The Influence of Maternal Prenatal Stress and Emotion Socialization on Infant Emotion Expression: Differentiating Positive and Negative Trajectories

by

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ABSTRACT

The first half-year of infancy represents a salient time in which emotion expression assumes a more psychological character as opposed to a predominantly physiological one. Although previous research has demonstrated the relations between early parenting and later emotional competencies, there has been less of a focus on differentiating positive and negative emotion expression across the early infancy period. Thus, the current study investigates the growth of positive and negative emotion expression across early infancy in a low-income, Mexican-American sample, and examines the development of emotion expression as a function of early maternal emotion socialization and prenatal stress. Participants included 322 mothers and their infants. Data were collected in participants' homes prenatally and when the infants were 12-, 18-, and 24-weeks old. Mothers were asked to interact with their infants in a semi-structured teaching task, and video-taped interactions of mother and infant behaviors were then coded. Data for mothers was collected at the prenatal and 12-week visits and data for infants was collected at the 12-, 18-, and 24-week visits. Prenatal stress was measured via two questionnaires (Daily Hassles Questionnaire and Perceived Stress Scale). Maternal socialization at 12 weeks was represented as a composite of four observational codes from the Coding Interactive Behavior coding system. Infant emotion expression was also globally rated across the 5-minute teaching task. Findings suggest that the normative development of emotion expression across early infancy is complex. Positive emotion expression may increase across the early infancy period whereas negative emotion expression decreases. Further, at 12 weeks, greater maternal emotion socialization relates

to more infant positivity and less negativity, in line with current conceptualization of parenting. However, across time, greater early socialization predicted decreased positivity and was unrelated to negative emotion expression. Findings also suggest that prenatal stress does not relate to socialization efforts or to infant emotion expression. A better understanding of the nuanced development of positive and negative emotion development as a function of early parenting may have implications for early intervention and prevention in this high-risk population.

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Introduction

A developmental perspective of emotion expression considers emotions in terms of when they emerge and how they develop, as well as the underlying process by which this occurs. It is important not only to identify the trajectory of a particular emotion but also to understand the nature of its development and identify the ways in which antecedent and concurrent processes work together to influence the course of that emotion (Sroufe, 1996).

Although research exists examining emotion expression over time (Charles, Reynolds, & Gatz, 2001), there has been less specific focus on the first six months of life (Bridgett, Laake, Gartstein, & Dorn, 2013; Olino et al., 2011; Sroufe, 1996). As early as three weeks of age, infants begin to express distinguishable positive and negative emotion (Camras, Ribordy, Hill, Martino, Spaccarelli, & Stefani, 1988). During the early weeks of infant life, expressions are thought to be physiologically based and spontaneous (Sroufe & Waters, 1976). Over time, however, these expressions develop in distinct ways depending on a variety of factors including prenatal risk contexts, maturation processes, and parenting behaviors among others.

A number of studies have found that atypical emotion expression during infancy and toddlerhood is linked to later deficiencies in peer relations, socioemotional incompetence, and problem behaviors (Garner & Estep, 2001; Taylor, Eisenberg, VanSchyndel, Eggum-Wilkens, & Spinrad, 2013). Specifically, children who express more negative emotion are thought to experience deficiencies in adjustment and social competency (Cole, Martin, & Dennis, 2004; Eisenberg et al., 2001). Alternatively, a

typical and appropriate course of emotion expression helps infants interact with their caregivers in a synchronous way (Feldman, 2007a; 2007b), a precursor for later developmental competencies (Lindsey, Colwell, Frabutt, Chambers, & MacKinnon-Lewis, 2008; Lindsey, Cremeens, Colwell, & Caldera, 2009).

A developmental perspective on emotion expression during infancy can help inform both research and intervention services by identifying the specific areas that may be targeted and the timing that might produce the best effect. For this reason, the proposed study examined developmental trajectories of positive and negative emotion expression across the first six months of infancy. The first half-year of infancy represents a salient period in which infant emotional expression begins to assume a more psychological character as opposed to a predominantly physiological one. Of particular interest is how these positive and negative emotion expressions develop over the first six months of life and whether they develop as a function of maternal emotion socialization and/or maternal prenatal stress factors. The way in which mothers respond to their infants are often associated with how infants express emotions (Malatesta & Haviland, 1982) and maternal prenatal stress represents one salient determinant of parenting that could alter her socialization efforts. But prenatal stress may be more directly related to infant emotion development through biological and physiological mechanisms, and as such, the proposed study will help to elucidate multiple developmental processes that underlie typical and atypical positive and negative emotion expression during early infancy.

Background Literature

Emerging Emotion Expression in Infancy

Human emotions serve myriad functions including communicating inner states and promoting exploratory competence in the environment (Sroufe, 1996). "Feeling" is thought to be the essence of emotion, and facial, vocal, and gestural movements are the outward manifestations of internal feeling states (Abe & Izard, 1999). Preverbal infants demonstrate these feelings through the use of various emotion expressions. In this sense, emotion expression serves as a signal from the infant about his/her internal state (Buss & Goldsmith, 1998). This affective state is thought to motivate caregiver responses to the infant's needs. These expressions are considered adaptive when infants deploy responses appropriately and flexibly with changing situational demands. Adaptive or not, emotion expression relates to subsequent perception, cognition, and behavior (Abe & Izard, 1999).

Individual differences in the trajectories of emotion expressions become apparent over time but begin to emerge in early infancy (Campos, Campos, & Barrett, 1989). Research on brain and cognitive development suggests that changes in emotional life occur from early infancy onward (Schore, 1994). Differential emotions theory (Izard, 1971) posits that emotion expressions change as a function of both maturation and experience. Although some researchers believe that emotional facial expressions are universal (Camras, Oster, Campos, Miyake, & Bradshaw, 1992), researchers also acknowledge that that the discrete expressions of one infant may or may not mirror those of another (Camras, Bakeman, Chen, Norris, & Cain, 2006; Stifter, Sprinrad, Braungart-Rieker, 1999). These individual differences in expression are partly biologically

determined but they become more susceptible to influence from external sources over time (Malatesta, Grigoryev, Lamb, Albin, & Culver, 1986).

Internal sources of influence include temperament, neuroregulatory systems, and cognitive systems whereas external sources include the infant's caregivers and social environment (Shaw, Keenan, Vondra, Delliquadri, & Giovannelli, 1997). In the early stages of emotion development, caregivers are thought to be responsible for helping their infants manage varying levels of distress (Campos, Campos, & Barrett, 1989; Crockenberg, Leerkes, & Lekka, 2007). In addition, mothers strive to elicit and maintain positive emotion during interactions with their infants (Stern, 1974). The caregivers' goal of maintaining low levels of negative emotion expression and high levels of positive emotion expression then reflects the typical pathway by which infants develop emotionally.

Although a mother's goal is for her child to maintain high levels of positivity and low levels of negativity, this does not imply that positive and negative emotions are on a single dimension. Indeed, research suggests that positive and negative emotion are only moderately negatively correlated with each other, indicating that they are distinct constructs (Belsky, Hsieh, & Crnic, 1996; Bradburn, 1969; Diener & Larson, 1993). As such, positive and negative emotion should be studied independently. Depending on the context and developmental period, infants might express more or less positive and negative emotion. Well-being, for example, may be evidenced through an increase in positive emotion, a decrease in negative emotion, or a combination of both depending on the context and individual (Ryff, 1989). An examination of the differential association of

parenting characteristics on positive versus negative emotions is possible when these constructs are examined independently.

Variability in how infants and mothers express emotion and cope with mild daily stressors is observable as early as the first weeks of an infant's life (Gunnar, Porter, Wolf, Rigatuso, & Larson, 1995). Mild perturbation techniques such as the still-face paradigm (Tronick, Als, Adamson, Wise, & Brazelton, 1978) and arm restraint (Stifter & Braungart, 1995) provide a context to better understand infant and mother responses and behavior during times of mild distress. These tasks, designed to illicit frustration in the mother or infant, are useful in capturing variability in behavior and expression. During the still-face, mothers actively engage with their infants and are then told to maintain a neutral face, provoking distress and frustration in their infants. Perturbation in the current study is elicited through a challenging teaching task in which mothers are instructed to have their infants engage in a task that was developmentally too advanced. Perturbation is likely to occur because mothers are not informed that the task is too difficult for their infants and may become frustrated or challenged when the infant cannot perform. The likely frustration in mothers would, in turn, affect infants' emotion state through strained parenting efforts or over-stimulation. Infants' own frustration in being given a task too difficult represents a second perturbation that may relate to infant expressions.

Positive versus Negative Emotion Development in Infancy

Keeping with a development perspective, only through the lens of normative emotion development can deviations from normal developmental pathways be interpreted and understood. Positive emotion expression begins with spontaneous, physiological

smiles and develops with age to include alert and social smiling and then laughter (Sroufe & Wunsch, 1972; Wolff, 1963). The expression of smiling, the single most salient evidence for positive emotion expression is seen in newborn infants, although research is not clear whether this earliest form of smiling represents a discrete emotion (Izard, Huebner, Risser, McGinnes, & Dougherty, 1980) or just an endogenous physiological response (Spitz, Emde, & Metcalf, 1970). Social smiling in reaction to mothers' smiles and gaze towards mothers is first apparent in infants around four to twelve weeks of age (Messinger, 2002; Spitz, 1965; Sroufe, 1996). Laughter is then incorporated into infants' emotional repertoire around 18 weeks but is, at first, mostly limited to tactile stimulation, such as tickling. Between 18 and 24 weeks, auditory stimulation additionally elicits laughter in infants (Sroufe, 1996). Over time, laughter becomes communicative and serves social purposes in addition to being elicited through heightened arousal and stimulation as in earlier ages (Rothbart, 1973).

The typical development of positive emotion expression during infancy is represented by spontaneous smiling before four weeks of age, social smiling between four and 12 weeks of age, and then finally the emergence of laughter between 18 and 24 weeks of age. This course of increased positive emotion expression relates to later developmental competencies, such as friendly peer interactions (Izard & Ackerman, 2000) and peer acceptance (Walter & LaFraniere, 2000). More frequent positive emotion during adulthood is related to happiness, which is associated with improved health and work performance (Lyubomirsky, King, & Diener, 2005). Although there has been less of a focus on the consequences of atypical positive emotion development, deviations from

the aforementioned trajectory are thought to be risk factors for later internalizing and externalizing problems in children. Indeed, recent research has examined the influence of blunted positive affect across time rather than increased negative affect as a risk factor for later depression (Olino et al., 2011).

Negative emotion expression reflects a similar pattern to positive emotion in that the first negative reactions are more physiological and become more content-specific and emotional with age (Sroufe, 1996). Research has suggested a peak in negative emotion expression around 2 months (Barr, 1990) after which capacities for arousal modulation emerge (Spitz et al, 1970; Waters, Matas, & Sroufe, 1975) and negative emotion decreases. Around two to three months of age, infants express negative emotion for a variety of reasons including a wet diaper, hunger, and fatigue. Most often, this distress is expressed through furrowed brows, crying, and/or screaming (Messinger, 2002) but the intensity and frequency change over time. By six months of age, infants demonstrate decreased emotional lability as well as an attenuation of negative affect (Malatesta & Haviland, 1982). Negative emotion expression has been examined more generally during early infancy. However, around six months it is thought to become more discrete, branching into distress, fear, disgust, and anger (Bridges, 1932).

Disruptions in the typical negative emotion trajectory could be responsible for later regulatory problems. In one study of 6-week-old infants considered "excessive criers" by their parents, evidence demonstrated lower emotion self-regulation at five and ten months in these "excessive criers" compared to those infants considered "typical criers." When attentional strategies emerge, reductions in negative arousal might occur,

suggesting a maturation process (Stifter & Sprinrad, 2002). In the aforementioned study, a possible disruption in the normal maturation process may have led to excessive crying. Others have supported the idea that irritability during early infancy may be associated with maturational delays associated with birth complications or biological risk (Barr, 1989; Pauli-Pott, Becker, Mertesacker, & Beckmann, 2000). To date, however, few researchers have examined, in depth, the changes in emotion expression across the first six months of life, especially with respect to emotion-specific parenting behaviors.

Maternal Emotion Socialization

Tronick (1980) proposed that the mother-infant dyad is a system characterized by mutual regulation in which both partners engage in goal-oriented behaviors. A mother's goal is often to maintain or increase positivity and decrease negativity in her infant (Tronick, 1989). Indeed, a mother's warmth and support give her infant cues as to the appropriateness of emotion expressions. Social referencing refers to the idea that infants often look to their mothers for affective information (Boccia & Campos, 1989). Work with maltreated infants supports the idea that infants who do not receive adequate assistance from their parents in emotionally arousing situations are less able to effectively express their emotions and constructively cope with emotional arousal (Shipman & Zeman, 2001).

Maternal emotion socialization is characterized by the way in which mothers encourage, respond to, and support a pattern of emotion expressiveness in their infants (Eisenberg, Cumberland, & Spinrad, 1998). This is accomplished through mothers' own expression of positive emotion, appropriate vocalizations that maintain infants' attention,

and acknowledgement of a range of both positive and negative emotions in their infants (Brazelton, Koslowski, & Main, 1974). Positive socioemotional and psychological competencies for infants are achieved through this socialization of emotions and effective modeling of appropriate emotions in context (Carter, Mayes, & Pajer, 1990; Cohn & Tronick, 1983; Malatesta & Haviland, 1982). Mothers who acknowledge all emotions of their children and support a range of emotion expressions typically have infants with better attachment security (Kochanska, 2001), improved emotion regulation strategies (Shaffer, Suveg, Thomassin, & Bradbury, 2012), more prosocial behavior (Roberts, 1999), and more competent peer relations (Denham, 1997; Garner & Estep, 2001; Garner, Jones, & Miner, 1994). In contrast, lower levels of warmth and support for appropriate emotion expressions, as well as mothers' restriction of expressiveness, has been associated with difficulties in emotion regulation and internalizing and externalizing problems (Eisenberg, Cumberland, & Spinrad, 1998; Eisenberg, Fabes, Schaller, Carlo, & Miller, 1991)

The developmental patterns that have emerged across studies to date suggest that maternal emotion socialization is linked to infant competence across domains from late infancy through the toddlerhood periods. However, links to affective competence during the early infancy period have not been well explored (Malatesta et al., 1986). Given the state of the field, there remains ambiguity as to the specific ages at which these maternal socialization behaviors are related to positive and negative emotion expressions in young children (Eisenberg, Cumberland, & Spinrad, 1998). Gottman and colleagues' (1996) work on emotion-coaching found that mothers' values and awareness of their own

emotional expressions, and their willingness to support their children's range of emotions was related to their children's ability to generate effective solutions during emotionally valiant situations at 8-years-old. Researchers have also found supportive socialization efforts to be associated with increased positivity and decreased negativity during toddlerhood and early childhood (Malatesta, Culver, Tesman, & Shepard, 1989; Stifter & Moyer, 1991). However, it is less clear how socialization efforts operate during early infancy and whether there exist patterns that parallel later developmental periods.

A discrepancy in the literature also exists as to the extent to which parenting behaviors and biological factors relate to positive versus negative child emotion. Positive emotion expression has been found to be more susceptible to environmental influences than genetic influences (Baker, Cesa, Gatz, & Mellins, 1992). For instance, in their study of twins, Goldsmith and colleagues (1997) found a shared environmental effect for infant positive affect, likely attributed to features of maternal behavior common to the twins. In addition, affectionate touch has been associated with more positive emotion during infancy (Palaez-Nogueras, Field, Hossain, Pickens, 1996). There is less clarity with regard to negative emotion. In one study on the heritability of emotion, there was evidence of a shared environmental effect for infant positive emotion expression whereas negative emotion expression showed a substantial genetic influence and negligible shared environmental effect. Of note, when observed emotion, rather than parental report of infant emotion, was examined no genetic effect was found (Emde et.al., 1992). In addition, Stifter and Fox (1990) found newborn infant reactivity, and more specifically infant crying and irritability, to be stable across a 5-month period, lending support to a

biological basis for negative emotion. However, without a parenting measure, one cannot assume that parenting has no association with negative emotion. In one study that included an observational parenting measure, maternal behavior with infants did not distinguish excessive criers from typical criers (Stifter & Spinrad, 2002). Other studies, however, have found infant negative emotion expression to be malleable to parenting (e.g. Braungart-Rieker, Hill-Soderlund, Karrass, 2010; Pauli-Pott, Mertescker, & Beckmann, 2004). Due to a discrepancy in the literature, the current study aims to elucidate these potential differences in positive and negative emotion expression development while also examining maternal emotion socialization influences.

Socialization of infant emotion can be measured through the examination of mothers' acknowledgement of appropriate emotions in her child (Malatesta & Haviland, 1982), as evidenced during face-to-face interactions between mothers and their infants (Brazelton, Koslowski, & Main, 1974; Forbes, Cohn, Allen, & Lewinsohn, 2004). These behaviors have been examined though lag-sequential analyses in which mothers' and infants' emotions are tracked microanalytically (Malatesta et al., 1989; Malatesta et al., 1986). In this way, the more often an infant's smiles are followed contingently by the mother's smiles, the more evidence for supportive emotion socialization. As children get older, socialization is often measured more globally through parental reactions to children's emotions, the way in which mothers discuss emotions, and the socializers' own expression of emotion (Eisenberg et al., 1998). During infancy, indices of maternal warmth, responsivity, and sensitivity on infant competencies are more common than more global measures of emotion socialization (e.g., Seiffer, Schiller, Sameroff, Resnick,

& Riordan, 1996). Although maternal sensitivity is likely involved in the emotion socialization process during infancy, the current study examined parenting behaviors that more specifically target emotion processes.

Prenatal Stress and Emotion Development

Parenting behaviors, such as emotion socialization, are best considered from an ecological and developmental perspective. This requires an examination of precursors that may be related to parenting behaviors. One of the factors that might correlate with mothers' behavior with infants is the experience of prenatal daily stress. Daily stress might help mothers to change in ways that are adaptive (DiPietro, 2004) but when these stressors are negatively perceived, they may carry over into the postnatal period. Although there is myriad research examining postnatal risk factors and their relation to parenting practices and infant socioemotional development (Crnic, Gaze, & Hoffman, 2005; Crnic & Greenberg, 1990; Crnic & Low, 2002; Deater-Deckard, 1998; Repetti & Wood, 1997), less attention has been focused on the prenatal period and its association with developmental competencies, both directly through fetal development and indirectly through parenting (Barker, 1995; Gutteling, de Weerth, Zandbelt, Mulder, Visser, Buitelaar, 2006).

Stress can impede fetal development through changes in the mother's physiological and biological responses (Austin, 2003; Zuckerman, Amaro, Bauchner, & Cabral, 1989). Human and animal studies have examined how stress elevates risk for deficiencies in offspring development (Gitau, Fisk, & Glover, 2001; Heron, O'Connor, Evans, Golding, & Glover, 2004). Risks include preterm birth, low birth weight, and

smaller head circumference (Dunkel-Schetter, 1998; Lobel, Dunkel-Schetter, & Scrimshaw, 1992). These perinatal sequelae of prenatal stress have in turn been associated with impaired neuromotor activity, impaired attention, and irritability during infancy and later development (Schneider, Moore, Kraemer, Roberts, & DeJesus, 2002; Van den Bergh, 1990; Dunkel-Schetter, 1998; Wurmser et al., 2006).

Prenatal dysregulated activation of mothers' Hypothalamic- Pituitary-Axis (HPA) is also thought to impact fetal development. A hypo-hormonal release during times of stress has been associated with poorer fetal development (DiPietro, 2004; Herlenius & Lagercrantz, 2001; Glover, O'Connor, & O'Donnell, 2009; Weinstock, 1997). This then confers risk for a dysregulated stress-response system in the infants (Meaney, 2001), which can lead to ineffective and inappropriate emotion expression. Likewise, prenatal stress has been related to temperamental and socioemotional difficulties (Davis, Glynn, Waffarn, & Sandman, 2010; Huizink, Medina, Mulder, Visser, & Buitelaar, 2002). In one study, perceived stress during the prenatal period accounted for 8.2% of the variance in difficult behavior in 3-month-old infants (Huizink et al., 2002).

Current Study

Prior research supports the importance of studying both parenting behavior and determinants of parenting as they relate to infants' developmental competencies. An examination of the trajectories of early emotional development is important for understanding successful adaptation at later developmental stages. However, to date, no study has compared the differential relations between maternal emotion socialization behaviors or prenatal stress and positive and negative emotion trajectories using

observational methodologies. As such, the purpose of the current study is: (1) to understand the developmental trajectories of positive and negative emotion expression across three time points during the first half year of life; (2) to examine associations between maternal emotion socialization behaviors and infant positive and negative emotion trajectories; (3) to identify whether maternal emotion socialization differentially predicts infant positive and negative emotion expression trajectories; and (4) to examine the associations among prenatal stress, maternal socialization efforts, and infant emotion expression trajectories. Specifically, the study tested five hypotheses reflected in the proposed conceptual models (see Figure 1.1 and 1.2). First, higher maternal emotion socialization at 12 weeks postpartum would be associated with higher initial levels of infants' positive emotion expression, as well as increases in infants' positive emotion expression across the early infancy period (*hypothesis 1).* In contrast, infants' negative emotion trajectories would decrease over time regardless of mothers' use of supportive emotion socialization behaviors (*hypothesis 2).* Prenatal stress, as indexed by both daily hassles and perceived stress, would be related to the initial level of infant positive and negative emotion expression (intercept) but would not predict the extent to which they change (i.e. the slopes of the trajectories) over time (*hypothesis 3).* Prenatal stress would predict mothers' emotion socialization behaviors with higher levels of prenatal stress predicting less supportive maternal emotion socialization behaviors (*hypothesis 4).* Finally, the relation between prenatal stress and infant emotion expression over time (slope) would be mediated by maternal emotion socialization but only in specific ways: (1) prenatal stress would be associated with infants' positive emotion slope indirectly,

fully mediated by maternal emotion socialization; and (2) infants' negative emotion slope would be unrelated to prenatal stress directly or indirectly through emotion socialization (*hypothesis 5).*

Method

Participants

Participants in the current study were 322 Mexican-American women and their infants. Data were taken from the Las Madres Nuevas (LMN) project, a prospective longitudinal study spanning from the prenatal period to 6 years after birth. Women were recruited for the study if they self-identified as Mexican American, had a self-reported annual income below $25,000 or were eligible for Medicaid funding, spoke English or Spanish fluently, were older than 18, and were expected to deliver a healthy, singleton baby. Time points for the current study included prenatal, 12 weeks postnatal, 18 weeks postnatal, and 24 weeks postnatal. At the prenatal time point, mothers were on average 28 years old (range 18 – 42) and 30% of mothers were married. Twenty-two percent were first time mothers, 23% had one other biological child, 37% had two to three other children, and 17% had more than three children. 83% of mothers were unemployed, 59% had an annual household income of $5,000 - $15,000, and 82% of mothers spoke Spanish as their first language.

Procedures

Mothers were recruited through clinics in the Phoenix metro area during routine prenatal care visits. The initial prenatal interview included obtaining informed consent and contact information. After the initial enrollment interview, home visits for data collection were conducted by bilingual, female interviewers prenatally and then every six weeks after the infants' birth across the first six postpartum months (6, 12, 18, and 24 weeks). The present study utilized data from the prenatal (34-37 weeks gestation), 12-

week, 18-week, and 24-week home visits. Through a planned missingness design (Graham, Taylor, Olchowski, & Cumsille, 2006), all participants were expected to complete the prenatal and 6 week home visit. However, each participant was randomly assigned to miss one of the 12, 18, or 24-week data collections.

Prenatal Interview. The prenatal interviews occurred when the mothers were between 35 and 37 weeks gestation. This was the first home visit in which families took part. A female, bilingual interviewer collected various prenatal questionnaires during this visit. Demographic variables were also collected including age, annual income, and education level.

Home Visits. Female, bilingual interviewers administered home visits every 6 weeks postpartum until 12 months. All questions were read aloud and recorded through Blaise Survey Software, which is designed specifically for computer-assisted questionnaire data entry. Reading the questions to every mother in their preferred language reduced the chance for error related to literacy among study participants. Home visits lasted two to three hours, and included structured interviews, questionnaire presentations, and interaction tasks with mothers and their infants.

Interaction tasks. Five interactions tasks were administered to mothers and their infants at each home visit in order to collect observational data. These interaction tasks varied in their level of stimulation for the mother and infant and also in the level of frustration that may or may not be elicited from infants and mothers. For this study, the teaching task was examined. In the teaching task, mothers were asked to have their child accomplish a task that was, in reality, developmentally too advanced for their child. This

task differed at each data collection point to account for infant developmental advance, and ensure that a level of appropriate challenge was maintained. Tasks were adapted from the Bayley Scales of Infant Development (Bayley, 1969) to provide a reference for the appropriate level of above age challenge. At the 12-week visit, the mothers were told to have their infants lift and turn a cup to reveal a red cube. At 18 weeks, the mothers were instructed to have their infants put the red cubes into a cup. At 24-weeks, mothers were instructed to have infants place pegs into a pegboard. These teaching tasks provided a mild perturbation that allows for the opportunity to see variability in emotion expressions and parenting behaviors.

Data Coding. Mother behavior and emotions were coded (at 12 weeks) using the Coding Interactive Behaviors (CIB) system (Feldman, 1998) and infant emotions were coded (at 12-, 18-, and 24-weeks of age) using the same coding system. CIB is a global coding system designed to capture the quality of mother and infant behavior and emotions as well as the dyadic relationship along a number of critical dimensions. Mother-infant interactions were videotaped in participants' homes and coded offline by pairs of trained undergraduate students. Individual behaviors of interest were scored on a 5-point likert scale (1 = a little of the behavior; 5 = a lot of the behavior). Reliability for the selected behavioral categories was calculated for 20% of coded videos by examining total percent agreement on codes between the pairs of coders and a master coder. An individual code was considered an "agreement" if it was within one point of the master coder's scores (standard procedure for CIB reliability). Across the teaching task, overall reliability for the selected behavioral codes averaged 94% (range 85%-100%).

Measures

Prenatal Stress. Maternal prenatal stress was indexed by two well-established measures:

- *Daily Stress.* The impact of daily hassles on participant's life was measured through a subscale of the Daily Hassles Questionnaire (Belsky, Crnic, & Woodworth, 1995). This subset of questions asked mothers to report the frequency and intensity of minor daily-life stressors. Validity and reliability for the measure is well established. The current study utilized the intensity subscale (Cronbach's Alpha = 0.90).
- *Perceived Stress.* The Perceived Stress Scale-Brief was adapted from Cohen and colleagues' 14-item Perceived Stress Scale (1983). This 4-item measure examines mothers' perceptions of the stress in their lives. The PSS was administered in participants' language of choice. The measure has been established as reliable and valid in both English and Spanish (Cronbach's Alpha = 0.65).

Positive and Negative Emotion Expression. Infant emotion expression was measured using the aforementioned CIB coding system. Using previously videotaped parent-infant interactions, infants' expressions were coded on both the positive and negative scales. Positive emotion expression was coded on a five-point scale with a one indicating no observed positive affect. Children scoring a one are observed to be dull or flat throughout the interaction. A five would indicate frequent smiles and a warm, positive, and relaxed emotion expression throughout the observation. Negative emotion expression was also coded on a five-point scale with a one indicating no negative affect

throughout the interaction and five indicating consistent negativity (i.e., crying without self-regulation).

Maternal Emotion Socialization. For purposes of this study, maternal emotion socialization was defined as maternal behavior that encourages appropriate and effective emotion expression in her infant. Emotion socialization is represented as a composite of four observational codes from the CIB scoring system. These included (1) mother's expression of positive emotion; (2) her appropriate range of affect throughout the task; (3) her vocal appropriateness; and (4) her acknowledging of the infant's emotions and behaviors (Cronbach's Alpha = 0.89).

Data Analytic Plan

Preliminary analyses. First, frequency distributions and descriptive statistics were run for all variables including demographics, infant emotion expression, mothers' socialization behaviors, and maternal prenatal stress. These were used to examine observed means, standard deviations, and outliers. Correlations were calculated between all variables to identify the degree of linear association between predictors and outcomes at all time points. Any demographic variables that were correlated significantly with multiple variables of interest were included as covariates within the appropriate analyses.

Hypothesis testing. To understand the development of positive and negative infant emotion over time, I first modeled how these emotions change across 12-, 18-, and 24-week time points using latent growth curve analyses (see Figure 2 for measurement model). With three time points, a constrained linear model and latent-basis model were fit for both positive and negative emotion expression and the model with the better fit was

used in subsequent analyses. The linear growth model is specified as

$$y_{ti} = b_{0i} + b_{1i}(age_{ti} - 12) + e_{ti}$$

where y_{ti} is the outcome score at $age_{ti,}$ b_{0i} is the person-specific intercept, b_{1i} is the person-specific slope, age_{ti} represents each time point centered at 12-weeks, and e_{ti} is the difference between an observed score and the growth trajectory (residual). The latent basis growth model is written as

$$y_{ti} = b_{0i} + b_{1i}(age_{ti}\lambda t) + e_{ti}$$

where y_{ti} represents individual i's outcome score at age t, b_{0i} and b_{1i} represent the individual's intercept and slope factor, λt is the basis coefficient (i.e., factor loading), and e_{ti} represents the residual for individual *i* at time *t*.

After examining how positive and negative emotion expression change over time, hypotheses for the proposed model were tested using structural equation modeling (SEM) in Mplus 6 (Muthén & Muthén, 2010). Two separate full-structural mediation models were tested: the first included prenatal stress, maternal emotion socialization, and positive emotion expression intercept and slope and the second included prenatal stress, maternal emotion socialization, and negative emotion expression intercept and slope. The indirect effect from prenatal stress to infant emotion expression through maternal emotion socialization was calculated, using the appropriate standard error to determine significance. The χ^2 test of model fit and the root mean square error of approximation (RMSEA) were calculated to assess the fit of the proposed conceptual models.

Missing Data Handling. Out of the original 322 participants, ten participants were removed prior to analyses due to missing data at all but the prenatal time-point. In

addition, the LMN study utilized a planned missingness design that minimally affects power and allows for the analysis and inclusion of more data. The current study included planned missing data points for participants at 12, 18, and 24 weeks. Missing data also included dyads in which the infants were asleep for greater than 50% of the time during the teaching task and dyads that missed a data point for reasons other than planned missingness. Incomplete data were treated as missing at random. In order to include all possible data points and produce unbiased parameter estimates, full information maximum likelihood (FIML) was used. With the utilization of FIML, the overall sample included 312 participants.

Results

Preliminary analyses

Descriptive statistics for demographic variables and variables of interest are presented in Table 1, and correlations between all variables are shown in Table 2. The distributions of all variables of interest were normal. To account for missing data across time points, FIML analyses were employed using Mplus. Descriptive analyses indicated that age was negatively associated with daily hassles ($r = -0.11$, $p < 0.05$), such that older mothers tended to report a lower intensity of daily hassles. In addition, older mothers exhibited more emotion socialization behaviors with their infants ($r = 0.25$, $p < 0.01$) than younger mothers. Mothers who were neither married or living with a partner demonstrated less emotion socialization behaviors ($r = -0.19$, $p < 0.01$) with their infants. Family income was positively associated with emotion socialization ($r = 0.15$, $p < 0.05$) and infant positive emotion expression at 12 weeks ($r = 0.14$, $p < .05$) and negatively associated with infant negative emotion expression at 12 weeks ($r = -0.13$, $p < 0.05$). Of interest, infant gender (1 = boy, 2 = girl) was related to mothers' use of emotion socialization behaviors in that mothers used more emotion socialization behaviors at 12 weeks with infant girls than boys ($r = 0.14$, $p < 0.05$). Boys also tended to exhibit more negative and less positive emotion expression than girls at 18 weeks. No associations were found between daily hassles or prenatal stress with key study variables. Based on both theoretical importance and the presence of significant correlations with infant emotion expression, income and infant gender were entered as covariates in the final model.

Infant Positive and Negative Emotion Expression Growth

Using latent growth model analyses (LGM) in Mplus, trajectories of infant positive and negative emotion expression were examined. LGM provides an intercept and slope for the variables of interest. With three time-points, linear growth and latent basis trajectories were estimated. Although linear models are more commonly employed, latent basis models help to understand unique aspects of the data better than that of a fixed linear model (Meredith & Tisak, 1990).

LGM for Negative Emotion Expression. Two models were tested to measure growth in negative emotion expression: 1) a constrained linear model with slope coefficients constrained to 0, 1, and 2; and 2) a latent basis model in which the first two slope coefficients were constrained to 0 and 1 and the 3rd slope coefficient was freely estimated. Both models were fit to determine the model that was most appropriate for the data and a likelihood ratio test was employed to compare the two models. Results of the likelihood ratio test indicated that the latent basis model fit significantly better than the linear growth model, χ^2 (1) = 5.55, p <05. The latent basis model's fit indices were as follows: χ^2 (2) = 1.72; SRMR = 0.06; RMSEA < 0.001. The estimated means of the measured variables indicated that negative emotion expression increased from 12 weeks (2.10) to 18 weeks (2.54) to 24 weeks (2.58), although most of the change occurred from 12 to 18 weeks.

The mean of the slope factor (β_1 = 0.48, p < 0.001) indicated a significant increase in negative emotion expression for a one-unit (6 week) change. Although the

slope factor represents overall change, the parameter estimates suggest that there's not much change from 18 to 24 weeks. The mean of the intercept (β_0 = 2.10, p < 0.001), represents expected 12-week infant negative emotion expression. The intercept variance (σ_0^2 = 0.44 p < 0.05) indicates significant differences in the initial level of negative emotion expression across individuals at 12 weeks. The non-significant slope variance (σ_1^2 = 0.71 p = 0.14) indicates that between-person differences in the rate of change across time were small. In addition, the correlation between the slope and intercept factors was significant (r = -.73, p < 0.001), suggesting that the lower the negative emotion expression value at 12-weeks, the steeper the change over time.

LGM for Positive Emotion Expression. Growth for positive emotion expression was tested using a linear growth model and latent basis model and a likelihood ratio test was employed to compare the two models. Results of the likelihood ratio test suggest that the latent basis model did fit the model significantly better than the linear model, χ^2 (1) = 23.24, p < .05. However, the latent basis model produced an out of bounds parameter, indicating that the model is inappropriate for the data. As such, the linear model was used in subsequent analyses. The linear model, however, provided poor fit to the data, χ^2 (3) = 36.47; SRMR = 0.19; RMSEA = 0.19. The estimated means of the measured variables indicated that positive emotion expression decreased from 12 weeks (2.38) to 18 weeks (2.03) and increased from 18 weeks to 24 weeks (2.21). This non-linearity in the observed trajectories contributed to misfit.

Although results should be interpreted with caution due to the misfit, the mean of the slope factor was non-significant (β_1 = -0.06, p = 0.14), indicating that there was not

significant change across time. The mean of the intercept (β_0 = 2.26, p < 0.001) represents the expected 12-week level of infant positive emotion expression. The intercept variance (σ_0^2 = .31, p < 0.001) indicates significant differences in the estimated starting level of positive emotion expression across individuals. The slope factor variance (σ_1^2 = 0.17, p < 0.001) indicates significant differences in the rate of linear change of positive emotion expression across individuals. In addition, the correlation between the slope and intercept factors was significant (r = -0.95, p < 0.001) suggesting that the higher the initial positive emotion expression, the less steep the change over time.

Relations between Key Variables and Infant Emotion

The full model examined the direct paths between prenatal stress, maternal emotion socialization, and infant emotion expression, while controlling for infant gender and household income. A second model using bootstrap standard errors measured the indirect pathways between prenatal stress and infant emotion expression as mediated by maternal emotion socialization at 12 weeks.

Infant Negative Emotion Expression SEM. Goodness of fit tests indicated that the full model fit the data well: RMSEA = 0.04, χ^2 (7) = 10.86, SRMR = 0.04. See Table 3.1 for all parameter estimates. Maternal emotion socialization behaviors at 12 weeks were not significantly related to the change in infant negative emotion expression over time (slope factor) but were significantly and negatively related to the initial level of infant negative emotion expression (intercept factor). Neither of the prenatal stress variables significantly predicted the intercept or slope factors for infant negative emotion expression, controlling for gender, income, and emotion socialization at 12 weeks. The

prenatal stress variables were also not significantly related to maternal emotion socialization at 12 weeks, controlling for infant gender and household income.

Although neither prenatal stress variable significantly predicted emotion socialization at 12 weeks, the indirect effect between prenatal stress and infant emotion expression through maternal emotion socialization was tested. Simple mediation analyses were conducted using bootstrapping with 5,000 bootstrap samples in M*plus* version 6.12. The first mediation analysis examined the indirect pathway between prenatal daily hassles and the intercept for infant negative emotion expression. Results from the bootstrapping analyses indicated that the indirect effect was not significant at the α = .05 level (95% CI [-0.003, 0.004]). The second mediation analysis examined the indirect pathway between prenatal daily hassles and the slope for infant negative emotion expression. Results from the bootstrapping analyses indicated that the indirect effect was not significant at the α = .05 level (95% CI [-0.003, 0.002]). The third mediation analysis examined the indirect pathway between prenatal perceived stress and the intercept for infant negative emotion expression. Results from the bootstrapping analyses indicated that the indirect effect was not significant at the α = .05 level (95% CI [-0.020, 0.004]). The final mediation analysis examined the indirect pathways between prenatal perceived stress and the slope for infant negative emotion expression. Results from the bootstrapping analyses indicated that the indirect effect was not significant at the α = .05 level (95% CI [-0.009, 0.018]).

Infant Positive Emotion Expression SEM. Goodness of fit tests indicated that the full model did not fit the data well, but this is likely due to the misfit in the linear growth

model. Fit indices are as follows: RMSEA = 0.12, χ^2 (8) = 45.29, SRMR = 0.10. See Table 3.2 for all parameter estimates. Maternal emotion socialization behaviors at 12 weeks were significantly and negatively related to the change in infant emotion expression over time (slope) and were significantly and positively related to the initial level of positive infant emotion expression (intercept). Neither of the prenatal stress variables significantly related to maternal emotion socialization at 12 weeks, controlling for gender and household income. These variables also did not significantly predict to the intercept and slope factors for infant positive emotion expression while controlling for gender, household income, and emotion socialization at 12 weeks.

Although neither prenatal stress variable significantly predicted emotion socialization, the indirect effect between prenatal stress and infant positive emotion expression through maternal emotion socialization was tested. Simple mediation analyses were conducted using bootstrapping with 5,000 bootstrap samples in Mplus 6.12. The first mediation analysis examined the indirect pathway between prenatal daily hassles and the intercept for infant positive emotion expression. Results from the bootstrapping analyses indicated that the indirect effect of was not significant at the α = .05 level (95% CI [-0.005, 0.005]). The second mediation analysis examined the indirect pathway between prenatal daily hassles and the slope for infant positive emotion expression. Results from the bootstrapping analyses indicated that the indirect effect was not significant at the α = .05 level (95% CI [-0.003, 0.003]). The third mediation analysis examined the indirect pathway between prenatal perceived stress and the intercept for infant positive emotion expression. Results from the bootstrapping analyses indicated that

the indirect effect was not significant at the α = .05 level (95% CI [-0.011, 0.031]). The final mediation analysis examined the indirect pathways between prenatal perceived stress and the slope for infant positive emotion expression. Results from the bootstrapping analyses indicated that the indirect effect was not significant at the α = .05 level (95% CI [-0.019, 0.007]).

Post-hoc Analyses

Given the poor fitting linear growth model for infant positive emotion expression, a second SEM employed a change score for infant positive emotion expression (change from 12 weeks to 24 weeks) as the dependent variable. The results of this model were consistent with the linear growth model. The mean of the change variable (M = -0.28) suggests that infant positive emotion decreased from 12 weeks to 24 weeks. Neither prenatal stress variable was associated with maternal emotion socialization or change in infant positive emotion expression (intercept or slope). In addition, a negative association between maternal emotion socialization and infant positive emotion expression emerged suggesting that higher levels of maternal emotion socialization at 12 weeks predicted more of a decrease in infant emotion expression over time and lower levels of maternal emotion socialization predicted less of a decrease over time.

Based on these findings, a cross-lag model of infant positive emotion expression and maternal emotion socialization at 12, 18, 24 weeks was employed to better understand the negative relation between emotion socialization and infant positive emotion expression over time. Goodness of fit tests indicated that the full model fit the data well: RMSEA = 0.03, χ^2 (4) = 5.37, SRMR = 0.05. Maternal emotion socialization

remained stable from 12 to 18 to 24 weeks with higher levels at 12 weeks predicting to higher levels at 18 weeks and higher maternal emotion socialization at 18-weeks predicted to higher levels at 24 weeks. Infant positive emotion expression was not stable but results suggested a decrease from 12 to 18 weeks. In addition, infant positive emotion at 12-weeks was negatively related to maternal socialization at 18 weeks ($\beta = -0.21$, $p < .05$), suggesting an effect of the infant on maternal socialization efforts.

Discussion

The current study sought to better understand the growth of positive and negative emotion expression across the first six months of infant life in low-income Mexican American mother-infant pairs, and to explore the contribution of maternal prenatal stress and early maternal emotion socialization behaviors to the growth of infant emotion expression. Results suggested that infant negative emotion expression increases from 12- to 24-weeks of age whereas positive emotion expression decreases, and although maternal emotion socialization was associated with concurrent positive and negative infant emotion, its prediction to change in infant affect during early infancy was more nuanced. Maternal prenatal stress, in contrast, predicted neither later maternal socialization behaviors nor infant emotion expression.

It was surprising to find that, in this sample, negative emotion increased from 12- to 24- weeks and positive emotion did not significantly change as prior studies have found an increase in positivity and a decrease in negativity across this same early infancy period (Malatesta & Haviland, 1982). Although Malatesta and colleagues (1986) identified a decrease in negative emotion and increase in positivity, they incorporated a data point at infant aged 30-weeks (7½ months). It may be beneficial to extend the current study to later time points to examine whether the expected pattern of emotional development emerges. Of note, though, the change in both negative and positive emotion from 12- to 24- weeks was minimal in the current study.

In line with previous research, results suggested that when mothers employed greater emotion socialization efforts at 12 weeks, infants exhibited more positivity and

less negativity (Bridgett, Laake, Gartstein, & Dorn, 2013). Studies of maternal responsiveness have found greater positive emotion among infants whose mothers respond contingently and immediately to their needs (Lowe et al., 2012). In general, mothers attempt to maintain and facilitate positive emotion expression and discourage negative emotion expression through various behaviors (Capatides & Bloom, 1993) including appropriate affect and vocalizations, expressions of positive emotion, and acknowledging infant needs, which were captured in the current study.

In line with study hypotheses, the change in negative emotion was not related to mothers' socialization efforts. Contrary to expectation, however, the more emotion socialization mothers employed at infant age 12-weeks, the less positivity infants expressed over time. This major finding is unanticipated and contrary to theories that fit parenting and developmental thinking. Indeed, mother's sensitivity and responsiveness during infancy has been frequently linked to later infant competencies such as attachment security (Bigelow et al., 2010) and more effective emotion regulation strategies (Shaffer, Suveg, Thomassin, & Bradbury, 2012). In addition, a recent study on emotional expressiveness between Mexican-American mothers and their toddlers found that greater shared positive emotion expression was related to less peer aggression eight months later (Lindsey, Caldera, & Rivera, 2013). As such, continued examination of these relations for children at later developmental periods is warranted and the current finding should be interpreted with caution.

In an attempt to better understand this finding, though, a post-hoc cross-lag model of infant positivity and maternal emotion socialization across 12-, 18-, and 24-weeks was

employed to examine the direction of effects at each time period and across time. Unfortunately, the cross-lag model did not clarify the surprising finding. It suggested that concurrent relations between emotion socialization and infant positivity work in ways that are consistent with theory, as previously noted. However, the cross-lag model did not show any effects of the mother on baby's positive emotion expression across time. One unanticipated child effect emerged, suggesting that infants who were more positive at 12-weeks had mothers who were less responsive at 18-weeks. Mothers may initially demonstrate behaviors that help to increase positive emotion, but over time, they may decrease their use of these behaviors, believing that their "already-positive" infant does not require continued use of these behaviors. Although not statistically significant, mothers' average socialization efforts did decrease from 12- to 18-weeks.

To increase positive infant emotion expression over time, mothers need to consistently acknowledge their infants' emotions and behaviors, regularly use an appropriate range of affect and appropriate vocalizations, and continually model appropriate positive emotion. In fact, previous research suggests that mothers may respond more often to negative infant responses or cues than to positive ones (Capatides & Bloom, 1993). When mothers respond more to negativity than positivity, infants learn that their expression of negative emotion will prompt a response from their mother. Given that results of the current study suggest that mother's behavior over time is related to infant positivity but not negativity, socialization efforts in support of positive emotion over and above those to address negative emotion are critical. Lower or reduced socialization efforts may result in decreased infant positivity over time. This finding has

not been previously supported or examined in the literature, though, and would need to be tested more directly in future research.

Alternatively, infants demonstrating less positivity at 12-weeks may elicit more responsiveness from mothers at a later time point. Mothers may realize that their socialization efforts were not sufficient at maintaining infants' positivity and thus, they will engage in more supportive socialization behaviors over time. Overall, the cross-lag model is non-intuitive, though, and did not find the connection between maternal socialization and decreased infant positivity that emerged in the SEM analysis.

The third hypothesis concerned the predictive relation between prenatal stress and infant emotion expression, and suggested that prenatal stress would predict absolute levels of infant positivity and negativity. Despite prior research that has found links between the prenatal stress environment and developmental competencies (i.e. Pietro, 2004), the current study did not support this prediction. Although mothers' perception of stress is informative, the self-report measures of prenatal stress that were utilized in this study do not directly assess the biological prenatal stress environment. Research has found maternal cortisol, a more objective measure of stress, to be indirectly related to three-month negativity through amniotic cortisol (Baibazarova et al., 2013). Other studies likewise note that the in utero environment may affect postnatal health and behavior (Pesonen et. al., 2006). Thus, to capture potential biological influences of stress, a direct and objective measure of the stress environment is warranted.

Alternatively, the more-proximally related postnatal stress environment might be more important to emotion expression than the prenatal stress environment measured in

this study. Indeed, one recent study examined the influence of prenatal and postnatal maternal distress on various child competencies and found that prenatal stress predicted cognitive, behavioral, and psychomotor development but socio-emotional development was predicted by postnatal distress only (Kingston, Tough, & Whitfield, 2012). This study illustrates the importance of examining both distal and proximal stress factors involved in infant emotion development.

Not only were links from prenatal stress to infant behavior absent, but the current study also failed to find links between prenatal stress and maternal emotion socialization. However, emotion socialization, like infant emotion expression, may be influenced more by postnatal stress factors that newly emerge or are carried over from the prenatal time period. For instance, numerous studies have found that mothers who experience high levels of parenting stress provide less optimal parenting than those mothers experiencing low levels of parenting stress (Bonds, Gondoli, Sturge-Apple, & Salem, 2002; Crnic, Gaze, & Hoffman, 2005). In addition, research suggests continuity between prenatal depressive symptoms and the presence of postnatal depression (Honey, Bennett, & Morgan, 2003), the adverse consequences of which have been frequently described. For instance, Mortenson & Barnett (2015) reported that postnatal depressive symptoms and relationship quality were uniquely associated with harsh parenting practices. As such, identifying mediating factors that link prenatal stress to parenting during infancy, such as postpartum depression and parenting stress, warrants future attention.

Study Limitations

Although the current study has a number of methodological strengths, it was not without limitations. Infant emotion expression was assessed in the context of a teaching task that was thought to best capture variability in infant emotional responses and parenting behaviors. Although ecologically valid, the teaching task was designed to elicit frustration for both mothers and infants and thus, may not have captured sufficient positive emotion expression from the dyad. It may be beneficial in future studies to aggregate emotion expression and socialization across all possible tasks administered, thus providing more context variability.

A second limitation was that this study did not examine postnatal stress factors such as postpartum depression or parenting stress that could have provided a missing link between prenatal stress and the caregiving environment. As illustrated above, a measure of postpartum psychological distress may offer an indirect pathway by which prenatal stress links to parenting and infant emotion (Leigh & Milgrom, 2008). In that same vein, the self-report measures of prenatal stress limit the extent to which a biological effect of stress on emotion expression could be observed. Thus, a more proximal measure of the prenatal stress environment is warranted in future research.

Third, the current study focused on emotion development during early infancy, a salient, yet understudied, period in which brain-behavior connections and emotional and sensory processing begins to emerge (Grossman, 2010). Despite addressing emotion using a longitudinal study, it may be necessary to examine emotion expression across later time points (i.e. toddlerhood) to better understand the predictive nature of parenting

during infancy on emotion expression. In addition, future research might examine emotion socialization and emotion expression as parallel processes to identify transactional relations that may exist. Furthermore, rather than solely focusing on the influence of maternal behaviors on infants, an examination of the effects of the infant on parenting would increase our understanding of reciprocity and bidirectionality in parent-child relationships across time.

Although this study utilized observational measures of parenting and infant emotion expression at multiple time points, infant and mother were coded using the same system and the same coders within time points. Independent systems and raters would decrease potential bias in the behavioral observations.

Finally, the sample of low-income Mexican-American families is unique, and an examination of cultural factors that potentially influence the nature of parent-infant relationships in these families may be informative. Importantly, promotive factors prevalent among Hispanic families may play a role in whether prenatal stress influences the postnatal parenting environment. For instance, an examination of parental self-efficacy among a sample of at-risk Mexican-American adolescent mothers revealed a protective factor wherein mothers that indicated greater self-efficacy with their parenting ability had infants that scored higher on a measure of cognitive ability (Jahromi, Umana-Taylor, Updegraff, & Lara, 2012). In the current study, mothers experiencing prenatal stress may still feel confident in their ability to parent, preventing the stress from interfering with their socialization efforts. Alternatively, social support, particularly family support, during pregnancy and the early postpartum period may buffer some of the

negative effects of prenatal stress on the postnatal parenting environment (Umana-Taylor, Guimond, Updegraff, & Jahromi, 2013).

Summary and Conclusions

In summary, the normative development of emotion expression across early infancy is complex and nuanced. Given such indications, a greater emphasis on how parenting across the infancy period is differentially related to infant positive and negative emotion development would be informative for current conceptualizations of early infant emotion development. Importantly, whereas most research has focused on the relations between infant negativity and later competencies, investigators should also include the potential deleterious effects of decreased positive emotion over time. An increased understanding of the process and manner by which infants develop emotionally, and a particular focus on the factors that contribute to this development, can also help inform prevention and intervention. For instance, explicit training in emotion socialization of positive emotion could be meaningfully incorporated into parent-training programs during early infancy (i.e. Herbert, Harvey, Roberts, Wichowski, & Lugo-Candelas, 2013).

References

Abe, J. A. A., & Izard, C. E. (1999). A longitudinal study of emotion expression and personality relations in early development. *Journal of Personality and Social Psychology, 77*(3), 566-577.

Austin M. P. (2003). Perinatal mental health: Opportunities and challenges for psychiatry. *Australasian Psychiatry, 11*(4), 399–403.

Baibazarova, E., van de Beek, C., Cohen-Kettenis, P. T., Buitelaar, J., Shelton, K. H., & van Goozen, S. H. M. (2013). Influence of prenatal maternal stress, maternal plasma cortisol and cortisol in the amniotic fluid on birth outcomes and child temperament at 3 months. *Psychoneuroendocrinology, 38*(6), 907-915.

Bayley, N. (1969). *Bayley Scales of Infant Development*. New York: The Psychological Corporation.

Baker, L. A., Cesa, I. L., Gatz, M., & Mellins, C. (1992). Genetic and environmental influences on positive and negative affect – support for a two-factor theory. *Psychology and Aging, 7,* 158-163.

Barker, D. J. (1995). Intrauterine programming of adult disease. *Mol. Med. Today,* 1, 418–423.

Barr, R. G. (1989). Recasting a clinical enigma: The case of infant crying *Challenges to developmental paradigms: Implications for theory, assessment and treatment.* (pp. 43-64): Lawrence Erlbaum Associates, Inc, Hillsdale, NJ.

Barr, R. G. (1990). The normal crying curve: What do we really know? *Developmental Medicine and Child Neurology, 32*, 356-362.

Belsky, J., Crnic, K., & Woodworth, S. (1995). Personality and parenting: Exploring the mediating role of transient mood and daily hassles. *Journal of Personality, 63*(4), 905-929.

Belsky, J., Hsieh, K-H., & Crnic, K. (1996). Infant positive and negative emotionality: One dimension or two? *Developmental Psychology, 32*, 289-298

Bigelow, A. E., MacLean, K., Proctor, J., Myatt, T., Gillis, R., & Power, M. (2010). Maternal sensitivity throughout infancy: Continuity and relation to attachment security. *Infant Behavior & Development, 33*(1), 50-60.

Boccia, M., & Campos, J.J. (1989). Maternal emotional signals, social referencing, and infants' reactions to strangers. *New Directions for Child Development*, *44*, 25–49.

Bonds, D. D., Gondoli, D. M., Sturge-Apple, M. L., & Salem, L. N. (2002). Parenting stress as a mediator of the relation between parenting support and optimal parenting. *Parenting: Science and Practice, 2*(4), 409-435.

Bradburn, N. M. (1969). The structure of psychological well-being. Chicago: Aldine.

Braungart-Rieker, J. M., Hill-Soderlund, A. L., & Karrass, J. (2010). Fear and anger reactivity trajectories from 4 to 16 months: The roles of temperament, regulation, and maternal sensitivity. *Developmental Psychology, 46*(4), 791-804.

Brazelton, B. T., Koslowski, B., & Main, M. (1974). The origin of reciprocity: The early mother-infant interaction. In M. Lewis & L. A. Rosenblum (Eds), *The effect of the infant on its caretaker.* New York: Wiley. (Pp. 49-76).

Bridges, J. W. (1932). *Personality, many in one*: Stratford, Oxford.

Bridgett, D. J., Laake, L. M., Gartstein, M. A., & Dorn, D. (2013). Development of infant positive emotionality: The contribution of maternal characteristics and effects on subsequent parenting. *Infant and Child Development, 22*(4), 362-382.

Buss, K. A., & Goldsmith, H. H. (1998). Fear and anger regulation in infancy: Effects on the temporal dynamics of affective expression. *Child Development, 69*(2), 359-374.

Campos, J. J., Campos, R. G., & Barrett, K. C. (1989). Emergent themes in the study of emotional development and emotion regulation. *Developmental Psychology, 25*(3), 394-402.

Camras, L. A., Bakeman, R., Chen, Y., Norris, K., & Cain, T. R. (2006). Culture, ethnicity, and children's facial expressions: A study of European American, mainland Chinese, Chinese American, and adopted Chinese girls. *Emotion, 6*(1), 103-114.

Camras, L. A., Oster, H., Campos, J. J., Miyake, K., & Bradshaw, D. (1992). Japanese and American infants' responses to arm restraint. *Developmental Psychology, 28*(4), 578-583.

Camras, L.A., Ribordy, S., Hill, J., Martino, S., Spaccarelli, S., & Stefani R. (1988). Recognition and posing of emotional expressions by abused children and their mothers. *Developmental Psychology*, *24*, 776–781.

Capatides, J. B. & Bloom, L. Underlying process in the socialization of emotion. In: Rovee-Collier, C.; Lipsitt, LP., editors. Advances in infancy research. 8. Ablex; Norwood, NJ: 1993. p. 99-135.

Carter, A. S., Mayes, L., & Pajer, K. A. (1990). The Role of dyadic affect in play and infant sex in predicting infant respones to the still-face situation. *Child Development, 61*, 764-773.

Charles, S. T., Reynolds, C. A., & Gatz, M. (2001). Age-related differences and change in positive and negative affect over 23 years. *Journal of Personality and Social Psychology, 80*(1), 136-151.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385-396.

Cohn, J. F., & Tronick, E. Z. (1983). Three-month-old infants' reaction to simulated maternal depression. *Child Development, 54*(1), 185-193.

Cole, P. M., Martin, S. E., & Dennis, T. A. (2004). Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development, 75*, 317–333.

Crnic, K. A., Gaze, C., & Hoffman, C. (2005). Cumulative parenting stress across the preschool period: Relations to maternal parenting and child behaviour at age 5. *Infant and Child Development, 14*(2), 117-132.

Crnic, K., & Greenberg, M. (1990). Minor parenting stresses with young children. *Child Development*, *61*, 1628–1637.

Crnic, K., & Low, C. (2002). Everyday stresses and parenting. In Handbook of Parenting: Practical Issues in Parenting (2nd ed.), Bornstein M (ed.), vol. 5. Lawrence Erlbaum Associates: Mahwah, NJ; 243–267.

Crockenberg, S. C., Leerkes, E. M., & Lekka, S. K. (2007). Pathways from marital aggression to infant emotion regulation: The development of withdrawal in infancy. *Infant Behavior and Development, 30*(1), 97-113.

Davis, E. P., Glynn, L. M., Waffarn, F., & Sandman, C. A. (2011). Prenatal maternal stress programs infant stress regulation. *Journal of Child Psychology and Psychiatry, 52*(2), 119-129.

Deater-Deckard K. (1998). Parenting stress and child adjustment: Some old hypotheses and new questions. *Clinical Psychology: Science and Practice, 5,* 314–332.

Denham, S. A. (1997). "When I have a bad dream mommy holds me": Preschoolers' conceptions of emotions, parental socialisation, and emotional competence. *International Journal of Behavioral Development, 20*(2), 301-319.

Denham, S. A., & Lehman, E. B. (1995). Continuity and change in emotional components of infant temperament. *Child Study Journal*, *25*(4), 289.

Diener, E., & Larsen, R. J. (1993) The experience of emotional well-being. In: Lewis, M.; Haviland, JM., editors. Handbook of emotions. Guilford; New York: p. 405-415.

DiPietro, J. A. (2004). The role of prenatal maternal stress in child development. *Current Directions in Psychological Science, 13*(2), 71-74.

Dunkel-Schetter, C. (1998). Maternal stress and pre-term delivery. *Prenatal and Neonatal Medicine*, *3*, 39-42.

Eisenberg, N., Cumberland, A., & Spinrad, T. L. (1998). Parental socialization of emotion. *Psychological Inquiry, 9*(4), 241-273.

Eisenberg, N., Cumberland, A., Spinrad, T. L., Fabes, R. A., Shepard, S. A., Reiser, M., et al. (2001). The relations of regulation and emotionality to children's externalizing and internalizing problem behavior. *Child Development, 72*(4), 1112-1134.

Eisenberg, N., Fabes, R. A., Schaller, M., Carlo, G., & Miller, P. A. (1991). The relations of parental characteristics and practices to children's vicarious emotional responding. *Child Development, 62*(6), 1393-1408.

Emde, R. N., Plomin, R., Robinson, J., Corley, R., DeFries, J., Fulker, D. W., . . . Zahn-Waxler, C. (1992). Temperament, emotion, and cognition at fourteen months: The MacArthur Longitudinal Twin Study. *Child Development, 63*(6), 1437-1455.

Feldman, R. (1998). Coding interactive behavior manual. Unpublished manual, Bar-Ilan University, Israel.

Feldman, R. (2007a). Parent-infant synchrony and the construction of shared timing: physiological precursors, developmental outcomes, and risk conditions. *Journal of Child Psychology and Psychiatry, 48*(3-4), 329-354.

Feldman, R. (2007b). Parent-infant synchrony: Biological foundations and developmental outcomes. *Current Directions in Psychological Science: A Jounral of the American Psychological Society, 16*(6), 340-345.

Forbes, E. E., Cohn, J. F., Allen, N. B., & Lewinsohn, P. M. (2004). Infant affect during parent-infant interaction at 3 and 6 Months: Differences between mothers and fathers and influence of parent history of depression. *Infancy, 5*(1), 61-84.

Garner, P. W., & Estep, K. M. (2001). Emotional competence, emotion socialization, and young children's peer-related social competence. *Early Education and Development, 12*(1), 29-48.

Garner, P. W., Jones, D. C., & Miner, J. L. (1994). Social competence among low-income preschoolers: Emotion socialization practices and social cognitive correlates. *Child Development, 65*(2), 622-637.

Gitau, R., Fisk, N. M., & Glover, V. (2001). Maternal stress in pregnancy and its effect on the human foetus: An overview of research findings. *Stress, 4*(3), 195-203.

Glover, V., O'Connor, T. G., & O'Donnell, K. (2009). Prenatal stress and the programming of the HPA axis. *Neuroscience and Biobehavioral Reviews, 35,* 17-22.

Goldsmith, H. H., Buss, K. A., & Lemery, K. S. (1997). Toddler and childhood temperament: Expanded content, stronger genetic evidence, new evidence for the importance of environment. *Developmental Psychology, 33*(6), 891-905.

Gottman, J. M., Katz, L. F., & Hooven, C. (1996). Parental meta-emotion philosophy and the emotional life of families: Theoretical models and preliminary data. *Journal of Family Psychology, 10,* 243-268.

Graham, J. W., Taylor, B. J., Olchowski, A. E., & Cumsille, P. E. (2006). Planned missing data designs in psychological research. *Psychological Methods, 11*(4), 323-343.

Grossmann, T. (2010). The development of emotion perception in face and voice during infancy. *Restorative Neurology and Neuroscience, 28*(2), 219-236.

Gunnar, M. R., Porter, F. L., Wolf, C. M., Rigatuso, J., & Larson, M. C. (1995). Neonatal stress reactivity: Predictions to later emotional temperament. *Child Development, 66*(1), 1-13.

Gutteling, B. M., Weerth, C., Zandbelt, N., Mulder, E. J. H., Visser, G. H. A., & Buitelaar, J. K. (2006). Does Maternal Prenatal Stress Adversely Affect the Child's Learning and Memory at Age Six? *Journal of Abnormal Child Psychology, 34*(6), 787-796.

Herlenius, E., & Lagercrantz, H. (2001). Neurotransmitters and neuromodulators during early human development. *Early Human Development, 65,* 21-37.

Heron, J., O'Connor, T. G., Evans, J., Golding, J., & Glover, V. (2004). The course of anxiety and depression through pregnancy and the postpartum in a community sample. *Journal of Affective Disorders, 80*(1), 65-73.

Honey, K. L., Bennett, P., & Morgan, M. (2003). Predicting postnatal depression. *Journal of Affective Disorders, 76*(1-3), 201-210.

Huizink, A. C., Robles de Medina, P. G., Mulder, E. J. H., Visser, G. H. A., & Buitelaar, J. K. (2002). Psychological measures of prenatal stress as predictors of infant temperament. *Journal of the American Academy of Child & Adolescent Psychiatry, 41*(9), 1078-1085.

Izard, C. E. (1971). The face of emotions. New York: Appleton-Century-Crofts.

Izard, C. E., & Ackerman, B. P. (2000). Motivational, organizational, and regulatory functions of discrete emotions. In M. Lewis, & J.M. Haviland-Jones (Eds.), Handbook of emotions (2nd ed., pp. 253–264). New York: Guilford Press.

Izard, C. E., Huebner, R. R., Risser, D., McGinnes, G. C., & Dougherty, L. M. (1980). The young infant's ability to produce discrete emotion expressions. *Developmental Psychology*, *16*, 132–140.

Jahromi, L. B., Umaña-Taylor, A. J., Updegraff, K. A., & Lara, E. E. (2012). Birth characteristics and developmental outcomes of infants of Mexican-origin adolescent mothers: Risk and promotive factors. *International Journal of Behavioral Development, 36*(2), 146-156.

Kingston, D., Tough, S., & Whitfield, H. (2012). Prenatal and postpartum maternal psychological distress and infant development: A systematic review. *Child Psychiatry and Human Development, 43*(5), 683-714.

Kochanska, G. (2001). Emotional development in children with different attachment histories: The first three years. *Child Development, 72*(2), 474-490.

Laible, D. (2004). Mother–child discourse in two contexts: Links with child temperament, attachment security, and socioemotional competence. *Developmental Psychology, 40,* 979–992.

Leigh, B., & Milgrom, J. (2008). Risk factors for antenatal depression, postnatal depression and parenting stress. *BMC Psychiatry, 8*.

Lindsey, E. W., Caldera, Y. M., & Rivera, M. (2013). Mother–child and father–child emotional expressiveness in Mexican-America families and toddlers' peer interactions. *Early Child Development and Care, 183*(3-4), 378-393.

Lindsey, E. W., Colwell, M. J., Frabutt, J. M., Chambers, J. C., & MacKinnon-Lewis, C. (2008). Mother-child dyadic synchrony in European American and African American families during early adolescence: Relations with self-esteem and prosocial behavior. *Merrill-Palmer Quarterly, 54*(3), 289-315.

Lindsey, E. W., Cremeens, P. R., Colwell, M. J., & Caldera, Y. M. (2009). The structure of parent–child dyadic synchrony in toddlerhood and children's communication competence and self-control. *Social Development, 18*(2), 375-396.

Lobel, M., Dunkel-Schetter, C., & Scrimshaw, S.C. (1992). Prenatal maternal stress and prematurity: A prospective study of socioeconomically disadvantaged women. *Health Psychology*, *11*, 31-40.

Lowe, J. R., MacLean, P. C., Duncan, A. F., Aragón, C., Schrader, R. M., Caprihan, A., & Phillips, J. P. (2012). Association of maternal interaction with emotional regulation in 4- and 9-month infants during the Still Face Paradigm. *Infant Behavior & Development, 35*(2), 295-302.

Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin, 131*(6), 803-855.

Malatesta, C. Z., Culver, C., Tesman, J. R., & Shepard, B. (1989). The development of emotion expression during the first two years of life. *Monographs of the Society for Research in Child Development, 54*(1-2), 1-104.

Malatesta, C. Z., Grigoryev, P., Lamb, C., Albin, M., & Culver, C. (1986). Emotion socialization and expressive development in preterm and full-term infants. *Child Development, 57*(2), 316-330.

Malatesta, C. Z., & Haviland, J. M. (1982). Learning display rules: The socialization of emotion expression in infancy. *Child Development*, 991-1003.

Meaney, M. J. (2001). Maternal care, gene expression, and the transmission of individual differences in stress reactivity across generations. *Annual review of neuroscience, 24*, 1161-1192.

Meredith, W., & Tisak, J. (1990). Latent curve analysis. *Psychometrika,* 55, 107-122.

Mesman, Linting, Joosen, Bakermans-Kranenburg, & van IJzendoorn. (2013). Robust patterns and individual variations: Stability and predictors of infant behavior in the still-face paradigm. *Infant Behavior and Development*, 36, 587-598.

Messinger, D. S. (2002). Positive and negative: Infant facial expressions and emotions. *Current Directions in Psychological Science, 11*(1), 1-6.

Mortensen, J. A., & Barnett, M. A. (2015). Risk and protective factors, parenting stress, and harsh parenting in Mexican origin mothers with toddlers. *Marriage & Family Review, 51*(1), 1-21.

Muthén, B. O., & Curran, P. J. (1997). General longitudinal modeling of individual differences in experimental designs: A latent variable framework for analysis and power estimation. *Psychological Methods, 2*(4), 371-402.

Muthén, L. K., & Muthén, B. O. (2010). *Mplus User's Guide* (6 ed.). Los Angeles: Muthén & Muthén.

Olino, T. M., Lopez‐Duran, N. L., Kovacs, M., George, C. J., Gentzler, A. L., & Shaw, D. S. (2011). Developmental trajectories of positive and negative affect in children at high and low familial risk for depressive disorder. *Journal of Child Psychology and Psychiatry, 52*(7), 792-799.

Peláez-Nogueras, M., Field, T. M., Hossain, Z., & Pickens, J. (1996). Depressed mothers' touching increases infants' positive affect and attention in still-face interactions. *Child Development, 67*(4), 1780-1792.

Pauli–Pott, U., Becker, K., Mertesacker, T. & Beckmann, D. (2000). Infant with "colic": Mothers' perspectives on the crying problem. *Journal of Psychosomatic Research. 48*, 125–132.

Pauli-Pott, U., Mertesacker, B., & Beckmann, D. (2004). Predicting the development of infant emotionality from maternal characteristics. *Development and Psychopathology, 16*(1), 19-42.

Pesonen, A.-K., Räikkönen, K., Kajantie, E., Heinonen, K., Strandberg, T. E., & Järvenpää, A.-L. (2006). Fetal programming of temperamental negative affectivity among children born healthy at term. *Developmental Psychobiology, 48*(8), 633-643.

Repetti, R., & Wood, J. (1997). Effects of daily stress at work on mothers' interactions with preschoolers. *Journal of Family Psychology, 11*, 90–108.

Roberts, W. L. (1999). The socialization of emotional expression: Relations with prosocial behaviour and competence in five samples. *Canadian Journal of Behavioural Science, 31*(2), 72-85.

Rothbart, M. K. (1973). Laughter in young children. *Psychological Bulletin, 80*(3), 247-256.

Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology, 57*(6), 1069-1081.

Schneider, M. L., Moore, C. F., Kraemer, G. W., Roberts, A. D., & DeJesus, O. T. (2002). The impact of prenatal stress, fetal alcohol exposure, or both on development: Perspectives from a primate model. *Psychoneuroendocrinology, 27*(1-2), 285-298.

Schore, A.N. (1994). Affect regulation and the origin of the self: The neurobiology of emotional development. Mahwah, NJ: Erlbaum.

Seifer, R., Schiller, M., Sameroff, A. J., Resnick, S., & Riordan, K. (1996). Attachment, maternal sensitivity, and infant temperament during the first year of life. *Developmental Psychology, 32*(1), 12-25.

Shaffer, A., Suveg, C., Thomassin, K., & Bradbury, L. L. (2012). Emotion socialization in the context of family risks: Links to child emotion regulation. *J Child Fam Stud, 21*(6), 917-924.

Shaw, D. S., Keenan, K., Vondra, J. I., Delliquadri, E., & Giovannelli, J. (1997). Antecedents of preschool children's internalizing problems: A longitudinal study of low-income families. *Journal of the American Academy of Child & Adolescent Psychiatry, 36*(12), 1760-1767.

Shipman, K. L., & Zeman, J. (2001). Socialization of children's emotion regulation in mother–child dyads: A developmental psychopathology perspective. *Development and Psychopathology,* 317-336.

Spitz, R. A., Emde, R. N., & Metcalf, D. R. (1970). Further prototypes of ego formation: A working paper from a research project on early development. *Psychoanalytic Study of the Child, 25*, 417-441.

Sroufe, L. A. (1996). Emotional development: The organization of emotional life in the early years. New York: Cambridge University Press.

Sroufe, L. A., & Waters, E. (1976). The ontogenesis of smiling and laughter: A perspective on the organization of development in infancy. *Psychological Review, 83*(3), 173-189.

Sroufe, L. A., & Wunsch, J. P. (1972). The development of laughter in the first year of life. *Child Development, 43*(4), 1326-1344.

Stern, D. N. (1974). The goal and structure of mother-infant play. *Journal of the American Academy of Child Psychiatry, 13*(3), 402-421.

Stifter, C. A., & Braungart, J. M. (1995). The regulation of negative reactivity in infancy: Function and development. *Developmental Psychology, 31*(3), 448-455.

Stifter, C. A., & Fox, N. A. (1990). Infant reactivity: Physiological correlates of newborn and 5-month temperament. *Developmental Psychology*, *26*(4), 582–588.

Stifter, C. A., & Moyer, D. (1991). The regulation of positive affect: Gaze aversion activity during mother-infant interaction. *Infant Behavior & Development, 14*(1), 111-123.

Stifter, C. A., & Spinrad, T. L. (2002). The effect of excessive crying on the development of emotion regulation. *Infancy, 3*(2), 133-152.

Stifter, C. A., Spinrad, T., & Braungart-Rieker, J. (1999). Toward a developmental model of child compliance: The role of emotion regulation in infancy. *Child Development, 70*(1), 21-32.

Taylor, Z. E., Eisenberg, N., VanSchyndel, S. K., Eggum-Wilkens, N. D., & Spinrad, T. L. (2014). Children's negative emotions and ego-resiliency: Longitudinal relations with social competence. *Emotion, 14*(2), 397-406.

Tronick, E. Z. (1989). Emotions and emotional communication in infants. *American Psychologist, 44*(2), 112-119.

Tronick, E. Z., Als, H., Adamson, L., Wise, S., & Brazelton, B. (1978). The infant's response to entrapment between contradictory messages in face-to-face interaction. *Journal of the American Academy of Child Psychiatry, 7,* 1–13.

Tronick, E., Als, H., & Brazelton, T. B. (1980). Monadic phases: A structural descriptive analysis of infant–mother face to face interaction. *Merrill-Palmer Quarterly: Journal of Developmental Psychology, 26*(1), 3-24.

Umaña‐Taylor, A. J., Guimond, A. B., Updegraff, K. A., & Jahromi, L. B. (2013). A longitudinal examination of support, self‐esteem, and Mexican-origin adolescent mothers' parenting efficacy. *Journal of Marriage and Family, 75*(3), 746-759.

Van den Bergh, B. R. (1990). The influence of maternal emotions during pregnancy on fetal and neonatal behavior. *Journal of Prenatal & Perinatal Psychology & Health, 5*(2), 119-130.

Walter, J. L., & LaFreniere, P. J. (2000). A naturalistic study of affective expression, social competence, and sociometric status in preschoolers. *Early Education and Development, 11*(1), 109-122.

Waters, E., Matas, L., & Sroufe, L. A. (1975). Infants' reactions to an approaching stranger: Description, validation, and functional significance of wariness. *Child Development, 46*(2), 348-356.

Weinstock, M. (1997). Does prenatal stress impair coping and regulation of hypothalamic-pituitary-adrenal axis? *Neuroscience and Biobehavioral Reviews, 21*(1), 1-10.

Wolff, P. (1963). Observations on the early development of smiling. In B. M. Foss (Ed.), Determinants of infant behavior, Vol. 2 (pp. 113–138). London: Methuen.

Wurmser, H., Rieger, M., Domogalla, C., Kahnt, A., Janine, B., Kowatsch, M., Kuehnert, N., Buske-Kirschbaum, A., Papousek, M., Pirke, K. M. & von Voss, H. (2006). Association between life stress during pregnancy and infant crying in the first six months postpartum: A prospective longitudinal study. *Early Human Development, 82,* 341–349.

Zuckerman, B., Amaro, H., Bauchner, H., & Cabral, H. (1989). Depressive symptoms during pregnancy: Relationship to poor health behaviors. *American Journal of Obstetrics and Gynecology, 160(5), 1107-1111.*

APPENDIX A

FIGURES AND TABLES

Figure 1.1. Conceptual Model for Infant Negative Emotion Expression

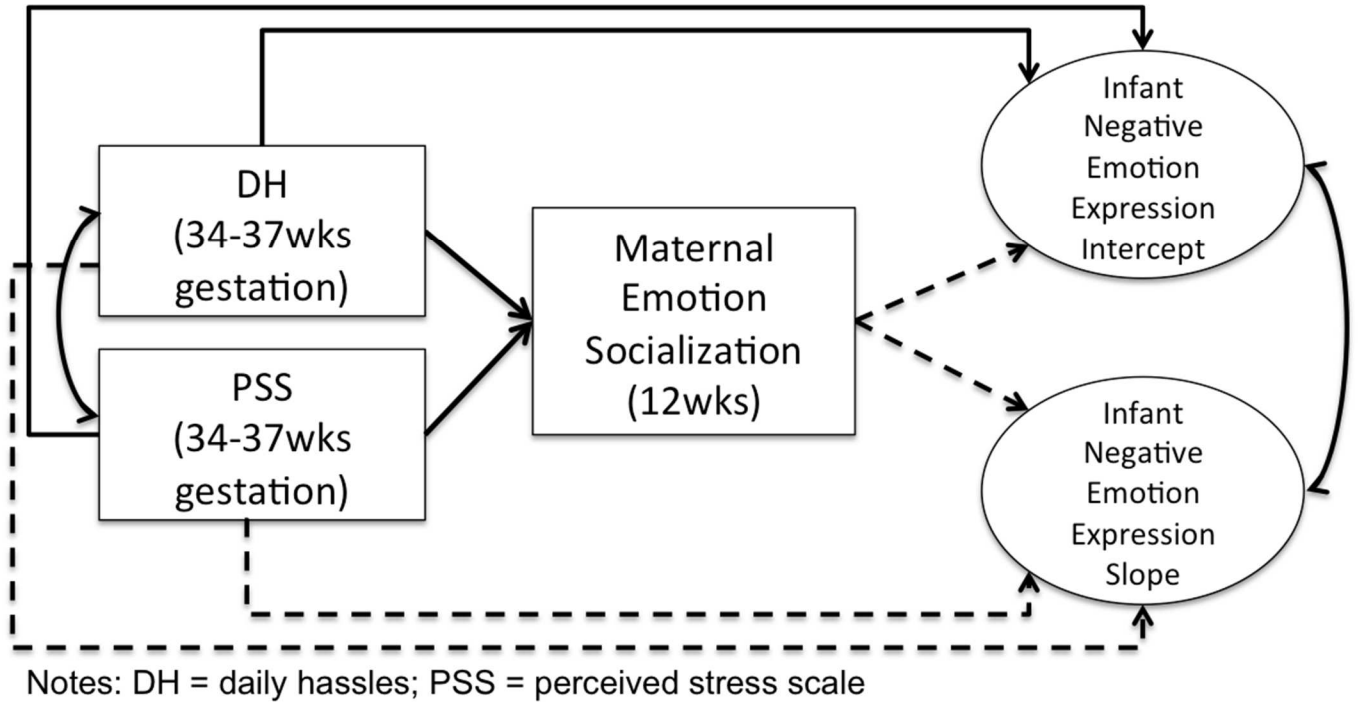


Figure 1.2. Conceptual Model for Infant Positive Emotion Expression

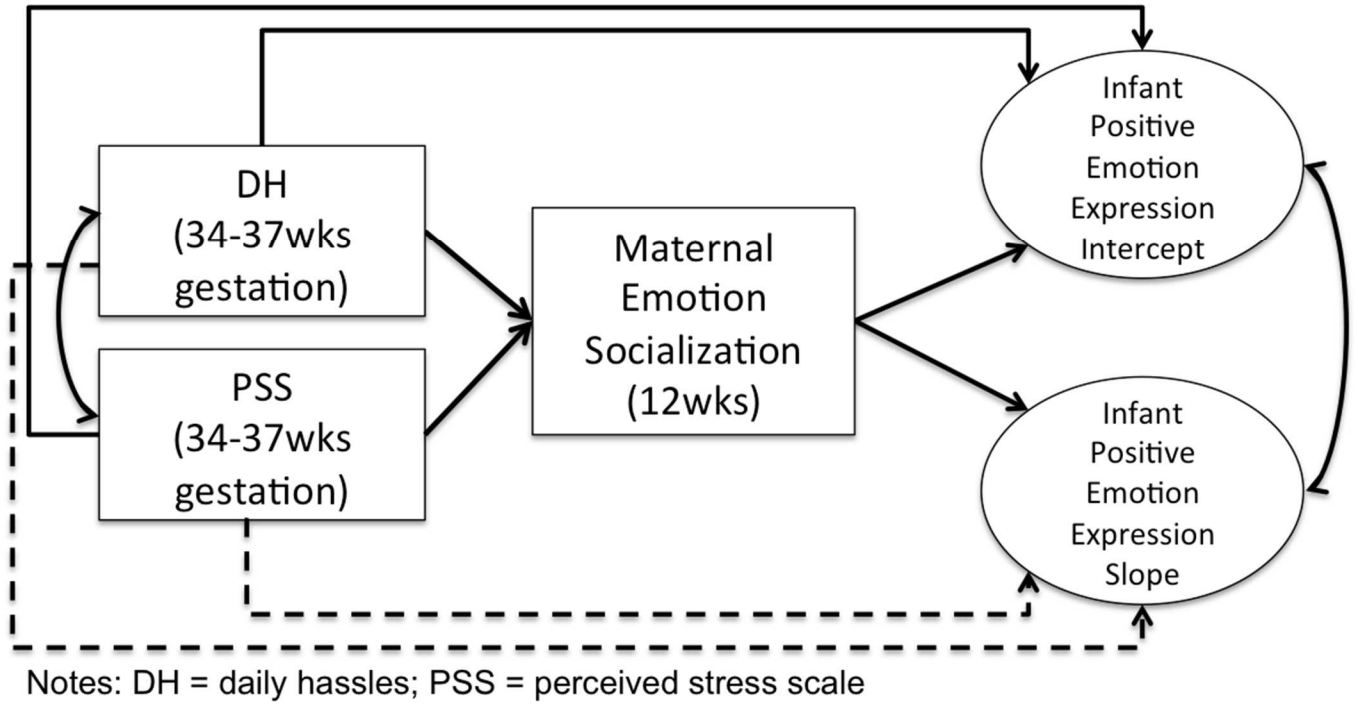
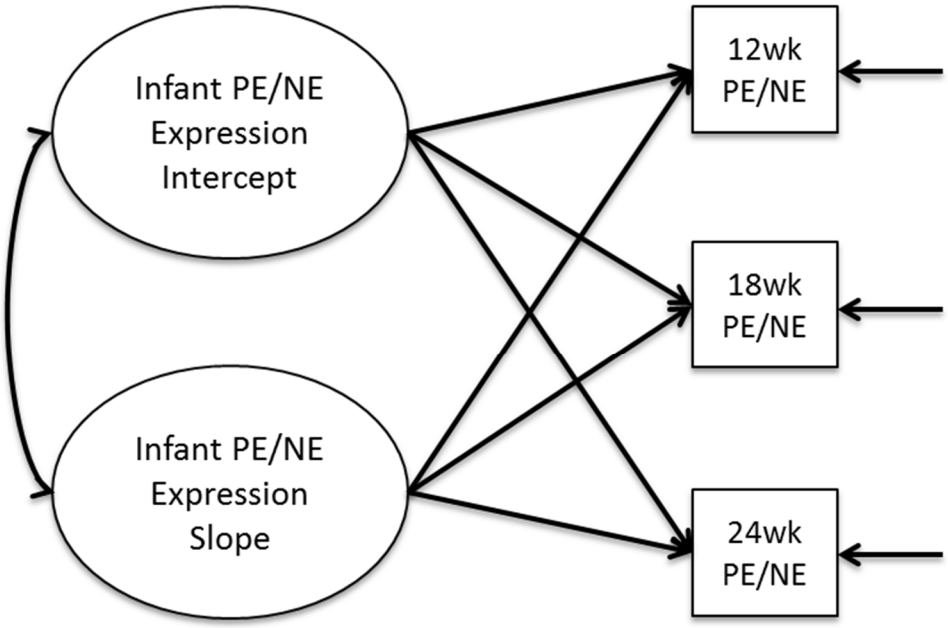


Figure 2. Measurement Model for Longitudinal Growth



Notes: PE = positive emotion; NE = negative emotion

Table 1
Descriptive Statistics of All Variables

Demographics	Means (sds) or %	Range	N
Mother's Mean Age at Prenatal Visit	27.8 (6.5)	18-42	311
Motherhood Status (% first time mother)	21.8%	--	310
Marital Status (% Married or Living Together)	77.5%	--	312
Mother's Years of Education	10.2 (3.2)	0-18	312
Median Annual Income	$10,001 - 15,000	--	304
Infant Gender (% male)	46.2%	--	312
Variables of Interest			
Prenatal Daily Hassles (intensity)	43 (13.6)	25-104	312
Prenatal Perceived Stress	4.8 (3.0)	0-13	312
T1 Maternal Emotion Socialization	3.7 (.8)	1.63-5	187
T1 Infant Negative Emotion Expression	2.1 (1.2)	1-5	191
T2 Infant Negative Emotion Expression	2.6 (1.2)	1-5	192
T3 Infant Negative Emotion Expression	2.6 (1.1)	1-5	195
T1 Infant Positive Emotion Expression	2.4 (.9)	1-5	191
T2 Infant Positive Emotion Expression	2.0 (.6)	1-3.5	192
T3 Infant Positive Emotion Expression	2.2 (.7)	1-5	195

Table 2
Correlations between all study variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Demographics																
1. Mother's Age	-	**.43****	**-.14***	**-.28****	.05	.07	-.08	**-.11***	.01	**.25****	.06	.04	**-.15***	.05	.03	.13
2. Motherhood Status		-	-.08	**-.32****	-.11	.00	.03	-.02	-.05	.09	.06	.03	.03	-.05	-.08	-.06
3. Marital Status			-	-.02	**-.18****	-.06	.10	.05	.06	**-.19****	.07	.07	-.00	-.08	-.04	-.07
4. Mother's Education				-	**.25****	.01	.06	**.12***	-.01	.05	-.07	.03	-.08	.11	-.10	.08
5. Family's Income					-	.08	.01	.06	-.05	**.15***	**-.13***	.02	-.12	**.14***	-.04	.11
6. Infant Gender						-	-.05	-.05	-.05	**.14***	-.00	-.06	**-.22****	.05	-.02	**.17***
Key Study Variables																
7. Prenatal Daily Hassles (how often)							-	**.87****	**.39****	.10	.00	-.08	-.04	-.01	.03	-.03
8. Prenatal Daily Hassles (how much)								-	**.45****	.03	.00	-.08	-.04	-.03	.04	-.02
9. Prenatal Perceived Stress									-	.05	-.06	-.15	.06	-.04	.07	-.05
10. Emotion Socialization T1										-	**-.28****	-.05	-.13	**.53****	.03	.05
11. Infant Negative Emotion Expression T1											-	-.03	.13	**-.45****	.01	-.03
12. Infant Negative Emotion Expression T2												-	.18	.11	**-.59****	.02
13. Infant Negative Emotion Expression T3													-	-.06	-.09	**-.57****
14. Infant Positive Emotion Expression T1														-	-.18	-.01
15. Infant Positive Emotion Expression T2															-	.05
16. Infant Positive Emotion Expression T3																-

Note. FIML in MPLUS was used; *p<.05 **p<.01; Variables were coded as follows: Motherhood Status, 0=First Time Mother, 1 = Not a First Time Mother; Marital Status, 0=Married or Living together, 1=other; Infant Gender, 1=boy, 2=girl

Table 3.1
Path Coefficients for Full SEM of Negative Emotion Expression

Path	Estimate	S.E.	p-value
Daily Hassles to Maternal Emotion Socialization	-0.03	0.08	ns
Perceived Stress to Maternal Emotion Socialization	0.07	0.08	ns
Daily Hassles to Negative Emotion Expression Intercept	0.07	0.15	ns
Perceived Stress to Negative Emotion Expression Intercept	-0.12	0.15	ns
Daily Hassles to Negative Emotion Expression Slope	-0.15	0.16	ns
Perceived Stress to Negative Emotion Expression Slope	0.06	0.17	ns
Maternal Emotion Socialization to Negative Emotion Expression Intercept	-0.41	0.16	< .01
Maternal Emotion Socialization to Negative Emotion Expression Slope	0.27	0.18	ns

Note. ns = not significant; estimates are standardized beta weights

Table 3.2
Path Coefficients for Full SEM of Positive Emotion Expression

Path	Estimate	S.E.	p-value
Daily Hassles to Maternal Emotion Socialization	0.00	0.08	ns
Perceived Stress to Maternal Emotion Socialization	0.07	0.08	ns
Daily Hassles to Positive Emotion Expression Intercept	-0.04	0.10	ns
Perceived Stress to Positive Emotion Expression Intercept	-0.03	0.10	ns
Daily Hassles to Positive Emotion Expression Slope	0.03	0.11	ns
Perceived Stress to Positive Emotion Expression Slope	0.00	0.11	ns
Maternal Emotion Socialization to Positive Emotion Expression Intercept	0.78	0.12	< .001
Maternal Emotion Socialization to Positive Emotion Expression Slope	-0.64	0.12	< .001

Note. ns = not significant; estimates are standardized beta weights