulting in a possible range from 0 to 12 ($M = 2.51$, $SD = 1.61$). These variables were standardized and averaged (reversing minimization and dominant emotion ratings) to create an *accurate distress detection* composite.

Causal Attributions About Crying

After watching each video clip, mothers rated the extent to which they agreed with 18 statements about why the infant from each clip was crying on a 4-point scale ranging from *strongly disagree* to *strongly agree*. Three attribution scores were created for each clip: *emotion-minimizing attributions* includes five items (having a bad day, in a bad mood, tired, hungry, not feeling well); *negative/internal attributions* includes seven items (spoiled, difficult temperament, trying to make mother's life difficult, unreasonable, crying on purpose, selfish, just wanted attention); and *situational/emotional attributions* includes four items (upset by the situation, no one was helping the baby, trying to show he or she needs help; had no way to feel better). Scores were averaged across the four clips.

Beliefs About Infant Crying

Mothers completed the Infant Crying Questionnaire (Haltigan et al., 2012) to assess their beliefs about infant crying by rating the extent to which they believed 43 statements on a 5-point scale ranging from 1 (*never*) to 5 (*always*). Four subscales that most clearly reflect the distinction between mother and infant orientation were used. Eight items reflecting *attachment* (e.g., when my baby cries, I will want to make my baby feel secure) and three items reflecting *crying as communication* (e.g., when my baby cries, I will think my baby is trying to communicate) were averaged to create a measure of infant-oriented cry beliefs. Nine items reflecting *minimization* (when my baby cries, I will want my baby to stop because I cannot get anything else done) and three items reflecting *spoiling* (how I respond when my baby cries could spoil my baby) were averaged to create a measure of mother-oriented cry beliefs.

Observation of Mother and Infant Behavior

During the 6-month visit, mothers and infants participated in three distress-eliciting tasks (after mothers changed infants into gender-neutral clothing and engaged them in a brief free play). Infants were strapped in an infant seat and mothers sat in a chair to their right. The first distress task was a 4-min *arm restraint* procedure designed to elicit infant frustration. The experimenter knelt in front of the infant seat and gently held the infant's forearms immobile while keeping her head down and not interacting with the infant. The second distress task was a *novel toy approach* designed to elicit infant fear. The infant was tucked into a table with a barrier that prevented the toy from touching the infant. A remote control-operated dump truck with flashing lights, motion, and sound and an action figure seated on top approached the infant three times. While immobile in front of the infant, the truck's horn, ignition, and a voice sounded, and music played while the truck vibrated and its lights flashed; this sequence was repeated twice. Then, the silent and still truck remained within the infant's reach for 1 min. The entire task lasted for 4 min. During the first minute of both tasks, the mother was instructed to remain neutral and uninvolved unless she wanted to end the activity. Then, the experimenter signaled the mother that she could interact with her infant as she pleased. The final distress eliciting task was the *still face* procedure (Tronick, Als, Adamson, Wise, & Brazelton, 1978). Mothers' seats were moved across from their infant so they were at eye level. For the first 2 min mothers played with their infant as they normally would using their voice and hands. Then mothers looked at their infant with a still face for 2 min. Finally, mothers were instructed to play with their infant as they normally would for 2 min. Infant affect and maternal behavior were continuously rated/coded from digital media files using INTERACT 9 (Mangold, Arnstorf, Germany).

Infant Affect

The average rating of *infant affect* during the arm restraint task, novelty task, and still face re-engagement episode was used as an index of infant affect which was rated on a 7-point scale ranging from 1 (*high positive affect; intense smile, laughing or squealing*) to 7 (*high negative affect; screams, wails, sobs intensely*). This system was adapted from Braungart-Ricker and Stifter (1996). Interrater reliability was good (weighted $\kappa = .76$) based on 34 double-coded tapes. Only 8 (4%) infants did not become distressed, and the average duration of distress across the tasks was 2 min (range = 0–7.75 min) demonstrating the effectiveness of the tasks at eliciting distress.

Maternal Sensitivity to Distress

Maternal behaviors during the distress-eliciting tasks were continuously coded using 12 mutually exclusive categories (negative, intrusive, mismatched affect, withdraw, distracted, persistent ineffective, monitor, task focused, calming, supportive, nontask focused engagement, routine care) described in Leerkes (2010). Coders were blind to other data. The sensitivity of maternal behavior given the infant's affective state at that moment was rated on a 3-point scale (1 = *insensitive*, 2 = *moderately sensitive*, 3 = *sensitive*). For example, monitoring a neutral infant is rated as sensitive because the infant is not signaling a need. Monitoring an infant who is displaying positive affect is moderately sensitive as the infant is not signaling a need for assistance but the mother is missing out on opportunities for positive engagement. Monitoring when an infant is distressed is rated as insensitive because the infant is signaling a clear need to which the mother does not respond. Sensitivity ratings for each discrete maternal behavior during infant positive, neutral and negative affect are described in Leerkes (2010). Thirty cases were double-coded for reliability ($\kappa = .67$) and disagreements were resolved via consensus. Mothers' average rating of sensitivity was calculated for the mother-involved portions of the arm restraint and novel toy approach tasks and for the still face re-engagement episode such that high scores reflect greater sensitivity during each task.

Results

Preliminary Analyses

Mothers who participated in the observation were more highly educated and were rated as having higher coherence of mind than women who did not participate in the observation, $t(257) = 2.89$, $p < .01$, and $t(257) = 2.32$, $p < .05$, respectively, but did not differ on maternal age, family income, ethnicity, measures of personality and emotional functioning, beliefs about crying, or responses during the prenatal emotion interview. Little's test indicated that the data were missing completely at random, $\chi^2(126) = 112.31$, $p = .80$. Missing data were handled in the analyses via full information maximum likelihood, which takes all available data into account and is recommended when data are missing at random (Acock, 2005). Post hoc Monte Carlo simulation analysis suggested there was adequate statistical power (> .80) in this model to detect small effects (.10 for standardized coefficients).

Means, standard deviations, and Cronbach's alpha for key variables along with their intercorrelations are presented in Table 1. Next, potential covariates were identified by examining simple correlations between maternal education, prior experience with infants, infant gender, and observed infant distress and primary variables. Prior experience caring for infants was associated with fewer mother-oriented negative emotions, marginally lower arousal, greater empathy, and higher maternal sensitivity. Mothers who were more highly educated were rated as having higher coherence of mind, reported lower general emotional risk, and were rated as more sensitive. Mothers whose infants were less distressed during the observational tasks were rated as more sensitive. Thus, maternal education, experience caring for infants, and observed infant affect were included as covariates.

Mean differences for European American and African American women were examined on all primary variables using *t* tests. African American mothers were rated as having lower coherence of mind, $t(257) = -4.22$, $p < .01$, and behaving less sensitively during each of the three observational tasks, *t*s(208) = −2.53, −2.45, and −3.05, all *p*s < .01; reported higher depressive symptoms, lower trait positive emotions, lower agreeableness, and fewer difficulties with emotion regulation, *t*s(257) = 2.44, −2.10, −4.20, −2.24, all *p*s < .01; and had lower SCL baseline and change scores, *t*s(257) = −3.49 and −6.36, both *p*s < .01, than European American women. Group differences in observed sensitivity, depressive symptoms, and trait positive emotions were no longer significant when maternal education was controlled.

Primary Analyses

Hypotheses were evaluated by conducting structural equation modeling (SEM) with Mplus version 7 (Muthén & Muthén, 1998–2012). The model included both observed variables (coherence of mind, mean-centered physiological arousal and regulation and their product term, maternal education, experience with infants) and latent factors (emotional risk, infant- and mother-oriented cry processing, infant affect, and maternal sensitivity to distress). Latent variables were specified as having multiple indicators that were described above. For example, the latent variable representing emotional risk was specified as having six indicators (depressive symptoms, agreeableness, neuroticism, difficulties with emotion regulation, and trait positive and negative emotions). Mother-oriented negative emotions were specified as an indicator of mother-oriented cry processing, but was removed from the model because it was the only indicator with a standardized loading < .30. To account for method effects, in the SEM model correlations were added between subscales from common measures and between ratings of mothers and infants during the same task; any that were nonsignificant were removed from the model. In addition, the residual errors for mother-oriented and infant-oriented cry processing were correlated, as were the residual errors for education and coherence of mind and education and emotional risk.

Standardized coefficients for the measurement model, covariances reflecting method effects, and correlated residual errors are displayed in Table 2.

In the path model, coherence of mind and emotional risk were specified as exogenous variables that predicted physiological arousal and regulation as well as mother- and infant-oriented cry processing and maternal sensitivity to distress. Physiological arousal and regulation in response to crying were also specified as predicting maternal responses to crying and sensitivity to distress as was the product term representing the interaction between arousal and regulation. Finally, mother and infant-oriented cry processing were linked to maternal sensitivity to distress. Prior experience caring for infants was included as a covariate and specified as predicting maternal arousal and regulation, mother- and infant-oriented cry processing and maternal sensitivity to distress. Likewise, infant affect and maternal education were included as covariates and specified as predicting maternal sensitivity. The structural model demonstrated good fit; $\chi^2(245) = 368.89$, $p < .001$, comparative fit index = .90, root mean square error of approximation = .044, standardized root mean square residual = .066.

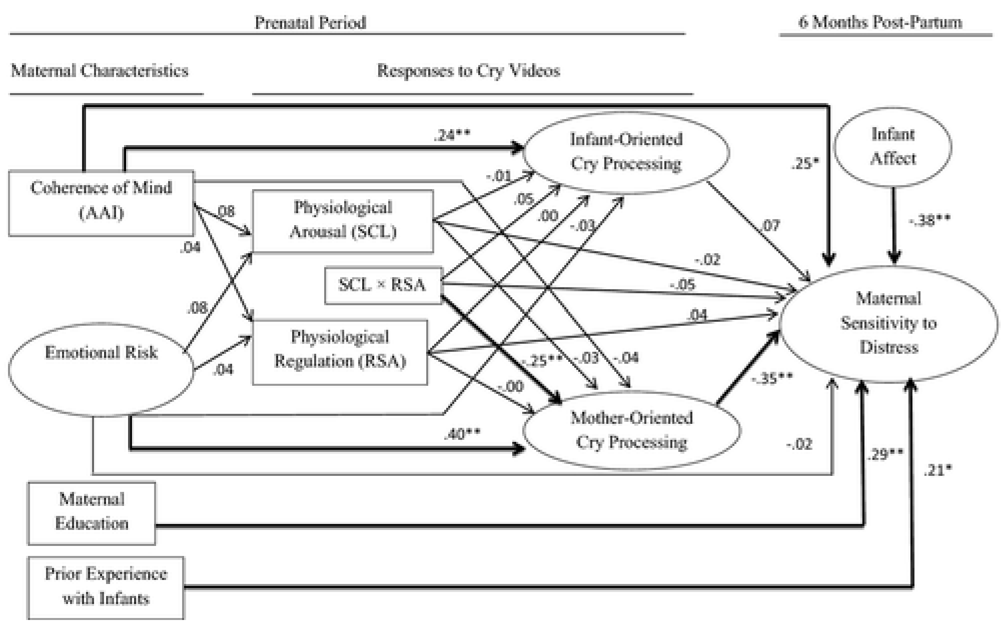

Figure 1. Structural model predicting maternal sensitivity to distress. Values are standardized coefficients. Statistically significant paths are bolded. Paths between experience with infants and physiological arousal and regulation and mother and infant oriented cry processing were included in the model, but were nonsignificant (βs ranged from −.12 to .07) and are not displayed given space constraints. $N = 259$. AAI = Adult Attachment Interview; SCL = skin conductance level; RSA = respiratory sinus arrhythmia. *$p < .05$. **$p < .01$.

Table 1. Descriptive Statistics and Intercorrelations

	M	*SD*	α	1	2	3	4	5	6	7	8	9	10
1. Coherence of mind	5.31	1.46	—	—									
2. Depressive symptoms	13.64	8.71	.87	.04	—								
3. Emotion reg. difficulties	1.87	0.43	.91	.02	.51**	—							
4. Trait negative emotions	1.94	0.53	.91	.01	.65**	.51**	—						
5. Trait positive emotions	3.36	0.55	.78	.13*	−.29**	−.23**	−.13*	—					
6. Agreeableness	44.50	6.15	.79	.16*	−.28**	−.32**	−.40**	.23**	—				
7. Neuroticism	30.07	7.01	.81	−.15*	.55**	.58**	.63**	−.23**	−.40**	—			
8. Physiological arousal	2.48	2.11	.93	−.08	.02	.11	.07	−.02	.00	.07	—		
9. Physiological regulation	0.73	0.91	.87	.04	−.03	.04	.08	.03	−.07	.02	−.05	—	
10. Empathy	2.16	0.60	.87	.19**	−.06	−.02	−.01	.16*	.16*	−.01	−.05	.04	—
11. Distress detection	0.05	0.81	.71	.08	−.06	−.10	.00	.03	.11	−.01	.06	−.03	.24**
12. Situational attributions	3.21	0.43	.87	.15*	.04	.00	.14*	.13*	.09	.03	.02	−.02	.43**
13. IO cry beliefs	4.62	0.36	.83	.03	−.08	−.17**	−.05	.11	.20**	−.04	.00	.03	.24**
14. MO negative emotions	1.11	0.15	.80	.14*	.10	.16*	.19**	.01	−.09	.13*	.03	.03	.03
15. Negative attributions	1.41	0.37	.92	−.02	.14*	.09	.19**	−.09	−.15*	.15*	−.01	−.02	−.17**
16. Minimizing attributions	1.58	0.53	.95	−.01	.11	.12	.16*	−.07	−.14*	.12	−.09	.04	−.08
17. MO cry beliefs	2.07	0.53	.78	−.01	.17**	.18**	.25**	−.11	−.25**	.17**	.00	.01	−.14*
18. Inf. affect arm restraint	4.11	0.37	—	−.04	.11	−.05	.02	−.08	−.11	.02	−.07	−.22**	.02
19. Inf. affect novel toy	4.09	0.31	—	.03	.00	−.13*	−.06	.05	.08	−.06	−.06	−.01	.03
20. Inf. affect still face	4.70	0.88	—	−.15*	.03	.07	.09	−.01	−.10	.15*	−.05	−.06	.07
21. MSen arm restraint	2.75	0.26	—	.20**	−.15*	−.06	−.07	.08	.16*	−.10	.02	.02	.16*
22. MSen novel toy	2.47	0.27	—	.19**	−.12	−.02	−.14*	.11	.19**	−.15*	−.04	.10	.15*
23. MSen still face	2.68	0.31	—	.27**	−.12	−.11	−.13*	.09	.30**	−.27**	.03	.10	.02

	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Coherence of mind													
2. Depressive symptoms													
3. Emotion reg. difficulties													
4. Trait negative emotions													
5. Trait positive emotions													
6. Agreeableness													
7. Neuroticism													
8. Physiological arousal													
9. Physiological regulation													
10. Empathy													
11. Distress detection	—												
12. Situational attributions	.35**	—											
13. IO cry beliefs	.11	.25**	—										
14. MO negative emotions	.02	.05	.00	—									
15. Negative attributions	−.14*	−.02	−.14*	.18**	—								
16. Minimizing attributions	−.07	.03	−.05	.22**	.65**	—							
17. MO cry beliefs	−.14*	−.07	−.31**	.08	.29**	.21**	—						
18. Inf. affect arm restraint	.03	−.03	−.12	.00	.03	.00	.06	—					
19. Inf. affect novel toy	.06	.04	.11	.00	−.05	−.11	−.11	.34**	—				
20. Inf. affect still face	.05	.07	.01	.04	.14*	.11	.04	.29**	.14*	—			
21. MSen arm restraint	.16*	.07	.01	.00	−.10	.01	−.10	−.38**	−.16*	−.08	—		
22. MSen novel toy	.11	.10	.02	.05	−.19**	−.13*	−.16*	−.06	−.16*	−.12	.36**	—	
23. MSen still face	.09	−.01	.03	−.10	−.23**	−.22**	−.08	−.24**	.01	−.67**	.24**	.28**	—

*Note. N*s = 211–259. Reg = regulation; IO = infant-oriented; MO = mother-oriented; Inf = infant; MSen = maternal sensitivity.
$^{*}p < .05$. $^{**}p < .01$.

Table 2. Standardized Loadings and Covariances for Measurement Model

Construct	**Indicator**	***B***
Emotional risk	Depressive symptoms	.78**
	Difficulties with emotion regulation	.66**
	Trait negative emotions	.82**
	Trait positive emotions	−.36**
	Agreeableness	−.52**
	Neuroticism	.76**
Infant-oriented cry processing	Empathy	.64**
	Accurate distress detection	.45**
	Situational/emotional attributions	.68**
	Infant-oriented cry beliefs	.36**
Mother-oriented cry processing	Negative attributions	.47**
	Minimizing attributions	.34**
	Mother-oriented cry beliefs	.58**
Observed infant affect	Arm restraint	.63**
	Novel toy approach	.52**
	Still face re-engagement	.36**
Maternal sensitivity to distress	Arm restraint	.62**
	Novel toy approach	.53**
	Still face reengagement	.42**
Covariances (method effects)		
Trait positive and negative emotions		.29**
Infant-oriented and mother-oriented cry beliefs		−.29**
Negative and minimizing attributions		.57**
Arm restraint infant and mother		−.28**
Still face infant and mother		−.68**
Correlated residual errors		
Infant-oriented and mother-oriented cry processing		−.34**
Education and coherence of mind		.38**
Education and emotional risk		−.27**

Note. Ns = 259. **$p < .01$.

To examine possible differences between African American and European American mothers, we first considered measurement equivalence for the factor loadings indicating each construct in the model. Multigroup analyses in Mplus set factor loadings and item intercepts to equality by default. An examination of modification indices suggested that one factor loading (linking infant distress during the truck task to the infant distress factor) and one intercept (an item from the Difficulties with Emotion Regulation Scale) should be freed to improve model fit. A subsequent multigroup confirmatory factor analysis model with those two parameters freed demonstrated a similar fit to a model with all parameters set free. This suggests partial measurement equivalence, which is sufficient to conclude that subsequent multigroup tests are not biased (Byrne, Shavelson, & Muthén, 1989). The next multigroup analyses considered group differences in structural paths by comparing a model with all paths constrained to equality with one that had all paths freely estimated across African American and European American women using a Wald test. The change in chi-square across these two models was nonsignificant

($\Delta\chi^2 = 31.85$, $\Delta df = 24$, $p = .15$). Given the partial measurement invariance and similarity in paths across race, the final results are based on analyses of the full sample. Standardized coefficients are presented in Figure 1; significant paths are bolded.

Hypotheses related to indirect associations were evaluated using bias-corrected bootstrapped 95% confidence intervals (MacKinnon, Lockwood, & Williams, 2004). Confidence intervals for unstandardized coefficients are presented for relevant direct and indirect effects. Confidence intervals that do not span 0 reflect significant effects; standardized betas are presented to evaluate effect size. Results of the structural path model are described below.

Correlates of Mothers' Prenatal Responses to Crying: H1–H3

Contrary to prediction, emotional risk and coherence of mind were not associated with mothers' physiological arousal or regulation in response to the infant cry videos. Likewise, emotional risk and the interaction between physiological arousal and regulation were unrelated to infant-oriented cry processing. However, coherence of mind was associated with greater infant-oriented cry processing. The predictors accounted for 5% of the variability in infant-oriented cry processing, a small effect ($f^2 = .05$). In contrast, the predictors accounted for 26% of the variability in mother-oriented cry processing, a large effect ($f^2 = .37$). Specifically, emotional risk was linked with greater mother-oriented cry processing. Further, the interaction between physiological arousal and regulation was significant such that emotional arousal in response to the cry videos was linked with higher mother orientation when regulation was low (−1 *SD*, $B = .29$, $p = .06$) but with lower mother orientation when regulation was high (+1 *SD*, $B = -.36$, $p = .01$), as illustrated in Figure 2. Contrary to prediction, coherence of mind with respect to attachment was unrelated to mother-oriented cry processing.

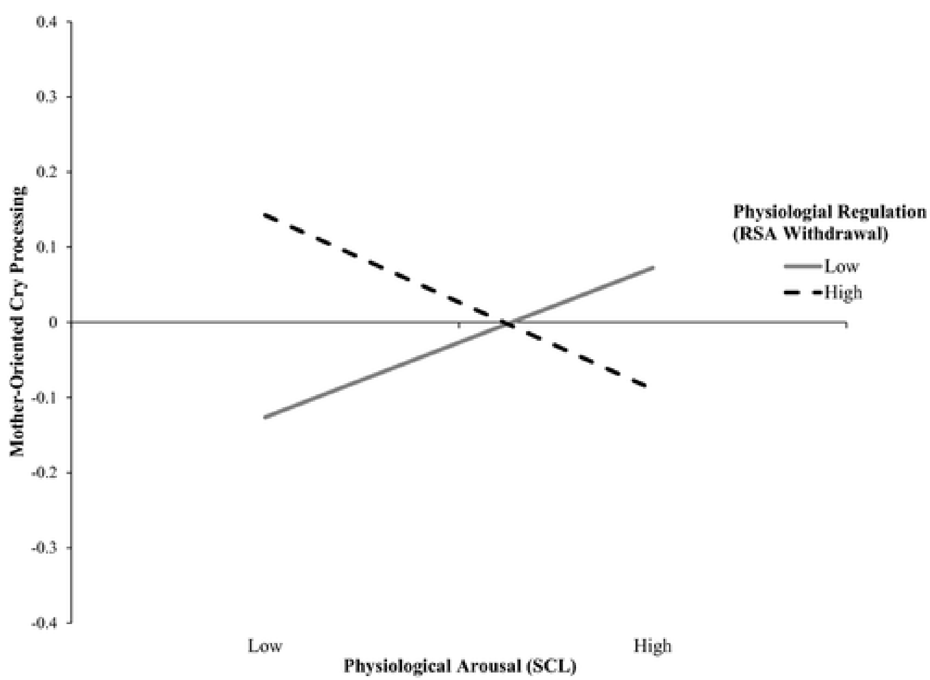

Figure 2. Interaction effect between physiological arousal and regulation in relation to mother-oriented cry processing. RSA = respiratory sinus arrhythmia; SCL = skin conductance level.

Pathways Predicting Maternal Sensitivity to Distress: H4 and H5

Independent of covariates, coherence of mind was associated with higher maternal sensitivity to distress, but the effect of coherence of mind on sensitivity to distress was not indirect via mothers' physiological reactions to crying or the degree to which they engaged in mother- or infant-oriented cry processing. In contrast, the indirect effect of emotional risk on maternal sensitivity via mother-oriented cry processing was significant, 95% CI [−.13, −.01], $\beta = -.14$, a small to medium effect (Shrout & Bolger, 2002). The remaining direct effect of emotional risk on sensitivity was not significant, 95% CI [−.06, .08], $\beta = -.01$. Thus, maternal emotional risk was linked with mothers' heightened focus on their own needs, which in turn predicted lower sensitivity to infant distress.

Also consistent with prediction, the interaction between prenatal physiological arousal and regulation in response to infant cries had a significant indirect effect on maternal sensitivity to infant distress via mother-oriented cry processing, 95% CI [.001, .040]. The standardized coefficient for this effect was .09, a small effect size (Shrout & Bolger, 2002). There was not a direct effect of the Physiological Arousal × Regulation interaction on sensitivity, 95% CI [−.03, .02], $\beta = -.05$. Thus, mothers who were highly aroused and poorly regulated in response to infant crying were more focused on their own needs when exposed to infant cry videos, which in turn predicted less sensitive responses to their own infants during distressing tasks.

The model as a whole predicted 58% of the variability in maternal sensitivity to distress, a large effect ($f^2 = 1.22$). Subsequent analyses, testing pieces of the model demonstrate that a model including only covariates accounted for 34% of the variability in sensitivity; a model including covariates, coherence, and emotional risk but excluding physiological responses to crying and cry processing accounted for 42% of the variability of sensitivity; and a model including all substantive predictors but excluding covariates accounted for 45% of the variability in sensitivity. These results demonstrate that the conceptual model predicted more variability in sensitivity than did covariates, and physiological, emotional, and cognitive responses to crying predicted variability in maternal sensitivity to distress over and above traditional predictors.

Discussion

The primary goal of this study was to test a more comprehensive model of the antecedents of maternal sensitivity to distress that integrated attachment, SIP, and psychobiological perspectives. Consistent with our conceptual model, the results demonstrated that factors implicated by all three perspectives are antecedents of maternal sensitivity to infant distress. Moreover, the results demonstrate three specific pathways by which these processes operate to influence maternal sensitivity to distress. The pattern of associations was comparable for European American and African American mothers.

The first pathway predicting maternal sensitivity to infant distress was a direct effect of coherence of mind. Consistent with prior research, coherence of mind with respect to attachment predicted greater maternal sensitivity during distress tasks (Ablow et al., 2013). Given interest in the predictive validity of various approaches to quantifying adult attachment and the relatively few studies that have relied on the coherence of mind score as the sole indicator of adult attachment, we ran additional analyses in which we replaced coherence with the dichotomous secure versus insecure score or with dimensional measures of dismissing and preoccupied states of mind (Whipple et al., 2011). The dichotomous security score predicted sensitivity to distress, but the effect was modestly weaker, and the model fit was no better in comparison to the coherence of mind results. Dismissing and preoccupied dimensions predicted maternal sensitivity to distress also, but only when coherence was included in the composites indicating that coherence of mind and not the other state of mind scales carried these associations.

Although coherence was linked with more infant-oriented cry processing in response to the cry videos as predicted, infant-oriented cry processing was unrelated to sensitivity to distress. Thus, infant-oriented cry processing did not explain the association between coherence of mind and maternal sensitivity. Inspection of the simple correlations demonstrates that empathy and accurate cry detection were associated with sensitivity to distress but infant-oriented attributions and beliefs were not. Perhaps measuring cry processing in response to more ambiguous infant cry stimuli would strengthen associations by capturing how mothers think about infant cues that are more susceptible to bias. Alternatively, maternal characteristics that reflect a general awareness of and appropriate interpretation of others' mental states such as reflective functioning (Fonagy, Steele, Steele, Moran, & Higgitt, 1991) or maternal mind-mindedness (Meins, Fernyhough, Fradley, & Tuckey, 2001) may mediate links between coherence of mind and maternal sensitivity to distress. Additional work is needed to identify the processes that explain the association between attachment representations and sensitive caregiving.

The second pathway that predicted maternal sensitivity to infant distress was an indirect effect of emotional risk via mother-oriented cry processing. Consistent with prior research, mothers characterized by higher negative emotionality, difficulties regulating their own emotions, high neuroticism, and low agreeableness were more likely to report feeling angry and anxious in response to the cry videos, made more negative and minimizing causal attributions, and reported more negative beliefs and goals about crying (Leung & Slep, 2006; Schuetze & Zeskind, 2001; Zeifman, 2003). In turn, this pattern of self-focused and negative cry processing predicted lower maternal sensitivity to infant distress, consistent with prior research (Leerkes et al., 2012). This process is highly consistent with Lemerise and Arsenio's (2000) view that trait emotionality and background mood influence SIP and subsequent behavior. It is important to note that in this sample mothers endorsed very few mother-oriented beliefs and attributions, indicating that even low levels of mother-oriented cry processing pose risk for less sensitive responding to infant distress.

The third pathway that predicted maternal sensitivity to infant distress was an indirect effect from the interaction between physiological arousal and regulation in response to crying via mother-oriented cry processing. Consistent with prediction, mothers who experienced high arousal and poor regulation in response to infant crying engaged in more mother-oriented cry processing, which in turn predicted lower maternal sensitivity to distress. This pattern supports the argument that high personal distress undermines an individual's ability to focus on the needs of others, which then undermines competent behavior (Eisenberg & Eggum, 2008). These results add to accumulating evidence that mothers' physiological arousal and regulation are linked with their parenting (Ablow et al., 2013; Hill-Soderlund et al., 2008; Mills-Koonce et al., 2009;

Moore et al., 2009), suggest a mechanism by which such effects may occur, and support the view that co-occurring patterns of arousal and regulation are useful predictors of behavior (Beauchaine, 2001). Moreover, our results demonstrate that patterns of arousal and regulation in response to cry cues are a significant correlate of mother-oriented cry processing and predict sensitivity over and above general emotional characteristics.

Contrary to prediction, neither coherence of mind nor emotional risk was associated with physiological arousal and regulation in response to infant crying. These results constrast with those reported by Ablow et al. (2013) and Groh and Roisman (2009), perhaps because of methodological differences across studies. To elaborate, our cry stimuli were video based in contrast to the auditory stimuli used by Groh and Roisman, and we used fear- and anger-eliciting tasks rather than a separation and reunion from mother as was the focus of the video used by Ablow et al. It may be that the stimuli in these other studies were more effective at activating attachment schema, maximizing links between attachment and physiological responding. Differing measures of adult attachment could also contribute to discrepant findings. The present study is the only one that used the coherence of mind rating from the AAI as the primary measure of adult attachment. However, ongoing analyses in this data set indicate that adult attachment status, whether measured in the classic categorical framework or using a dimensional approach (e.g., Whipple et al., 2011) is unrelated to mother's physiological reactions to crying, indicating the reported null associations are not merely an artifact of using the coherence of mind scale. Ultimately, additional research is needed to better understand the links between adult attachment representations and physiological reactions to infant crying. In particular, the possibility that adult attachment distinguishes between joint patterns of arousal and regulation in response to infant cries warrants investigation via a person-oriented approach given evidence that joint patterns of arousal and regulation were associated with mother-oriented cry processing and subsequent sensitivity to distress. It may also be the case that adult attachment has indirect effects on physiological reactions to and mother-oriented processing of cry cues via other aspects of SIP that were unmeasured in the current study: attention and memory. For example, processes of defensive exclusion may lend mothers with low attachment coherence to attend less carefully to the cry stimuli and to recall fewer details (Dykas & Cassidy, 2011), which could affect their perceptions, attributions, emotions, and physiology.

Two features of the design are particularly noteworthy. First, that adult attachment, emotional risk, and physiological, emotional, and cognitive responses to crying were assessed prenatally in primiparous mothers is a strength because this rules out the possibility that infant characteristics or parenting experience affected our results. Second, the sample was moderately large and diverse with respect to race and socioeconomic status, enhancing the generalizability of results in comparison to prior research in this area (e.g., Ablow et al., 2013; Leerkes, 2010) and allowing for formal comparison of the model across European American and African American mothers. Our preliminary analyses demonstrated group differences in a number of key variables that suggested greater risk among African American mothers relative to European American mothers (e.g., higher depression, lower sensitivity). However, differences in depression and sensitivity were accounted for by differences in education level, suggesting these racial group differences are an artifact of differences in socioeconomic status as has been reported in other samples (Bakermans-Kranenburg et al., 2004). Of most importance, results of the multigroup analyses demonstrated that none of the proposed pathways varied by maternal race. This adds to the accumulating evidence supporting the universality of attachment theory (Bakermans-Kranenburg et al., 2004; Mesman et al., 2012), and suggests that the processes that promote maternal sensitivity to distress are comparable across groups.

Limitations of the study include that this was a community sample; efforts should be made to determine if similar results emerge for mothers with clinical symptoms or other risk characteristics. Second, the observation of maternal sensitivity to distress was relatively brief, approximately 8 min. On the other hand, that is longer than prior studies of maternal sensitivity in distress contexts that have relied on a single distress task (Ablow et al., 2013; Hill-Soderlund et al., 2008; Mills-Koonce et al., 2009; Moore et al., 2009). Finally, the prenatal variables were measured at a single point in time undermining tests of indirect effects. Specifically, it could be argued that the manner in which mothers process cry cues affects their physiological responses to those cues rather than the reverse.

In conclusion, our results demonstrate three pathways that predict variation in maternal sensitivity to distress and demonstrate the relevance of attachment, psychobiological, and SIP perspective in doing so. It appears that the psychobiological and SIP perspectives can be effectively integrated together to predict variation in sensitivity; however, neither explained the process by which adult attachment is linked with maternal sensitivity to distress, demonstrating the need for continued research in this area.

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