Emerging Self-Regulation:

Contributing Infant and Maternal Factors

by

Lauren van Huisstede

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved April 2019 by the
Graduate Supervisory Committee:

Keith Crnic, Chair
Tracy Spinrad
Robert Bradley
Kathryn Lemery-Chalfant

ARIZONA STATE UNIVERSITY

May 2019

ABSTRACT

The ability to self-regulate is arguably the single most important skill a child develops early in life. Self-regulation skills are consistently linked to indices of health, success, and wellbeing. The predominating perspective in self-regulation developmental research has emphasized the role of the early caregiving environment, specifically maternal characteristics and behavior, in shaping infants' emerging regulatory skills. Using two complementary studies, this dissertation draws from a longitudinal sample of 322 low-income, Mexican American mother-infant dyads to better understand mothers' *and* infants' unique roles in contributing to emerging infant regulatory processes. The first study explores the unique contributions of intrinsic (i.e., infant gaze) and extrinsic (i.e., maternal gaze) factors in understanding infant dysregulated emotion and behavior during mother-infant interactions. Using actor partner interdependent models (APIMs), the role of infant and maternal gaze in understanding infant dysregulation were examined longitudinally across three mother-infant interaction tasks (i.e., soothing, teaching, and peekaboo), as well as within task. The expected relations among gaze and dysregulation did not emerge in the longitudinal model; however, differential patterns of associations emerged by task. Findings are discussed within the intersection of risk, culture, and the dyadic interaction context.

The second study connects patterns of specific maternal behaviors (i.e., acknowledging, gaze, vocal appropriateness, appropriate range of affect, consistency of style, resourcefulness, and touch) associated with maternal sensitivity to infant cortisol reactivity and recovery. Latent profile analysis (LPA) revealed four distinct combinations of maternal sensitivity behaviors. One pattern emerged as a risk profile—differentiated

by higher maternal stress—and was associated with significantly more infant cortisol recovery compared to other profiles. Both studies offer a more nuanced understanding of the respective roles of infant and maternal factors in the development of self-regulation. Further explication of developmental processes involved in early regulatory functioning has implications for advancing both scientific knowledge and improved targeting of prevention and early intervention efforts to promote optimal child outcomes, particularly in populations that at increased risk for developmental psychopathology.

DEDICATION

To my daughter, Mina Rose. I started this for me, but I finished it for you.

ACKNOWLEDGEMENTS

I must first and foremost acknowledge my adviser and mentor, Dr. Keith Crnic, who has guided me through graduate school and shaped my development as an independent research scientist. I cannot thank you enough for your constant support and belief in me and my abilities. My distinguished committee—Drs. Robert Bradley, Tracy Spinrad, and Kathryn Lemery-Chalfant—also deserves recognition and accolades for their encouragement of my ideas and invaluable feedback. I also want to recognize Drs. Megan Pratt and Masumi Iida, who provided consultation on the statistical analysis used in this dissertation. Finally, I would also like to thank Drs. Richard Fabes and Kimberly Updegraff, who have supported my diverse, interdisciplinary research interests and advocated for me the during my time in graduate school.

Finally, I am incredibly thankful for my family—especially my sister, Jenny van Huisstede—who provided immeasurable support during my graduate program. I also want to acknowledge my friends and my cohort, especially Diana Gal, for going through the ups and downs of graduate school with me. But most of all, I must acknowledge my darling husband, Brad Matush. Without his endless encouragement, support, and love, I would not be here.

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General Introduction

Self-regulation is broadly defined as "the ability to monitor and modulate cognition, emotion, and behavior to accomplish one's goals and/or to adapt to the cognitive and social demands of specific situations" (Berger, 2011, p. 4). Self-regulatory skills are linked to adaptive social relationships, fewer behavioral problems, and academic success later in life (Calkins & Leerkes, 2010). In fact, "understanding self-regulation is the single most crucial goal in advancing an understanding of development and psychopathology" (Posner & Rothbart, 2000, p. 427). Infancy is considered a particularly sensitive period for emerging regulatory processes, where rapidly developing brain systems are more susceptible to influences from the environment (Lupien et al., 2009). As such, understanding emerging regulatory processes during infancy has important implications for early intervention to promote optimal child development and prevent psychopathology.

Drawing from developmental systems theory, early regulatory development is characterized by the coordination and integration of multiple systems—including stress, emotion, and behavioral response systems—to accomplish individual goals (Thompson, 2011). Self-regulation involves both extrinsic (e.g., early caregiving) and intrinsic (e.g., attentional control and self-soothing behaviors) regulatory processes, both of which operate concurrently across development. Although the child is an active agent in the development of his/her regulatory functioning, considerably more attention has been paid to understanding extrinsic processes in the ontogenesis of self-regulation, such as the influence of early caregiving experiences on self-regulatory capabilities (Schore, 1994; Bernier et al., 2010). Indeed, the emerging self-regulation is traditionally conceptualized as a transition from external coregulation (i.e., of parent to infant) during infancy to internal self-regulation in early childhood (Kopp, 1982; Sroufe, 1995; Kochanska et al., 2001).

One aspect of the early caregiving environment that has received considerable attention is maternal sensitivity. Although many studies have emphasized the role of maternal sensitivity in early regulatory processes (e.g., Spanglar, Schieche, Ilg, Maier, & Ackermann, 1994), much remains to be learned. A preference for variable-centered analyses in examining relations among maternal sensitivity and child self-regulation is limiting in that variable-centered approaches cannot account for intra-individual differences in maternal sensitivity. It is possible that mothers are not sensitive in the same way, differing on individual behaviors but appearing similar overall in mean levels of sensitivity. These differences in sensitivity likely have meaningful implications for infant developmental outcomes. Studies that do employ a person-centered approach typically focus on trajectories of maternal sensitivity (e.g., Hirsh-Pasek & Burchinal, 2006), rather than profiles of the specific behaviors that constitute sensitivity. A further limitation in the current literature is that many of the behaviors that define maternal sensitivity are contingent on infant behavior, making it difficult to parse out the unique contributions of infant versus maternal factors.

It is especially important to understand early regulatory processes in contexts that increase risk for dysregulation, such as poverty (Evans & Kim, 2007). Living in poverty is associated with increased parental stress, which can negatively impact the quality of parent-child interactions (Conger & Donnellan, 2007; Grant et al., 2003). Parents coping with stressful life circumstances may be less responsive to their children, which can impede the development of self-regulation (Blair & Raver, 2012). The nature of risk and its impact on development also varies as a function of population characteristics (Pachter et al., 2006). Due to differences in culture, context, family structure, parenting style, and resources available, it cannot be assumed that the impact of risk on developmental processes operates in the same way across different groups. For example, harsh discipline is more often endorsed by African American parents relative to other ethnic groups (Taylor, Hamvas & Paris, 2011), but the negative effects commonly associated with harsh discipline (e.g., externalizing behavior) are not always observed in African American children (e.g., Deater-Deckard, Dodge, Bates, & Pettit, 1996). A possible explanation is that strict discipline may be considered culturally normative (e.g., as a response to discrimination; Pinderhughes, Dodge, Bates, Pettit, & Zelli, 2000). In this context, strict discipline could be viewed as evidence of parental involvement and effective caregiving (Whaley, 2000).

One cultural group that is particularly salient in the United States (U.S.) is the Mexican-American population. In the past decade, the number of Latinos in the U.S. reached 17.3% of the total population and accounted for over half of the nation's growth (Pew Hispanic Center, 2011; 2015). It is anticipated that one in three U.S. residents will be Latino by 2050 (Bernstein & Edwards, 2008), making Latinos the fastest growing population in the U.S. Despite the prevalence and anticipated growth of the Latino population in the U.S., Mexican-Americans continue to be widely underrepresented in social science research and underserved in practice. Although warm, consistent, responsive parenting is likely to be beneficial to infant development of self-regulatory competencies regardless of culture, it remains important to examine the same developmental processes involved in the development of self-regulation across different cultural populations to determine whether these processes operate in a similar way across groups.

The proposed dissertation is guided by an interdisciplinary biopsychosocial approach (Michel, Marcinowski, Babik, Campbell, & Nelson, 2015) and involves connecting multiple systems related to self-regulation (i.e., emotion, behavior, and biological) to offer a deeper understanding of developmental processes involved in self-regulation in a cultural group underrepresented in developmental research. Specifically, the role of infant and maternal behavior in emerging infant regulatory processes will be examined in a sample of at-risk, Mexican-American mothers and their infants. The first study will explore the unique role of infant and maternal behavior, specifically gaze and attention, in understanding infant and maternal affective and behavioral dysregulation during a series of parent-child interaction tasks at six months. Specifically, this study will explore whether infant gaze predicts his/her own level of dysregulation during a given task *and* maternal dysregulation, as well as compare the relative contribution of infant and maternal gaze on infant dysregulation. In the second study, a person-centered approach will be used to examine patterns of specific maternal behaviors (e.g., touch, vocal appropriateness) that characterize sensitivity and connect these profiles to later infant stress physiology.

The findings from the proposed studies will significantly advance scientific knowledge regarding early regulatory processes during infancy in several ways. First, research to date has predominately emphasized the role of the early caregiving environment on emerging self-regulation, and too little is known about the unique contributions of infant's *own* characteristics and behaviors on the development of their own self-regulation. Third, connecting behavioral, emotional, and biological systems involved in dysregulation bridges multiple literatures to create a new understanding of developmental processes involved in self-regulation and highlights the need for continued research in this area. Fourth, it is crucial to understand these processes in a population that is underrepresented in research and known to be disproportionately susceptible to risk. In addition to furthering scientific knowledge, targeting the early infancy period has important implications for practice, as many early intervention programs focus on early parenting behavior to promote optimal infant development. The proposed studies will explicate which parenting behaviors are most likely influence the developmental trajectory of child self-regulation (e.g., gaze, physical touch, vocal appropriateness). Furthermore, whereas many parent education programs target parent behavior, knowledge of how infant behavior impacts an infant's own development as well as parent behavior may be beneficial (e.g., to teach parents to encourage infant behaviors that have a positive regulatory effect on their own behavior).

Study #1: Gaze and Dysregulation in Mother-Infant Dyads

Dysregulation represents any emotional, behavioral, or physiological response to environmental stressors that is maladaptive and interferes with typical development. It is important to note that dysregulated is not the opposite of 'regulated', nor is it synonymous with 'unregulated' (Cole, Michel, & Teti, 1994; Thompson, 2011). Rather, dysregulation should be conceptualized as normal regulatory processes operating in a dysfunctional manner (Cole et al., 1994). During infancy, dysregulation broadly refers to increased or excessive irritability and crying, over-activity, colic, or difficulties with sleep or feeding. Infant's regulatory capabilities are thought to set the foundation for the ontogenesis of self-regulation (Rothbart, Ellis, & Posner, 2004), and these early regulatory processes may contribute to whether a child begins an adaptive (i.e., regulated) or maladaptive (i.e., dysregulated) trajectory of development. For example, infants who are able to manage arousal during a frustration task are more likely to be compliant during early childhood (Stifter, Spinrad, & Braungrt-Rieker, 1999). Most compelling is the growing number of studies that find connections between infant behavioral dysregulation and child functioning years later. Infant dysregulation has predicted hyperactivity, conduct problems, negative emotionality (Wolke, Rizzo, & Woods, 2002), and increased behavioral problems (DeSantis, Coster, Bigsby, & Lester, 2004; Hyde, O'Callaghan, Bor, Williams, & Najman, 2012) during elementary and middle school.

Infants are not at equal risk for developing dysregulated responses to stressors in their environment. A number of maternal psychosocial factors—including prenatal stress and anxiety, maternal psychopathology, and poverty—and infant factors—such as low birth weight—place infants at increased risk for dysregulation (Papoušek, & Von

Hofacker, 1998). Further, there are a number of maternal and infant factors that may buffer infants who experience increased risk against the negative, long-term effects associated with infant dysregulation. Broadly, the aims of the proposed study are: (a) to identify infant and maternal behaviors implicated in infant dysregulation that can be targeted for intervention; (b) to better understand the dynamic nature of these behaviors; and (c) to explore how these processes operate in a population at increased risk for dysregulation.

The role of infant attention in self-regulation

Infants have few regulatory strategies to modulate their own arousal when they are born, but one that develops early during infancy is looking behavior. By six months, infants actively use gaze aversion strategies (e.g., looking away, turning their head) to modulate arousal (Rothbart et al., 1992). Whereas disengagement of attention is relatively stable between six and 13 months, orienting towards the mother and objects of joint attention (compared to looking at other aspects of the immediate environment) increases during this developmental period (Rothbart et al., 1992). Infant attention is foundational and organizing in emerging regulatory processes. Morales, Mundy, Crowson, Neal, and Delgado (2005) reported that infants' ability to follow their mother's gaze and duration of orienting was significantly and positively related to effective emotion regulation strategies used at 24 months (e.g., active play strategies vs. comfort-seeking).

Infant looking behavior is thought to be shaped by early caregiving experiences. For instance, caregivers can help move infants out of negative affective states and into positive ones by directing or sustaining an infant's gaze (Kopp, 1989; Mundy, Kasari, & Sigman, 1992). This type of external regulatory support provided by caregivers becomes increasingly internalized as infants develop (i.e., infants are able to actively direct their own gaze to manage levels of arousal (Cohn & Tronick, 1988; Carter, Mayes, & Pajer, 1990). Findings from more recent studies, however, suggest that the developmental processes involved in the role of attention in emerging self-regulation are more complex than initially thought. For example, Crockenberg and Leerkes (2004) examined contingencies (i.e., the likelihood of the occurrence of one behavior following another) between infant and maternal behaviors implicated in infant emotion regulation during a novelty task. They reported that specific maternal behaviors related to regulating infant affective and behavioral responses (i.e., engaging and supporting) were contingent on regulatory behaviors in which infants were already engaged (i.e., looking away and self-soothing). These findings support the assertion that caregiver's strategies for helping an infant regulate distress may depend in part on the infant's capacity to engage in regulatory behaviors.

Mother-infant interactions as a context for emerging self-regulation

The idea that joint attention and reciprocity during mother-infant interactions are coregulatory is not a new one and has been redefined and refined by researchers over the years. For example, Dunham and Dunham (1995) introduced the idea that joint attention and dyadic reciprocity serve as an *optimal social structure*, or an interactive framework in which infant regulatory skills can develop. Raver (1996) expanded on this idea of an optimal social structure, which she called the *social contingency model*, and found that joint attention was differentially associated with toddlers' use of self-regulatory strategies, with joint attention predicting more distraction and less comfort seeking. Tronick (1982) first introduced the notion that maternal and infant behaviors operate as a system to regulate infant emotion, where mothers both elicit and respond to infant behaviors as part of a regulatory process. This model is known as the *mutual regulation model* (Gianino & Tronick, 1988; Tronick, 1982; Tronick, 1989). More recently, Beeghly, Fuertes, Liu, Delonis, & Tronick (2011) draw from the mutual regulation model and developmental systems perspective to posit that infant-caregiver interactions are a dyadic, mutually regulating system comprised of an infant subsystem, a caregiver subsystem, and the dynamic interaction between the two. They identify four reciprocal processes that may affect the quality of infant-caregiver interactions: (a) the infant's developmental ability to organize and manage their own affective and behavioral states; (b) the infant's capacity to signal or cue the caregiver; (c) the caregiver's capacity to accurately recognize and interpret infant cues; and (d) the caregiver's ability to respond to those cues contingently and appropriately.

Of notable absence in these models are the role of caregivers' own regulation abilities and connections between infant characteristics or behavior and caregivers' own self-regulation. The assertion is not that infants have a conscious role in helping their caregivers regulate affect and behavior in the same way that caregivers do for infants. Rather, infant characteristics and behavior are likely linked to their caregivers' state of regulation (or dysregulation) in ways that are meaningful for the caregiver's ability to manage their own emotions. For example, infant crying is an infant behavior that is consistently found to be distressing for parents (Hall & Morsbach, 1989; Wilkie & Ames, 1986), and parents who are distressed may be less likely to notice or accurately interpret infant cues. Although there is an abundance of literature examining the role of maternal behavior in infant regulatory processes, far less is known about reciprocal effects of infant behavior on maternal dysregulation.

The present study

Taken together, past research has focused primarily on the role of caregivers as an external regulator even though there is evidence that infants have a role in their own emerging self-regulation. Furthermore, too little is known about the regulatory effects infants may have on their caregivers. Although studies such as Crockenberg and Leerkes' (2004) lend greater understanding to the role of infants' own behaviors and maternal behaviors in emerging self-regulation, studies have yet to examine the *relative contribution* of infant and maternal behavior on infant regulatory development. The proposed study seeks to address these limitations and offer new understanding of infant and maternal contributions to co-regulatory processes. A longitudinal actor partner interdependence model (APIM) will be tested using observational data from three, consecutive mother-infant interaction tasks. The APIM (Kashy & Kenny, 1999) is a data analytic technique for nonindependent data (e.g., mother-infant dyads) that simultaneously estimates the effect that one dyad member's predictor variable has on his/her own outcome variable and on his/her partner's outcome variable, partialing out variance shared across dyads in the predictor variable. This method has been modified for use with longitudinal data (Adams, Bukowski, & Bagwell, 2005; Cook & Kenny, 2005). The primary goals of the proposed study are threefold: (1) to explore the contribution of infant gazing behavior on their own dysregulation (i.e., the infant actor effect); (2) to examine the role of infant gaze on maternal dysregulation (i.e., the infant partner effect); and (3) to explicitly test whether infant versus maternal gaze more strongly predicts infant dysregulation. Specifically, the proposed study will address the following research questions:

Research question 1: Does infants' gazing behavior contribute to their own dysregulation? The first research question examines actor effects of infant and maternal attention on their own dysregulation, respectively. It is hypothesized that infants who spend more time gazing at their mother or an object of joint attention will be less dysregulated during the subsequent task. It is not expected that maternal gazing behavior will be directly related to their own dysregulation, as adults have more complex strategies to manage emotion dysregulation, such as cognitive reappraisal.

Research question 2: Does infant gaze play a significant role in maternal dysregulation? The second research question explores partner effects. Specifically, the extent to which maternal gaze predicts infant dysregulation and infant gaze predicts maternal dysregulation will be examined. It is expected that mothers who spend more time engaged in joint attention will have infants who are less dysregulated in subsequent tasks. Given prior research that supports that infants can influence mother's emotional state (Hall & Morsbach, 1989; Wilkie & Ames, 1986), it is predicted that infant gaze will be associated with less maternal dysregulation.

Research question 3: Does infant or maternal gaze play a greater role in understanding infant dysregulation? The third research question compares the magnitude of the actor and partner effects on infant dysregulation (i.e., comparing the size of the effect of infant gaze on infant dysregulation and maternal gaze on infant dysregulation. Although infants are considered active agents in their own regulatory development, infants are still immature and rely heavily on the support of their caregiver as an external regulator (Beeghly et al., 2011). It is therefore predicted that the effect of maternal gaze on infant dysregulation will be stronger than the influence of infant's own gaze.

Method

The aims of the proposed study will be addressed using existing data from the *Las Madres Nuevas* (LMN) Project, a longitudinal investigation of post-partum depression in high-risk, Mexican-American mothers.

Participants

The full sample included 322 Mexican-American mothers and their children (53.7% are female). The majority of mothers (86.1%) were born in Mexico, 54.1% of whom came to the U.S. before age 17; 85.7% reported an annual household income of $25,000 or less, 83.6% are unemployed, 59.1% did not complete high school, and only 30.0% are married. This is a low-income, low-resource sample and is therefore ideal to address the aims of the research proposal.

Procedure

In the parent LMN study, pregnant Mexican American women were recruited from prenatal care clinics in the Phoenix metro area. Initial eligibility criteria included fluency in either Spanish or English, self-identification as Mexican American, and being in less than the 34^{th} week of pregnancy. Of women who were approached, 56% agreed to schedule a prenatal home visit, during which informed consent was obtained. To minimize participant burden, the study followed a "planned missingness" design (Little & Rhemtulla, 2013) for the home visits in which all participants were assigned to the 6-week visit, but two-thirds of the sample were then assigned to the 3-, 4.5-, and 6-month home visits. Each participant “missed” one of the three planned missing data collection periods. As part of the larger study, a home visit was completed at six months, during which mothers were video recorded interacting with their infants during five structured tasks. Participants were compensated monetarily for data collection at each time point. The Institutional Review Board at the recipient institution approved all study procedures.

Mother-infant interaction tasks. As part of a larger, longitudinal study, a home visit was completed when infants were six months old. During the home visits, research assistants traveled to participants’ homes to video record mothers interacting with their infants during five specified tasks. These tasks varied in their structure and demand for the mother and infant and also in the level of frustration that may or may not be elicited from infants. The *free play* task (5 minutes) served as a “warm up” context in which the mother was provided a small basket of toys and objects and asked simply to play with her infant as she usually would when alone. During the a*rm restraint* task (2 minutes), mothers were asked to stand behind their infants and gently hold their arms by their sides while the experimenter held a book in front to the infant. This task is intended to elicit mild frustration in the infant. The arm restraint task provided the context for the subsequent *soothing* task (3 minutes), during which mothers were asked to comfort the infant as they normally would. No explicit instructions were provided to mothers about how to accomplish this goal (Calkins, Hungerford, & Dedmon, 2004). In the *teaching* task (5 minutes), mothers were provided with a set of objects and asked to “teach” their child a particular skill. Skills were selected from the Bayley Scales of Infant Development-III (BSID-III; Bayley, 2005) and reflected skills one to two months beyond the infant’s capabilities, creating a context for mother and infant to experience mild frustration. Finally, during the pe*ek-a-boo* task (3 minutes), mothers were instructed to use an object (e.g., book or blanket) to play "peek-a-boo" with their infant.

Measures

Recorded mother-infant interactions were later coded for different behaviors by trained undergraduate research assistants using multiple coding systems. The arm restraint task was not coded for gaze behavior due to the nature of the task (i.e., the mother stood behind the infant, so joint attention was not an option during this interaction).

Gaze. Mother-infant interactions were coded using the Coding Interactive Behavior (CIB) manual (Feldman, 1998). The CIB is a global rating system for parent-child interactions that has demonstrated validity in various social and cultural contexts (Feldman & Masalha, 2007). Undergraduate research assistants coded video observations for infant and mother gaze. Infant gaze is defined as any instance where the infant was consistently focused on the mother or object of joint activity and was rated using a 5-point Likert scale (1 = *infant gaze is averted and not focused on mother/object*; 3 = *infant gaze is occasionally focused on the mother/object*; 5 = *infant looks at mother/object throughout the interaction*). Maternal gaze was defined as any instance where the mother focuses her gaze/attention on the infant or on an object of joint activity and was rated using a 5-point Likert scale (1 = *mother gaze is rarely focused on the infant or object of joint attention*; 3 = *mother focuses on the child for half of the observation*; 5 = *mother gaze is consistently focused on the infant/object*).

Observed dysregulation. The global coding system used to rate infant and maternal dysregulation was developed specifically for the project (Lin & Crnic, 2012).

During the same mother-infant interaction tasks, dysregulation was assessed with respect to the lability, intensity, duration, frequency, and recovery time of affective or behavioral expressions of emotions using a 5-point Likert scale (1= *none*, 2 = *low*, 3 = *moderate*, 4 = *moderately high*, 5 = *high*). Infants were considered highly dysregulated if they were easily or overly aroused, consistently struggle to recover from distress, and have difficulty self-soothing or being soothed. Affect or behavioral responses may be inappropriate or incongruous to the situational context. For mothers to be coded as highly dysregulated, evidence of multiple signs of emotional, behavioral, and/or attentional dysregulation must be observed. Alternatively, mothers could be highly dysregulated if they exhibit one or more instances of intense dysregulation or have difficulty with behavioral activation (e.g., "spacing out").

Cultural orientation. Mothers completed the Acculturation Rating Scale II (ARMSA II) to measure acculturation and cultural orientation (Cuellar, Arnold, & Maldonado, 1995). The subscales Anglo Orientation ($\alpha = .93$) and Mexican Orientation ($\alpha = .87$) were derived from a total of 30 items. Example items for the Anglo Orientation include "I enjoy English language TV" and "I enjoy reading in English." Items from the Mexican Orientation include "My family cooks Mexican foods" and "I enjoy listening to Spanish language music." Mothers reported how often each of the items were true for them using a 5-point Likert scale (1 = *not at all*; 5 = *extremely often or almost always*).

Familism. During the prenatal home visit, cultural values—including familism—were assessed using a slightly modified version of the Mexican American Cultural Values Scale (MACVS; Knight et al., 2010; Sabogal, Marin, Otero-Sabogal, & Marin, 1987). All mothers responded to 50 items designed to assess multiple subscales of familism, including support and emotional closeness (α = .77), obligations (α = .59), and family as referent (α = .69). Example items within each subscale include: support and emotional closeness ("Family provides a sense of security because they will always be there for you"), obligations ("If a relative is having a hard time financially, you should help them out if you can"), and family as referent ("Children should be taught to always be good because they represent the family"). Each item was scored on a Likert scale of 1 (*strongly disagree*) to 5 (*strongly agree*). The MACVS has demonstrated construct validity in two large-scale, longitudinal studies following Mexican American adolescents and adults (Knight et al., 2010).

Daily hassles. The Parenting Daily Hassles (PDH) Scale (Crnic & Greenberg, 1990) was used to assess daily stresses specific to parenting during the 6-month home visit. The PDH comprises 20 items (e.g., "Continually cleaning up messes of toys or food" and "being nagged, whined at, or complained to"). Each item was rated using 5-point Likert scales regarding *how often* this has occurred during the past month (1 = *none of the time*; 5 = *an extreme amount of time*) and *how much* this has been a hassle or annoyance (1 = *this is not a hassle for me at all*; 3 = *this is somewhat of a hassle*; 5 = *this is a big hassle*). Internal consistency for the PDH was excellent for *how often* (α = .90) and *how much* (α = .93).

Perceived stress. During the 6-month home visit, the Perceived Stress Scale (PSS) was used to measure the degree of stress mothers perceived in their lives (Cohen, Kamarck, & Mermelstein, 1983). The PSS has four items (e.g., "How often have you felt difficulties were piling up so high that you could not overcome them?"), each rated on a 5-point Likert scale (0 = *Never*; 1 = *Almost never*; 2 = *Sometimes*; 3 = *Fairly often*; 4 =

Very often). Internal consistency for this measure was good (α = .69). The Spanish-version of the PSS has been validated and demonstrated good internal consistency (Ramírez & Hernández, 2007).

Maternal depression. The Edinburgh Postnatal Depression Scale (EPDS) was used to assess maternal symptoms of depression and anxiety at six months (Cox, Holden, & Sagovsky, 1987). Example items included "You have been able to laugh and see the funny side of things" and "You have blamed yourself unnecessarily when things went wrong" (reverse scored). This 10-item scale was rated using a 4-point Likert scale (0 = *as much as you always do*; 3 = *not at all*). Internal consistency was very good (α = .83). The EPDS has also been validated in Spanish-speaking samples by Garcia-Esteve, Ascaso, Ojuel, and Navarro, 2003.

Analytic Plan

Preliminary analyses

Prior to the primary analyses, descriptive statistics and correlations among all study variables (i.e., gaze and dysregulation during the soothing, teaching, and peek-a-boo tasks) were examined using SPSS version 24. Paired samples *t*-tests were performed to examined differences among gaze and dysregulation between and within tasks for mothers and infants. Although the free play task was coded for gaze, this task was not included in the proposed analyses due to methodological difficulties anticipated with interpreting connections between gaze behavior during the free play task with dysregulation during the soothing task. Next, autoregressive models for dysregulation were fitted separately for infants and mothers in Mplus, with dysregulation at one time point predicting dysregulation at another time point and estimates for each path freely estimated. Next, a second model was fitted with the autoregressive paths constrained to be equal. Because the constrained model is nested within the first model estimated, a chi-square difference test can be calculated to determine whether model fit improves or worsens by constraining the paths to be equal. If model fit does not worsen when the paths are constrained to be equal, these paths will be constrained in the full actor partner interdependence model (APIM) for parsimony.

Primary analyses

To address the first two research questions (i.e., to examine actor and partner effects of gaze on dysregulation in mother-infant dyads), a longitudinal APIM model was estimated using a structural equation modeling (SEM) framework. Missing data was accounted for in the model with full information likelihood estimation (FIML). Infant and maternal gaze during the soothing and teaching tasks predicted infant and maternal dysregulation during the teaching and peek-a-boo tasks, respectively. Dysregulation during the previous task was controlled for, so that the path from gaze to dysregulation could be interpreted as the effect of gaze during one task on the change in dysregulation to the subsequent task. See Figure 1 for paths and covariances of interest. Unstandardized coefficients were examined because the research questions test the null hypotheses that the two regression coefficients are equal. For example, to test whether gaze has a stronger effect on infant dysregulation for infants compared to mothers, change in infant dysregulation for a 1 unit increase in infant gaze is compared to a 1 unit increase in maternal gaze. Standardization loses the metric equivalence, and parameter comparisons become meaningless (Kenny & Ledermann, 2010).

The SEM framework has several advantages over the traditional, ordinary least squares (OLS) regression approach, including the ability to test multiple equations simultaneously and compare and evaluate the size of parameters within a model (Cook & Kenny, 2005). In order to compare the size of the effect of maternal gaze on infant dysregulation to the size of the effect of infant gaze on his/her own dysregulation (i.e., research question 3), a k ratio will be calculated (Kenny & Ledermann, 2010). The k ratio provides an index of the relative size of the partner effect to the actor effect. Referring to Figure 1, the ratio of the partner to the actor effect for infants (i.e., the relative effect of maternal gaze on infant dysregulation compared to the effect of infant gaze on his/her own dysregulation) can be calculated as follows: $k_1 = \frac{p_{12}}{a_1}$. The ratio of the partner to the actor effect for mothers can be calculated as well: $k_2 = \frac{p_{21}}{a_2}$. The k ratio can be directly estimated in an SEM framework with the use of a phantom variable, which is a latent variable that has no value and no error (Kenny & Ledermann, 2010). Phantom variables are treated as auxiliary variables in model estimation and therefore do not affect parameter estimates, implied variances and covariances, or model fit statistics. In the model presented in Figure 2—which is abbreviated from the full model shown in Figure 1—the two phantom variables (P_1 and P_2) are included as a mediator in the paths of the two partner effects, and k_1 and k_2 can be directly estimated. Kenny and Ledermann (2010) provide guidelines for interpreting the k ratio for expected dyadic patterns described in Kenny and Cook (1999): if $k = 1$, there is a couple pattern (i.e., the actor and partner effect are equal in size); if $k = -1$, there is a contrast pattern (i.e., the actor and partner effects are the same size but in opposite directions); and if $k = 0$, there is an actor-only pattern (i.e., there is an actor effect but not a partner effect).

Results

Descriptive statistics and preliminary analyses

Table 1 presents descriptive statistics for and bivariate correlations among all study variables. All variables were within conventional benchmarks for skew and kurtosis (upper and lower bounds of 2 and 7, respectively; Chou & Bentler, 1995; Curran, West, & Finch, 1996) save for maternal dysregulation during the peekaboo task, which was positively skewed and leptokurtic. The nonnormality of maternal dysregulation is not problematic because maternal dysregulation is an endogenous variable. Paired samples *t*-tests revealed significant differences in levels among gaze and dysregulation for infants and mothers both within and across tasks. Maternal gaze was lowest during the soothing task ($M = 4.25$) and highest during the peekaboo task ($M = 4.61$). Maternal gaze during soothing significantly differed from the teaching task ($M = 4.42$; $t[196] = -3.16$, $p = .002$) and peekaboo task ($t[195] = -7.29$, $p < .001$). Maternal gaze during the teaching task was also significantly lower than during the peekaboo task ($t[196] = -4.79$, $p < .001$). Infant gaze followed a similar pattern to maternal gaze, with infant gaze during the soothing task ($M = 2.94$) and significantly differed from the teaching task ($M = 3.41$; $t[196] = -6.03$, $p < .001$) and peekaboo task ($M = 3.75$; $t[195] = -9.59$, $p < .001$). Infant gaze during the teaching task was also significantly lower than during the peekaboo task ($t[196] = -4.97$, $p < .001$). Maternal gaze was significantly higher than infant gaze during the soothing ($t[196] = -20.00$, $p < .001$), teaching ($t[196] = -17.89$, $p < .001$), and peekaboo task ($t[195] = -21.90$, $p < .001$).

Maternal dysregulation was lowest during the soothing task (*M* = 1.24) and highest during the teaching task (*M* = 1.51). Maternal dysregulation during soothing significantly differed from teaching ($t[192] = -4.82$, $p < .001$) and peekaboo (*M* = 1.31; $t[192] = 4.13$, $p < .001$). Maternal dysregulation during the teaching task, however, did not significantly differ from the peekaboo task. Infant dysregulation followed a similar pattern to maternal dysregulation, with infant dysregulation during the soothing task (*M* = 1.62) significantly differing from infant dysregulation during the teaching task (*M* = 2.25; $t[193] = -8.34$, $p < .001$) and peekaboo task (*M* = 2.01; $t[192] = 3.08$, $p = .002$). Unlike maternal dysregulation, infant dysregulation during the teaching task was significantly higher than during the peekaboo task ($t[192] = -4.46$, $p < .001$). Maternal dysregulation only significantly differed from infant dysregulation during the teaching ($t[192] = 11.23$, $p < .001$) and peekaboo task ($t[192] = 4.46$, $p < .001$). See Figure 3.

Bivariate correlations associated with the paths to be estimated in the APIM were examined first. Autoregressive correlations among all variables were significant, positive in direction, and moderate to large in magnitude. Infant and maternal gaze during the soothing task was not significantly related to infant and maternal dysregulation, respectively, during the teaching task ($r[193] = .009$, $p = .90$). Maternal gaze during the teaching task was negatively correlated with maternal dysregulation during the peekaboo task ($r[193] = -.20$, $p = .005$). Similarly for infants, gaze during the soothing task was not significantly related to dysregulation during the teaching task ($r[193] = -.04$, $p = .61$), but gaze during the teaching gaze was negatively correlated with dysregulation during the peekaboo task ($r[193] = -.18$, $p = .01$). With respect to partner effects, only infant gaze during the teaching task was significantly and negatively associated with maternal dysregulation during the peekaboo task (*r*[193] = -.25, $p < .001$).

Zero-order associations among gaze and dysregulation were also examined within task with respect to actor and partner effects. During the soothing task, only maternal gaze was significantly related to maternal dysregulation, and this association was negative (*r*[194] = -.28, $p < .001$). For the teaching task, maternal gaze was significantly and negatively related to maternal dysregulation (*r*[194] = -.18, $p = .01$), and infant gaze was significantly and negatively associated with infant dysregulation (*r*[194] = -.32, $p < .001$). Only infant gaze was significantly and negatively correlated with maternal dysregulation (*r*[194] = -.22, $p = .002$). During the peekaboo task, maternal gaze was significantly and negatively related to maternal dysregulation (*r*[193] = -.18, $p = .01$), and infant gaze was significantly and negatively associated with infant dysregulation (*r*[193] = -.40, $p < .001$). Infant gaze was only significantly and negatively related to maternal dysregulation (*r*[193] = -.33, $p < .001$).

Resilience and risk factors associated with maternal and infant gaze and dysregulation behavior across interaction tasks. Maternal and infant gaze and dysregulation within each interaction task (i.e., soothing, teaching, and peekaboo) were also examined in relation to several indices of resilience and risk: cultural orientation, familism, daily hassles, perceived stress, and maternal depression. Infant dysregulation during peekaboo was positively associated with Mexican cultural orientation, r(193) = .16, p = .03. Maternal dysregulation during soothing was positively related to familism, but only the aspect of familism concerning children as representative of the family, r(194) = .15, p = .04. Notably, these associations were not in the expected direction. Infant gaze during the peekaboo task was significantly and negatively correlated with how much mothers were bothered by daily hassles (r[197] = -.17, p = .02) and perceived stress r[197] = -.14, p = .048. Maternal dysregulation during peekaboo was positively associated with perceived stress, r(193) = .16, p = .02. How much mothers were bothered by daily hassles was positively associated with infant dysregulation during teaching (r[194] = .15, p = .04) and peekaboo tasks (r[193] = .18, p = .01). How frequently mothers experienced daily hassles was positively associated with infant dysregulation during the teaching task (r[194] = .20, p = .006). Maternal depression was only significantly correlated with maternal dysregulation during the teaching task, and this association was positive, r(156) = .24, p = .003.

Longitudinal APIM

A series of autoregressive models for infant and maternal dysregulation across tasks were estimated to test the stability of these constructs prior to estimating the full, longitudinal APIM. In the unconstrained model, infant dysregulation during the soothing task significantly predicted infant dysregulation during the teaching task (b = .71, $p < .001$), and dysregulation during the teaching task significantly predicted dysregulation during the peekaboo task (b = .73, $p < .001$; $\chi^2[N = 194; df = 1] = 2.02$, $p = .16$; CFI = .99; RMSEA = .02; SRMR = .07). In the constrained model (bs = .72, *p*s < .001), model fit improved slightly ($\chi^2[N = 194; df = 2] = 2.06$, $p = .36$; CFI = 1.00; RMSEA = .01; SRMR = .02). In the full APIM, the paths from infant dysregulation during the soothing task to the teaching task and infant dysregulation during the teaching task to the peekaboo task were constrained to be equal. For mothers, dysregulation during the soothing task significantly predicted dysregulation during the teaching task (b = .65, $p < .001$), and dysregulation during the teaching task significantly predicted dysregulation during the peekaboo task (b = .45, $p < .001$; $\chi^2[N = 193; df = 1] = 1.31$, $p = .25$; CFI = 1.00; RMSEA = .04; SRMR = .02). In the constrained model (bs = .47, *p*s < .001), model fit worsened ($\chi^2[N = 193; df = 2] = 4.10$, $p = .13$; CFI = .98; RMSEA = .07; SRMR = .06), and these paths were not constrained in the full APIM.

Figure 3 presents the results of the full estimated longitudinal APIM. Model fit was adequate ($\chi^2[N = 199; df = 31] = 50.88$, $p = .01$; CFI = .97; RMSEA = .06; SRMR = .07). All autoregressive paths were significant and in the expected direction (i.e., positive). There were no significant infant actor or partner effects across any of the tasks. For mothers, there were no significant actor effects (i.e., maternal gaze did not maternal dysregulation across tasks); however, a significant partner effect emerged from the soothing to the teaching task, such that maternal gaze significantly predicted infant dysregulation (b = .24, $z = 2.40$, $p = .02$). Additionally, a trend-level infant partner effect emerged from the teaching to the peekaboo task, with infant gaze predicting maternal dysregulation (b = -.09, $z = -1.89$, $p = .06$).

Task-specific APIMs

Based on the different patterns of associations among gaze and dysregulation for infants and mothers from the within-task bivariate correlations, separate APIMs were estimated for each task to test whether actor and partner effects differed depending on the interaction context. Figure 4a, b, and c present the results for the APIM for the soothing, teaching and peekaboo tasks, respectively. For the soothing task, only the maternal actor effect was significant, such that higher maternal gaze was related to lower maternal dysregulation (b = -.21, $p < .001$). In contrast, the maternal actor effect was the only path that was nonsignificant during the teaching task. Higher infant gaze was related to lower maternal dysregulation (i.e., a significant maternal partner effect; b = -.17, $p = .02$). Similarly, elevated infant gaze was also related to lower infant dysregulation (i.e., the infant actor effect; b = -.55, $p < .001$). Interestingly, however, maternal gaze was positively related infant dysregulation (i.e., the infant partner effect; b = .46, $p = .002$). In the peekaboo task, only the infant actor (b = -.58, $p < .001$) and partner effect (b = -.21, $p < .001$) were significant.

K ratios

Although few significant actor and partner effects emerged in the longitudinal APIM across tasks, observed differences in actor and partner effects for infants and mothers between tasks suggested the presence of possible dyadic patterns (e.g., actor-only). The advantage of using the *k*-ratio is that patterns can be detected that may be missed by only examining the significance tests for actor and partner effects (Kenny & Ledermann, 2010). However, the models estimated to calculate the *k* parameter and confidence ratios would not converge, and so the results cannot be presented.

A series of three models were estimated to test whether concurrent relations among mother and infant gaze and mother and infant dysregulation differed between interaction tasks. Following steps outlined by Fitzpatrik, Gareau, Lafontaine, and Gaudreau (2016), the task-specific APIM models were adjusted to include two latent (i.e., phantom) variables to estimate the *k* parameter. Confidence intervals for the *k* parameters were obtained using a bias-corrected bootstrap 95% confidence interval for the unstandardized effects. The estimates presented in the following section are based on 5000 bootstrap samples. Identical models with the same specifications were also estimated using a new, online program called *APIM_SEM* (Stas, Kenny, Mayer, & Loeys, 2018), which automatically estimates *k* parameters and confidence intervals for dyadic analyses and provides interpretation of results.

Results indicated that different dyadic patterns emerged among the three interaction tasks. During the soothing task, the infant *k* parameter is .75, suggesting the infant actor effect is more than twice as large as the partner effect, indicating something in between a couple and actor-only pattern. However, the infant *k*-ratio cannot actually be interpreted, as the confidence interval range is very wide (k_1 = .75, 95% CI [-1.53 25.00]; Stas et al., 2018). For mothers, the *k*-ratio was close to 0, indicating an actor-only effect is plausible (k_2 = -.18, 95% CI [-.59 .15]). For the teaching task, the infant *k*-ratio suggests a contrast pattern (k_1 = -.84, 95% CI [-1.44 -.35]), in which the actor and partner effects are of similar size but in opposite directions. For mothers, the dyadic pattern most closely resembles a couple pattern, although the confidence interval range is very wide and the *k*-ratio cannot actually be determined (k_2 = 1.01, 95% CI [.08 22.38]). In the peekaboo task, the confidence interval for the infant *k*-ratio suggests an actor-only pattern (k_1 = -.32, 95% CI [-.98 .38]). The appropriate pattern for mothers, however, cannot be determined due to the wide confidence interval range (k_2 = 1.74, 95% CI [.44 27.03]) but suggests a larger partner effect compared to the actor effect.

Discussion

Too often, the framework for understanding emerging infant regulatory processes defaults to the role of caregiver factors that may influence infant regulation. However, infants are independent actors capable of altering the trajectories of their own regulatory development as well as the regulatory functioning of their caregiver. Too little is known about how infant behavior contributes to their *own* regulatory functioning, and too few investigators have examined the respective roles of infant and maternal behavior on infant dysregulation concurrently. The current study sought to examine the respective contributions of maternal and infant gaze on infant dysregulation and explicitly test whether infant versus maternal gaze contributes greater prediction to infant dysregulation in a sample of low-income, Mexican-American dyads. Overall, findings suggest that examining the study research questions in a longitudinal framework (i.e., predicting dysregulation from gaze during a preceding task) did not lend great insight into the actor and partner effects of gaze on dysregulation. Rather, considering actor and partner effects separately by interaction context provided a more nuanced, deeper understanding of the interplay between maternal and infant gaze and dysregulation.

Stability of gaze and dysregulation

As expected, results from the bivariate correlations and autoregressive models suggested that gaze was relatively stable for both mothers and infants across tasks, suggesting that mothers and infants who spend more time jointly attending or looking at one another during the soothing task are more likely to do so in the teaching and peekaboo tasks. Relative stability in infant gazing behavior has been reported longitudinally in other studies; for example, individual differences in infant looking behavior and visual attention were stable across different phases of the still-face task in a sample of 4- and 6-month old infants (Abelkop & Frick, 2003). On average, mean levels of gaze were significantly higher for mothers compared to infants across all three tasks. This finding is unsurprising, as infant attentional capabilities are still emerging at six months (Colombo 2001) compared to adult levels of visual attention.

Levels of maternal and infant gaze also significantly differed across the three interaction tasks examined in the current study. Specifically, infants and mothers engaged in the highest mean levels of joint attention during the peekaboo task and the lowest during the soothing task. It may be that the peekaboo task had the most potential for engagement for both mother and infant; whereas the teaching task required joint attention for the infant to complete a developmentally difficult task, the peekaboo task called for mother and infant to play a fun game of peekaboo together. One study found that visual attention was highest between infant age six and nine months (across the first 18 months of life) when of a game of peekaboo was characterized by hiding, coming out, and saying 'peekaboo' in an animated voice (Miller & Commons, 2007). During the teaching task, on the other hand, mothers were encouraged to teach their infant a task (i.e., placing a cube in a cup) that as developmentally too difficult, which may have motivated mothers and infants to utilize gaze aversion regulation strategies (e.g., distraction).

Maternal and infant dysregulation were also relatively stable across interaction tasks. Consistent with the findings from the current study, negative affect during a still-face procedure was moderately stable across phases of the task (i.e., normal interaction, still face, reunion) although it should be noted that negative affect in this study included any instances of fussiness or crying (Abelkop & Frick, 2003), rather than *dysregulated* negative affect. Mean levels of dysregulation were lower, in general, compared to mean levels of gaze, but infants exhibited significantly higher dysregulation compared to mothers for all three tasks. This finding is expected and consistent with developmental research that mothers, as adults, have higher capabilities of regulating behavior and emotion than younger children (Zimmerman & Iwanski, 2014). With respect to absolute stability, dysregulation followed a more curvilinear trajectory, with mean levels of dysregulation highest during the teaching task for both mothers and infants. The teaching task was the most dysregulating for both mom and baby, which is consistent with the intent of the task—to mildly frustrate both mom and infant.

Longitudinal APIM

The primary goal of the current study was to test the identified hypotheses using a longitudinal framework. The advantage of examining the effect of gaze during one task on dysregulation during a subsequent task is that it establishes temporal ordering of effects and provides some evidence for causality. The longitudinal APIM however did not yield the desired utility in addressing the research questions. Indeed, hypotheses regarding the association between infant gazing behavior for their own and for maternal dysregulation were not supported. With respect to the second research question, it was expected that mothers who spent more time engaged in joint attention would have less dysregulated infants in subsequent tasks. The findings from the current study provided evidence to the contrary. In the longitudinal model, maternal gaze during the soothing task significantly and *positively* predicted infant dysregulation during the teaching task, with higher levels of maternal gaze related to increased infant dysregulation. The direction of this association was unexpected, but considering the interaction context may lend insight into explaining this relation. Mean levels of maternal gaze were lowest during the soothing task compared to the teaching and peekaboo tasks. It is likely that other maternal strategies, such as holding or rocking, are more appropriate and effective for soothing distressed infants. Indeed, one study found that presenting face (i.e., when the mother makes an overt attempt to look into the infant's face and the most comparable variable to gaze in the current study), was unrelated to reducing infant distress during an inoculation task, but other strategies (e.g., holding/rocking and feeding/pacifying) were considerably more effective (Jahromi et al., 2004). It is possible that mothers who engaged in higher levels of gazing behavior did not opt for these other soothing strategies, resulting in a more dysregulated infant going into the teaching task.

The lack of significant findings in the longitudinal model, although unexpected, has implications for developmental methodology. Longitudinal design offers many advantages to cross-sectional studies, including the ability to establish temporal ordering of effects. Certain developmental processes may be confined to specific situations, whereas others may generalize longitudinally, and still others may demonstrate longitudinal and context-specific effects. For example, toddler compliance with adults is situation-specific, rather than a general response to all adults (Damon, 1980). Toddler compliance has also been longitudinally predicted from attachment security and child temperament (Lickenbrock et al., 2013). It is possible that the effects of gaze on dysregulation are largely confined to the interaction context and do not go beyond the demands of the specific situation. The field's current preference for publication of longitudinal compared to cross-sectional studies—particularly as new statistical methods are discovered to analyze developmental phenomena—may limit scientific knowledge in that relations among behaviors that are context-specific may go unexamined.

Task-specific APIMs

The study hypotheses were also tested in separate APIMs for each task (i.e., soothing, teaching, and peekaboo).

Soothing. During the soothing task, an actor-only pattern for mothers emerged, such that only maternal gaze negatively predicted maternal dysregulation, with more gaze relating to less dysregulation. There is some evidence that the attention is associated with adult ability to regulate emotion. Specifically, taking longer to switch from a neutral to an emotional set of stimuli was associated with more anxiety and worrisome, and more efficient switching was related to more frustration during a stressful task (Johnson, 2009). Although the measure used in the current study broadly measured gaze and could not distinguish between duration of gaze and number of gaze shifts, gaze/joint attention in this study was related to lower dysregulation during a soothing task. The nature of this task is potentially stressful for the mother, as crying is inherently stressful to mothers (Hall & Morsbach, 1989; Wilkie & Ames, 1986). Mothers who are attending to their distressed infants, however, may be more likely to soothe them, thereby reducing fussing or crying and lowering their own dysregulation.

Null findings regarding infant actor and partner effects were also unexpected. Mean infant gaze was lower during soothing than in other tasks, so gaze may not be the regulatory strategy of choice following a distressing arm restraint task. Gaze may be a more appropriate distraction or focusing strategy in gaze-oriented tasks, such as teaching or peekaboo, in which the task includes looking at an object or the mother. In a sample of 12- to 13-month-old infants and their mothers, Diener, Mangelsdorf, McHale, and Frosch (2002) examined a number of infant regulation strategies, including social referencing (similar to gaze in the current study), self-soothing, and distraction. Only distraction and passive disengagement—both of which involve looking away from the mother—were associated with lower distress during the Strange Situation Paradigm. It is also likely that infants in the current study were not distressed by the arm restraint task, as mean levels of dysregulation during this task were lower than in the soothing task ($M = 1.48$, $SD = 1.00$). Finally, maternal gaze was unrelated to infant dysregulation during the soothing task. Similar to the explanation for nonsignificant associations between infant gaze and dysregulation, maternal gaze may be unrelated to infant dysregulation because mothers are engaging in other, potentially more effective strategies (e.g., holding/rocking and feeding/pacifying; Jahromi et al., 2004) to soothe distressed infants.

Teaching. During the teaching task, a different pattern of actor and partner effects was found. A contrast pattern for infant dysregulation emerged, in which the infant actor and partner effects are of similar size but in opposite directions. In this case, infant gaze operated in the expected direction and was linked to less infant dysregulation. Higher infant gaze in this context may be indicative of more engagement with the task, which could facilitate infant organization of behavioral and emotional responses to the task. Higher maternal gaze, however was significantly related to *more* infant dysregulation in the context of the teaching task, which was unexpected and suggests that maternal gaze may not have been a regulating force during this task. The purpose of the task was to mildly stress the mother as well as the infant by asking the mother to teach her infant a task that was developmentally too difficult for a typical six-month-old to complete. Maternal gaze/joint attention in this case may have been a function of maternal intrusiveness or negative attention to encourage the child to accomplish the too-difficult task, resulting in more infant dysregulated response. Infant and maternal gaze, in the context of the teaching task, may serve opposite functions for infant dysregulation.

For maternal dysregulation, a couple pattern seems most likely, in which both the actor and partner effects contribute similarly and in the same direction. In this task, the maternal actor effect was nonsignificant, but higher maternal gaze was associated with lower dysregulation. Maternal dysregulation was also highest during this task, and maternal gaze and dysregulation were negatively and significantly correlated. Higher infant gaze was also associated with less maternal dysregulation, which is consistent with initial hypotheses regarding the infant partner effect. It could be that infant gaze (or joint attention) is indicative that the infant is engaged with the task at hand, which may help mothers feel more engaged as well.

Peekaboo. Infants appeared to be the drivers of the peekaboo interaction task, with an actor-only pattern explaining infant dysregulation. As predicted, higher infant gaze was associated with less maternal and infant dysregulation. Unexpectedly, maternal gaze was unrelated to infant dysregulation during this task. Perhaps gaze was less meaningful as a regulatory or organizing function during this task, as the purpose of this task was to gaze at their infant to play the peekaboo game. Another possibility is that the *timing* of gaze during this task mattered, as the peekaboo game involves hiding behind an object, peeking out at the infant, and hiding again, preferably with consideration to infant responses to the game (Miller & Commons, 2007). In a series of novelty tasks, mothers who gaze contingently when their infant looks away from a novel toy had infants who express less distress compared to infants whose mothers' gazing behavior was not contingent (Crockenberg & Leerkes, 2004). This finding may lend insight to the null finding regarding associations between maternal gaze and infant dysregulation during the peekaboo task. It is possible some mothers who were contingent responders (i.e., gazers) and had less dysregulated infants, whereas other mothers were not contingent gazers and had more highly dysregulated infants. However, the measure used to assess gaze/joint attention in the current study does not explicitly capture contingency, so this nuanced relation could not be tested or detected.

Resilience and risk factors in gaze and dysregulation

In addition to considering the observational context, situating gaze and dysregulation in a context of resilience and risk contributed to understanding more nuanced relations among gaze and dysregulation for infants and mothers. Mexican cultural orientation and familism was initially thought to uniformly buffer dysregulation—with more adherence to cultural values and familism related to lower dysregulation—but the interaction between culture and task produced unexpected results. For example, the association that emerged regarding mother's endorsement of Mexican orientation and infant dysregulation during the peekaboo task was positive. One explanation is that Mexican mothers may not see themselves as proper play partners for their children (Farver, 1993) and may have less practice playing interactive games (i.e., peekaboo) with their infants. Mothers may be too intrusive, startling, or even scary if they are not familiar with the pacing of a typical peekaboo interaction or confident in their role as an active play partner, thereby increasing infant dysregulation. Another possibility is that peekaboo is not a culturally salient game that Mexican-origin and Mexican-American mothers typically play with their infants, and it is was the lack of familiarity with the task that was associated with infant dysregulation. Although there is evidence that hiding games, such as peekaboo, are universal among mothers and infants, they may be less common among cultures that endorse proximal parenting interactions (Fernald &

O'Neill, 1993). Proximal parenting practices emphasize body contact and stimulation (e.g., holding and rocking) rather than face-to-face (i.e., distal) interactions, and previous work has established that Hispanic mothers may engage in proximal parenting practices at a higher rate compared to European American mothers (Keller et al., 2009). It is possible that the Mexican American mothers in the current study sample were similarly more likely to prefer proximal to distal parenting practices and less experienced in playing hiding games, such as peekaboo, with their infants.

Another unexpected finding was that mothers who value familism, specifically the aspect of familism regarding family as referent, were also more likely to be dysregulated during the soothing task. Mothers who believe their children's behavior and actions are representative of the family may have developmentally inappropriate expectations, and they may become more upset when their infant behaves in ways they consider inappropriate or embarrassing to the family (e.g., crying inconsolably during a home visit with research assistants and staff present). Acevedo (2000) reported that Mexican American mothers reported more developmentally unrealistic expectations compared to their European American counterparts, and these differences were not fully explained by acculturation. Familism is likely be embedded in parenting practices, and these beliefs may persist as infants develop and have implications for children's later competencies (Stein et al., 2014). Taken together, maternal cultural orientation and adherence to familism may actually place mothers *and* infants at risk for dysregulation during certain interaction contexts. The meaning of maternal behaviors, therefore, cannot be fully understood without considering the contexts in which the behavior is occurring.

More complete, contextualized interpretations and understandings of maternal behavior can not only inform science but targeted prevention and early intervention.

With respect to risk factors, maternal depression only mattered for maternal dysregulation during the context of the teaching task and was nonsignificant for soothing and peekaboo. Depressed adults are more likely to be negative in speech quality and content, engage in aversive feedback-seeking behaviors, exhibit less eye contact, and are less likely to have animated facial expressions (Joiner & Timmons, 2002). The interpersonal qualities associated with depression may help explain why mothers with higher depressive symptoms present as more dysregulated, particularly during the teaching context. Of the three interaction tasks, the teaching task requires the most complex interpersonal social skills (i.e., scaffolding placing the block into the cup), which may have frustrated, stressed, or overwhelmed mothers. Another notable finding was the direct association between parenting stress and daily hassles and infant gazing behavior and dysregulation across teaching and peekaboo tasks. The Family Stress Model posits that parent distress impacts child developmental competencies through diminished quality of parenting (Conger, Rueter, & Conger, 2000). The preliminary findings from this study, however, suggest that parenting stress may also have a direct effect on infant regulatory competencies. Previous work has also established direct links between parenting stress and child behavior that cannot be explained by parent behavior (Crnic, Gaze, & Hoffman, 2005). The finding of associations among mother-level stressors and infant dysregulation provides further evidence to include infant behaviors when analyzing maternal behavior in interactional contexts to understand infant developmental outcomes.

Limitations

Despite its many strengths, this study was not without limitations. Due to wide ranges in confidence intervals for several *k* parameters, it was not possible to confidently describe all interactive patterns for infants and mothers in each of the tasks. Another limitation was that the dysregulation measure did not differentiate between mothers spacing out or prolonged overactivation. These distinct dysregulated responses could conceivably have received the same coded score but yielded vastly different implications for maternal gazing behavior and infant dysregulation. Gaze could be meaningfully but differentially related to both types of dysregulation, which may account for the null results in the longitudinal model and the teaching- and peekaboo-specific models. Likewise, underactivation (i.e., spacing out) may not facilitate development but is not overtly, whereas overactivation could be startling or even frightening to the infant (Jacobvitz, Leon, & Hazen, 2006), thereby increasing infant dysregulation. Similarly, the measure of gaze used in the current study did not distinguish between infant looking at the mother or a shared object of interaction, for example, which limits the ability to pinpoint the specific aspect of gazing behavior that is important for infants (e.g., looking at the object could also be a form of distraction).

Maternal gaze and infant gaze were not technically identical measures—developmentally appropriate, but different nonetheless. Measurement invariance is becoming a salient issue in dyadic interdependence research (Sakaluk, Kilshaw, Fisher, & Leshner, 2019). Measures for distinguishable dyads should be conceptually identical to determine to accurately compare actor and partner effects. Although the measures used in the current study were identical in name, gaze and dysregulation were necessarily coded differently for mothers and infants to account for the obvious discrepancy in infant age and developmental capability. It is challenging to identify and collect comparable or identical behavioral data for mothers and infants, but the use of latent variables to account for measurement invariance (Sakaluk et al., 2019) offers a useful solution for testing APIMs with mother-infant dyads.

A further limitation is that it was not possible to consistently control for dysregulation—in both the longitudinal and task-specific models—at the previous time point. The task preceding soothing was arm restraint, but dysregulation was only coded for infants, as the mothers were instructed during this task to lightly restrain their infants' arms while an experimenter presented the infant with a desirable object (e.g., a picture book). Because maternal dysregulation could not be controlled for at the previous time point during the soothing task, dysregulation at the previous time point was excluded as a covariate for all the task-specific models to be consistent across models.

Future directions and conclusions

The findings from the current study add to a growing body of literature that identifies and explicates infants' roles in their own development. There are several directions future work can pursue to continue this program of research. First, the use of more nuanced coding schemes (e.g., micro coding, time series analysis, state-space grids) of infant and maternal attention and gaze would go far to further unpack the complex relations among gaze and dysregulated responses within mother-infant interactions. Second, it is important to examine other behaviors that may be important for infant and maternal dysregulation, such as self-comforting and distraction. Identifying behaviors that can be examined for both mothers and infants can be challenging because to compare actor and partner effects, identical measures of infant and adult behaviors are needed. As previously discussed, parent-child observational measures are typically not identical because of developmental differences. Researchers should be thoughtful about how observational measures for infants can be more congruent to maternal measures of the same construct and identify new infant behaviors that can be reliably coded. Future work should also examine dyadic processes across different developmental periods. For example, infant visual behavior and attention rapidly matures during the first six months of life (Colombo 2001), and in turn dyadic attentional processes with mothers develop as well. These patterns may change even in the same interactive context as infants continue to develop (e.g., 9 versus 12 months).

Third, future work should examine the role of maternal and infant factors concurrently in a variety of contexts, including observational, socioeconomic, and cultural. When examining dyadic patterns of interaction in specific cultural groups, it is critically important to identify culturally salient interaction tasks. The findings from the current study provide preliminary evidence that the cultural orientation and attitudes of the mothers interacted with the observational context and linked to both maternal and infant dysregulation. Considering the intersection between parent culture and the observational context can also inform the behavior coding systems selected or specific behaviors to examine for a given interaction task. The findings from the current study are specific to the mother-infant interaction context, but there are other social contexts (e.g., infant-father, infant-sibling, infant-caregiver) in which infants can exert their own agency and impact the quality of those interactions. Infant behaviors should be considered when examining dyadic relationships in these social contexts as well.

Literature that speaks to how infants may actively contribute to their own regulatory development is still emerging. The current study provided evidence of the role infant gaze may play in understanding their own dysregulation and presented important considerations for the cultural and interactional context in which dyadic patterns of gaze and dysregulation were examined. The findings from the current study address a current limitation in the field of child development that undervalues infant's role in their own development. Infant attention is a potentially modifiable behavior to target in prevention and early intervention in conjunction to addressing parent behavior. Results from the current study suggest dyadic effects on infant dysregulation, and both mother and infant should be considered when working towards promoting optimal regulatory development.

Study #2: Profiles of Maternal Sensitivity and Infant Stress Physiology

Stress is an adaptive and important aspect of our daily functioning. It motivates us to engage with our environment, pursue our goals, and alerts us to potential danger in our environment to keep us safe. The ability to adaptively respond to stressful situations is critical for human survival. When responses to stress become dysregulated, functioning can become impaired. Dysregulation of the stress response system has been implicated in physical health, such as immune system functioning (Dhabar & McEwen, 1997; Kirschbaum & Hellhammer, 1989; 1994), and risk for psychopathology, including depression (Bhagwagar, Hafizi, & Cowen, 2003, 2005; Dougherty, Klein, Olino, Dyson, & Rose, 2009; Gunnar & Vazquez, 2001; Vreeburg et al., 2009), anxiety (Steudte et al., 2011a), and post-traumatic stress disorders (Steudte et al., 2011b; Luo et al., 2012). The study of stress is complex and involves the integration and coordination of multiple systems that fall into four distinct domains: physiology, behavior, subjective experience, and cognitive function (Steptoe, 2000). Behavioral and physiological domains of stress are emphasized in infancy research, in part due to the inherent challenges associated with assessing the subjective experience and cognitive processing of stress in infants. One marker of stress reactivity that has received attention in recent years is cortisol, a stress hormone associated with the hypothalamic-pituitary-adrenal (HPA) axis. Prior research strongly suggests that formation and functioning of the stress response system begins prenatally and is susceptible to influences from the postnatal environment, particularly early caregiving (see Gunnar & Quevedo, 2007 for review). The opportunities to study stress-related processes involving the HPA axis have significantly expanded in recent years due to the advent of noninvasive (i.e., salivary) collection methods for cortisol

(Hostinar & Gunnar, 2013), and indeed the past 20 years have seen an influx of studies connecting early caregiving to infant stress physiology (Atkinson et al., 2013; Blair et al., 2006; Blair et al., 2008; Brummelte et al., 2011; Feldman, Singer, & Zagoory, 2010; Grant et al., 2009; Spangler, Schieche, Ilg, Maier, & Ackermann, 1994; Van Bakel & Riksen-Walraven, 2008). Much remains to be learned, however, regarding the role of early caregiving and infant stress physiology. The proposed study aims to offer a deeper understanding of early caregiving behaviors in relation to later infant stress functioning.

The role of early caregiving in the developing HPA axis

There is a significant body of literature exploring the role of early caregiving environments on the development of stress processes in animal models, particularly in rodents and non-human primates. Maternal care has consistently been shown to attenuate rat pup responses to stress, effectively "programming" the HPA axis (Liu et al., 1997; Meaney & Szyf, 2005). Researchers find that daily handling (i.e., short-term, daily separations from rat dams) of rat pups is associated with reduced adult rat cortisol responses to stressors (Bhatnagar & Meaney, 1995; Levine, 1957; Liu, Caldji, Sharma, Plotsky, & Meaney, 2000; Meaney, Aitken, Viau, Sharma, & Sarrieau, 1989). Rat dams are also more likely to engage in grooming and licking behaviors following a brief separation with their pups, which may account for this buffering effect and result in a more adaptive adult animal (Levine, 2005). The animal literature, however, does not directly translate to explain processes of social regulation of the developing HPA axis in human infants. For example, there is no direct human equivalent of the stress hyporesponsive period (SHRP) in rat pups, or the period of approximately three weeks postpartum where corticosterone (the rodent equivalent of cortisol) is suppressed (Loman

& Gunnar, 2010). Hostinar and Gunnar (2013) have proposed that the attachment relationship may serve to suppress the HPA axis from approximately three months of age into the toddler years, but the exact initiation and duration of this buffering effect has not been verified. Furthermore, many animal studies use extreme stress conditions (e.g., peer-raising, prolonged maternal separation) to study associations between maternal caregiving behavior and infant stress physiology. According to Levine (2005), the lack or loss of parental caregiving is the most stressful situation an infant can experience. Whereas there is some information on stress functioning in infants being raised in contexts of extreme deprivation, such as Romanian orphanages (Dienstbier, 1989; Gunnar & Vasquez, 2001), many experimental caregiving conditions from animal models do not directly translate to human caregiving situations. In part due to ethical considerations, human models have focused more on normative variations in maternal caregiving quality and mild to moderate stressors (Loman & Gunnar, 2010). However, it is important to note that even normative variations in parenting quality can produce long-term effects on child development.

Maternal sensitivity and infant stress physiology

There are limitations in using animal models to inform models of development in humans, and the bridge between animal models is often more theoretical than empirical (Bremner & Vermetten, 2001). Furthermore, human-child interactions and relationships are more complex, and it is difficult to identify human caregiving behaviors that best approximate animal caregiving behaviors that are critical to external regulation of the HPA axis. The current literature connecting maternal behavior to infant stress physiology has emphasized the role of maternal sensitivity, as sensitive and responsive caregiving serves as a best approximation for grooming and licking behaviors in rats (Loman & Gunnar, 2010). This line of research, however, is emerging and findings are mixed. With respect to cortisol reactivity (i.e., a marked increase in cortisol levels pre- to post-stressor), few studies reported a significant association between maternal sensitivity and infant cortisol reactivity, such that higher maternal sensitivity was associated with elevations in infant cortisol (Atkinson et al., 2013; Blair et al., 2006; Blair et al., 2008; Van Bakel & Riksen-Walraven, 2008). Others find that maternal sensitivity is associated with smaller increases in cortisol levels (Blair et al., 2008; Brummelte et al., 2011; Grant et al., 2009; Feldman, Singer, & Zagoory, 2010; Spangler et al., 1994). Far more studies find no relation between maternal sensitivity and infant cortisol reactivity (Albers, Riksen-Walraven, Sweep, & De Weerth, 2008; Haley & Stansbury, 2003; Lewis & Ramsay, 1999; Thompson & Trevathan, 2008; Thompson & Trevathan, 2009). Relative to studies examining the role of maternal sensitivity and cortisol reactivity, far fewer researchers examine the role of maternal behavior in infant cortisol regulation, reflecting the infant's ability to recover from the cortisol response. Several researchers find that more sensitive maternal behavior is associated with better recovery (i.e., a steeper decrease in cortisol; Albers et al., 2008; Blair et al., 2006), wheras others find no direct association (e.g., Grant et al., 2009). It is surprising, given that stress reactivity is often conceptualized as having a strong temperamental component (Huizink, De Medina, Mulder, Visser, & Buitelaar, 2002), that the role of caregiving behavior in an infant's capacity to *regulate* a stress response has been largely unexamined.

The role of risk in understanding maternal sensitivity and infant cortisol

There is a substantial literature that supports the important role of understanding parenting from a context of various socioeconomic factors and poverty-related risk (Conger & Elder, 1994; Conger et al., 2002; Hoff, Laursen, & Tardif, 2002; National Institute of Child Health and Human Development Early Child Care Research Network [NICHD ECCRN], 2005). Living in chronic poverty has been associated with lower quality caregiving environments (NICHD ECCRN, 2005) and chronic exposure to physical and psychosocial stressors, such as crowded household and community violence (Evans & English, 2002). There is also evidence that being raised in the context of poverty-related risk—such as crowded household, household chaos, or intimate partner violence—can alter biological profiles of children across time (Lupien, King, Meaney, & McEwen, 2000; Evan, 2003; Chen, Cohen, & Miller, 2010). The effects of poverty-related risk have been shown to extend through infancy and into early childhood, with low income-to-needs predicting a flattened cortisol response to a mild stressor and household chaos related to higher baseline cortisol levels in 48-month-olds (Blair et al., 2013). Evidence from these studies highlights the importance of discriminating between which environmental stressors have the greatest overall impact on both basal cortisol levels and stress responding and recovery. Considering chronicity of the stressor (Blair et al., 2013), as well as severity and developmental timing, may contribute to understanding individual differences in how infants respond to stress.

Boyce and Ellis' (2005) biological-sensitivity-to-context thesis provides a theoretical framework for understanding why some infants' stress responding may be more affected by maternal caregiving than others. They argue that the relation between physiological stress reactivity and the supportiveness of the developmental context is curvilinear, such that it is adaptive for reactivity to be highest in both extremely low and high supportive contexts. To explain, it is adaptive for children being raised in highly supportive environments to be maximally influenced by the environment, whereas children being raised in unsupportive, or even dangerous, environments can adapt by developing heightened vigilance. Assessing the level of risk in a study sample to contextualize infant cortisol responses to stressor paradigms may be critical for unpacking mixed findings in the current literature connecting maternal sensitivity to infant cortisol reactivity.

Methodological considerations in assessing cortisol reactivity

Considering that cortisol reactivity may sensitive to context, the differences in sociodemographics of the samples and stressor paradigms used in the reviewed studies connecting maternal sensitivity to cortisol reactivity likely play a role in explaining differences in findings. To illustrate, Thompson and Trevathan (2009) reported no association between maternal sensitivity and infant cortisol reactivity at six months in their sample, whereas connections among maternal sensitivity and infant cortisol reactivity emerged in other studies of infants of the same age. Blair and colleagues (2006) reported that maternal sensitivity was associated with lower levels of cortisol and greater cortisol reactivity and regulation when infants were six months. There are a number of differences between the two studies that could explain this discrepancy in findings, including statistical power to detect an effect, the type of stressor task employed, and sample characteristics. Thompson and Trevathan (2009) reported a sample size of 94 mother-infant dyads, while Blair et al. (2006) drew from a sample of 1,292 families. The two studies also differed in the stressor task used as a context for cortisol sampling: Thompson and Trevathan (2009) used novelty tasks, whereas Blair and colleagues (2006) employed a series of tasks designed to elicit frustration or anger from the infant. In their review, Jansen, Beijers, Risksen-Walraven, and De Weerth (2010) discuss the difficulty of eliciting a cortisol response from infants during psychological stressor tasks and effect sizes tend to be small (i.e., novelty task mean $d = -.15$; frustration task mean $d = .13$). Taken together, it is possible that Thompson and Trevathan (2009) did not have enough statistical power to detect a small effect in their sample. Finally, Blair and colleagues (2006) used data from the Family Life Project (FLP), with participants recruited from the rural South and northern Appalachia and oversampled for low-income and African-American families (Burchinal, Vernon-Feagans, Cox, & the FLP Investigators, 2008). This is a very specific, unique sample, and findings from studies published using these data should be carefully considered within the context of sociodemographic risk. Thompson and Trevathan (2009), on the other hand, did not provide adequate sample information, and so it is difficult to connect the study's findings with others in any type of sociodemographic context. It is critical to examine a variety of stressor paradigms, including tasks designed to elicit mild frustration responses, in multiple contexts of risk to gain a fuller understanding of how stress physiology operates across time and context.

Approaches to examining maternal sensitivity and infant stress physiology

Maternal sensitivity is most often operationalized as an aggregate (e.g., mean, latent factor) of different parenting behaviors that have consistently been found to underlie sensitivity rather than direct measures of specific behaviors. There is evidence, however, that supports the notion that specific behaviors, such as touch or vocalizations, may differentiate patterns of infant stress responding over and above the aggregate measure of maternal sensitivity. For example, Lewis and Ramsay (1999) did not find maternal soothing to be effective in attenuating infant stress response to inoculation at six months. However, the authors reported that maternal soothing was operationalized using a global, 4-point Likert scale (i.e., none, low, moderate, high) that did not measure specific soothing behaviors. Jahromi, Putnam, and Stifter (2004), on the other hand, did find an association between maternal soothing—which was characterized by specific maternal soothing behaviors (i.e., maternal holding/rocking and vocalizing)—and reduced infant behavioral reactivity at infant age six months. They noted that the co-occurrence of multiple maternal soothing behaviors was more effective in reducing infant distress than any one soothing behavior alone (e.g., only vocalizing). Similar findings are presented in Haley and Stansbury's (2003) study that examined one specific parenting behavior (i.e., vocalizations or expressions) as a measure of sensitivity. The authors reported that they did not find associations between maternal responsiveness and infant cortisol reactivity and discussed the possibility that their measurement of maternal behavior may have been too narrow. Studies such as Haley and Stansbury's are important in clarifying which maternal behaviors are most impactful on the developing HPA axis and which are less important. There is a need, however, to examine multiple parenting behaviors simultaneously to gain an understanding of which specific behaviors (or combinations of behaviors) uniquely explain discrepant findings the past studies examining the role of maternal sensitivity in infant stress physiology.

The current approach to exploring relations among maternal sensitivity and infant stress dysregulation demonstrates a clear preference for variable-centered analyses. This approach is limiting in that variable-centered approaches cannot account for intra-individual differences in maternal sensitivity. Studies that do employ a person-centered approach typically focus on trajectories of maternal sensitivity (e.g., Hirsh-Pasek & Burchinal, 2006), rather than profiles of the specific behaviors that constitute sensitivity. This type of analysis can only provide information about mean-level changes in sensitivity across time, rather than mean differences in specific behaviors associated with sensitivity between people. It is possible that mothers are not sensitive in the same way, differing on individual behaviors but appearing similar overall in mean levels of sensitivity. To illustrate with a hypothetical example, consider two mothers who are measured on two behaviors associated with sensitivity on a 5-point scale (1 = *not present*; 5 = *frequent occurrence*): affectionate touch and vocalization. One mother receives a score of 2 for touch and 5 for vocalizations, while the second mother is assessed at 4 for touch and 3 for vocalizations. If sensitivity were operationalized by averaging scores on specific behaviors, however, both mothers would receive a mean score of 3.5, even though they differ in their scores on the individual behaviors. These variations in sensitivity likely have meaningful implications for infant stress dysregulation (e.g., mothers who frequently touch their infant may be more likely to reduce dysregulation during a stressful task than a mother who does not touch her infant often).

The present study

It is possible that the inconsistent findings in the literature connecting maternal sensitivity to infant stress physiology may, in part, be attributable to issues with measurement and operationalization of maternal sensitivity. The first goal of the proposed study is to offer a more nuanced understanding of different parenting behaviors that underlie maternal sensitivity. To accomplish this goal, latent profile analysis (LPA) will be used to determine whether distinct patterns characterized by different combinations of sensitive parenting behaviors. The second goal of the proposed study is to explore connections between the maternal sensitivity profiles found and infant cortisol reactivity and recovery in response to mildly frustrating tasks at 12 months. The aims of the proposed study will be addressed using a sample of at-risk, Mexican-American mothers and their infants. Specifically, the proposed study will address the following research questions:

Research question 1: Are there different patterns of sensitive maternal behaviors? The first research question examines whether a person-oriented approach will identify coherent patterns of maternal behavior that underlie the construct of maternal sensitivity. Although no specific predictions are made about the expected number of profiles, it is anticipated that unique patterns of maternal behaviors will emerge.

Research question 2: Do these patterns of maternal sensitivity differentially and longitudinally predict infant cortisol reactivity and recovery? The second research question explores whether the sensitivity profiles that emerge will be connected to infant stress physiology later in development. For example, touch may be a crucial behavior to consider when connecting maternal sensitivity to infant stress functioning, as synchronous touch functions as an external regulator and attenuates HPA reactivity during infancy (Feldman et al., 2010). Specifically, based on findings from previous studies (e.g., Haley & Stansbury, 2003) it is expected that profiles characterized by regulating behaviors (e.g., touch, gaze) at six months will be associated with greater recovery at 12 months. Hypotheses concerning the relation between sensitivity profiles and infant cortisol reactivity, however, are more complicated. Previous research has connected global measures of maternal sensitivity to greater cortisol reactivity (Blair et al., 2006), a smaller increase in cortisol (Spangler et al., 1994), and no relation (Lewis & Ramsay, 1999; Thompson & Trevathan, 2009). Based on the at-risk nature and mildly frustrating stressor paradigms used in Blair and colleagues' (2006) study, it is predicted that profiles characterized by broader sensitivity indicators, such as acknowledging and supportive presence, will be related to lower baseline cortisol levels and increased cortisol reactivity.

Methods

The proposed study will use existing data from the *Las Madres Nuevas* (LMN) Project, a longitudinal investigation of post-partum depression and coregulation in at-risk, Mexican-American mothers and infants.

Participants

The full sample includes 322 Mexican-American mothers and their children (53.7% female). The majority of mothers (86.1%) were born in Mexico, 54.1% of whom came to the U.S. before age 17; 85.7% reported an annual household income of $25,000 or less, 83.6% are unemployed, 59.1% did not complete high school, and only 30.0% are married. This is a low-income, low-resource sample and is therefore ideal to address the aims of the research proposal.

Procedure

In the parent LMN study, pregnant Mexican American women were recruited from prenatal care clinics in the Phoenix metro area. Initial eligibility criteria included fluency in either Spanish or English, self-identification as Mexican American, and being in less than the 34th week of pregnancy. Of women who were approached, 56% agreed to schedule a prenatal home visit, during which informed consent was obtained. To minimize participant burden, the study followed a "planned missingness" design (Little & Rhemtulla, 2013) for the home visits in which all participants were assigned to the 6-week visit, but two-thirds of the sample were then assigned to the 3-, 4.5-, and 6-month home visits. Each participant "missed" one of the three planned missing data collection periods. As part of the larger study, a home visit was completed at six months, during which mothers were video recorded interacting with their infants during five structured tasks. Then, at 12 months, mothers and their infants traveled to the university campus to complete a lab visit, during which mothers and infants were video recorded participating in structured tasks and physiological data were collected. Participants were compensated monetarily for data collection at each time point. The Institutional Review Board (IRB) at the recipient institution approved all study procedures.

Mother-infant interaction tasks. As part of a larger, longitudinal study, a home visit was completed when infants were six months old. During the home visits, research assistants traveled to participants' homes to video record mothers interacting with their infants during a series of structured tasks. The *free play* task (5 minutes) served as a "warm up" context in which the mother was provided a small basket of toys and objects and asked simply to play with her infant as she usually would when alone. During the a*rm restraint* task (2 minutes), mothers were asked to stand behind their infants and gently hold their arms by their sides while the experimenter held a book in front to the infant. This task is intended to elicit mild frustration in the infant. The arm restraint task provided the context for the subsequent *soothing* task (3 minutes), during which mothers were asked to comfort the infant as they normally would. No explicit instructions were provided to mothers about how to accomplish this goal (Calkins, Hungerford, & Dedmon, 2004). In the *teaching* task (5 minutes), mothers were provided with a set of objects and asked to "teach" their child a particular skill. Skills were selected from the Bayley Scales of Infant Development-III (BSID-III; Bayley, 2005) and reflected skills one to two months beyond the infant's capabilities, creating a context for mother and infant to experience mild frustration. Finally, during the pe*ek-a-boo* task (3 minutes), mothers were instructed to use an object (e.g., book or blanket) to play "peek-a-boo" with their infant.

During the 12-month lab visit, tasks varied somewhat to account for infant development across the measurement periods. Mothers and their infants first participated in an unstructured *free play* task (5 minutes) followed by a *clean-up* task (up to 5 minutes). Next, mothers blew *bubbles* for their infant to pop (3 minutes). Finally, mothers were instructed in four separate *teaching* tasks (4 minutes each) to elicit mild frustration in the infant and mother (e.g., have the infant make a block tower).

Saliva collection. The interaction tasks provided context for salivary cortisol sampling. During the 12-, 18- and 24-week home visits, infant saliva was collected at four time points: baseline (before the interaction tasks); 0 minutes post-task (immediately following the peek-a-boo task): 20 minutes post-task, and 40 minutes post-task. Because there is a delay in the infant stress response and the expression of cortisol in saliva, the baseline sample represents the child's cortisol levels before the interaction tasks began, the 20 minutes post-task sample represents the child's physiological stress response to the tasks, and the 40 minutes post-task sample represents the infant's ability to recover from a stressful experience. Passive drool was collected non-invasively by placing a cotton roll in the infant's mouth for two minutes per collection. Saliva samples were frozen and mailed to Salimetrics where they were assayed for cortisol. All relevant saliva samples have been assayed for cortisol.

Measures

Maternal sensitivity indicators. The teaching tasks from the six-month home visit was coded using the Coding Interactive Behavior (CIB) manual (Feldman, 1998). The CIB is a global rating system for parent-child interactions that has demonstrated validity in various social and cultural contexts (Feldman & Masalha, 2007). Undergraduate research assistants rated mother-infant interactions on ten indicators of maternal sensitivity (i.e., acknowledging, imitating, elaborating, gaze, positive affect, vocal appropriateness, supportive presence, appropriate range of affect, consistency of style, resourcefulness, enthusiasm, and affectionate touch).

Acknowledging. This scale is associated with the highest loading on maternal sensitivity. Behaviors associated acknowledging include vocalizations, gaze, facial expressions, and body movements that indicate that the mother is aware and receptive of the child's cues. For example, the infant yawns and the mother says, "Are you tired?" Scores for this scale are contingent on infant social signals and always refers to infant-leads-parent-responds interactions. Acknowledging is assessed on a 5-point Likert scale (1 = *mother does not show any awareness or response to the infant's cues*; 3 = *some of the infant's cues are recognized while others may be overlooked*; 5 = *mother is consistently responsive to the infant's cues*).

Imitating. Maternal imitation included instances where the mother imitates the infant's behavior, facial expressions, body movements, or vocalizations. Imitation is coded using a 5-point Likert scale (1 = *minimal or no imitation is observed*; 3 = *medium level of imitation is observed or imitation is part of a give-and-take interaction but is not very frequent or consistent*; 5 = *parent imitates the infant's actions frequently and consistently throughout the interaction*). It is important to note that optimal levels of imitation are considered a 3 or less.

Elaborating. Mothers expand and elaborate their imitated behaviors or expressions by adding variations and increasing the complexity of the infant's social signal. For example, the infant may vocalize "ba," and the mother responds with "ba ba ba" in an excited voice, adding "you are really telling me how much you like this game." Elaborating is coded using a 5-point Likert scale (1 = mother does not share or expand the infant's affect, actions, or symbolic output; 3 = mother may acknowledge the infant's cues but provides little elaboration, although few instances of expansion show that this type of behavior is within the mother's repertoire; 5 = mother elaborates the infant's actions or signals frequently, raising the infant's level of interest in the joint activity).

Gaze. Maternal gaze was defined as any instance where the mother focuses her gaze/attention on the infant or on an object of joint activity and was rated using a 5-point Likert scale (1 = *mother gaze is rarely focused on the infant or object of joint attention*; 3 = *mother focuses on the child for half of the observation*; 5 = *mother gaze is consistently focused on the infant/object*).

Positive affect. Expressions of positive affect are characterized by warmth and emotional openness during the interaction. Maternal positive affect is expressed by relaxed body posture, warm tone of voice, frequent smiling or laughter, and happy facial expressions. Positive affect was rated using a 5-point Likert scale (1 = *very little or no parental warmth and positive affect is expressed throughout the interaction*; 3 = *warm and positive affect is expressed occasionally but not consistently*; 5 = *parent is consistently positive and warm to the child*). Note that mothers who were consistently warm and positive throughout the task, but not overly positive, could still earn a score of 5.

Vocal appropriateness. Mother's use of appropriate tone of voice and level of repetition was assessed based on the infant's developmental ability. For infants up to six months of age, vocal appropriateness is defined by "motherese". Vocal appropriateness was rated using a 5-point Likert scale that accounted for both the quality and quantity of vocalizations (1 = *mother's voice is rough, abrupt, monotonous, or flat; or mother does not speak to infant*; 3 = *mother's voice is relatively warm and variable but is often un-adapted to the child's developmental level or behavior state*; 5 = *maternal vocalization is warm, appropriate, and adapted to the infant's age*).

Appropriate range of affect. Mothers were assessed as to whether they expressed a full range of emotional behaviors and flexibly shift affective states in accordance with the infant's activity and emotional state. During infancy, it is important to consider whether the mother's affect is predictable and comfortable vs. shocking, unnatural, or uncomfortable. Appropriate range of affect was assessed using a 5-point Likert scale (1 = *no modulations are observed in the mother's affective intensity, and the range of affect is limited and unsynchronized with modulations in the infant's state*; 3 = *modulations in the mother's affect are observed but are not frequent and the use of affective range is not* *typical*; 5 = *mother expresses a wide range of affect and appropriate levels of arousal in response to the infant's social signals*). Certain interactions call for a wider range of parental affect than others (e.g., when the infant cries before resuming play), and mothers are not penalized for not using a range of affect if not appropriate to the situation.

Consistency of style. Mothers who are consistent during interactions with the infant, and their movement, behavior, and expression appear predictable to the infant. No abrupt changes are observed in the mother's level of attention or involvement during the interaction. Consistency of style is rated using a 5-point Likert scale (1 = *low consistency, with frequent and abrupt changes of interaction style*; 3 = *medium consistency, with several changes of style and level of interest amid a consistent parenting style*; 5 = *parent style is consistent and predictable throughout the interaction*).

Resourcefulness. Mothers who are resourceful are flexible and creative in managing changes in their infant's affect, behavior, fussiness, or level of interest. They are also able to maintain their infant's interest in creative and flexible ways. Resourcefulness is scored on a 5-point Likert scale (1 = mother exhibits limited skills in maintaining or elaborating infant's attention; 3 = mother shows resourcefulness at some moments but not others; 5 = mother is creative, resourceful, and flexible in managing changes in infant's affect, behavior, distress, and interest.

Affectionate touch. Maternal affectionate touch refers to the mother touching her infant affectionately, often, and spontaneously. Examples of affectionate touch include kissing, hugging, and caressing. Affectionate touch is distinct from instrumental touch (e.g., dressing, feeding, diaper changing), physical manipulation (e.g., playing with the infant's fingers), or unintentional touch (e.g., accidentally brushing against the infant).

Affectionate touch is rated using a 5-point Likert scale that accounted for both the quality and quantity of touching as well as the mother's proximity to the infant (1 = *mother and infant are not in close proximity, and no non-instrumental touch is observed*; 3 = *mother touches infant occasionally but not frequently*; 5 = *mother and infant remain in close proximity and parent touches the infant often with overt affection and warmth*).

Enthusiasm. Mothers demonstrate genuine enthusiasm during the interaction when they are involved, display positive affect, and demonstrate clear signs that they enjoy interacting with their infant. This construct is distinct from positive affect in that it captures the mother's *own* enjoyment during the interaction apart from expressing positive affect towards the infant. Enthusiasm was rated on a 5-point Likert scale (1 = *no enthusiasm or pleasure in the interaction*; 3 = *medium; enthusiasm is occasional*; 5 = *mother is enthusiastic, involved, and exhibits clear pleasure in interacting with infant*).

Supportive presence. This summary scale addresses the degree to which the mother's presence provides a "secure base" for the infant with respect to warmth, closeness, and mutuality (Bowlby, 1988). The infant's behavior can be considered in this scale (e.g., infant referencing behavior). Maternal responses must be appropriate, receptive, and provide an external regulatory structure for the infant's activities and emotions. Supportive presence may be observed in maternal affect, verbalizations, touch, gaze, or physical proximity (e.g., holding the infant in the mother's arms). This scale is rated using a 5-point Likert scale (1 = *the mother's presence does not provide a "secure base" and may even increase the infant's distress, or the infant may be disorganized or uninvolved*; 3 = *there are indications that the mother's presence may serves a "secure base" function, but this is not consistently observed*; 5 = *mother's presence provides an* *overall framework for the infant that regulates the infant's state, affect, interest, learning, and emerging social skills*).

Cortisol reactivity and recovery. Previous studies have established that cortisol reactivity and recovery are independent constructs (Ramsay & Lewis, 2003), and both are needed to accurately assess the infant stress response. Residualized change scores were calculated to operationalize cortisol reactivity and recovery. Residualized change refers to fact that an outcome Y_t is regressed on itself at a previous time point Y_{t-1} such that the remaining variability in the outcome Y_t that is variability unexplained by Y_{t-1}, which can be understood as variability due to change (Castro-Schilo & Grimm, 2018). Operationalizing change using residualized scores compared to difference scores offers a significant advantage in that it can account for infant's baseline levels of cortisol and other covariates. Specifically, residualized change scores can be interpreted as the amount of increase or decrease in a variable that is *independent* of baseline cortisol levels and selected covariates. To calculate the residualized change scores, infant's individual peak scores were first selected by identifying whether the infant's raw cortisol value at 0 or 20 minutes post task was higher. Next the residualized score for cortisol reactivity was calculated by regressing the peak cortisol score on the infant's baseline score, controlling for a number of covariates (see next section). The residualized change score for cortisol recovery was calculated by regressing the infant's cortisol value at 40 minutes post-task on their peak value, controlling for baseline cortisol and covariates. The residualized scores for cortisol reactivity and recovery were saved as new variables.

Risk. Three indices of risk were assessed at 4.5 months to aid in validating the profiles: daily hassles, perceived stress, and maternal depression. The Parenting Daily

Hassles (PDH) Scale (Crnic & Greenberg, 1990) was used to assess daily stresses specific to parenting. The PDH comprises 20 items, with each item rated using 5-point Likert scales regarding *how often* this has occurred during the past month (1 = *none of the time*; 5 = *an extreme amount of time*) and *how much* this has been a hassle or annoyance (1 = *this is not a hassle for me at all*; 3 = *this is somewhat of a hassle*; 5 = *this is a big hassle*). Internal consistency for the PDH was excellent for *how often* (α = .91) and *how much* (α = .94). The Perceived Stress Scale (PSS) was used to measure the degree of stress mothers perceived in their lives (Cohen, Kamarck, & Mermelstein, 1983). The PSS has four items, each rated on a 5-point Likert scale (0 = *Never*; 1 = *Almost never*; 2 = *Sometimes*; 3 = *Fairly often*; 4 = *Very often*). Internal consistency for this measure was good (α = .70). The Edinburgh Postnatal Depression Scale (EPDS) was used to assess maternal symptoms of depression and anxiety (Cox, Holden, & Sagovsky, 1987). This 10-item scale was rated using a 4-point Likert scale (0 = *as much as you always do*; 3 = *not at all*). Internal consistency was very good (α = .84).

Covariates. During the prenatal home visit, mothers reported their age, the number of years they had been living in the U.S., and their level of education. Time of saliva sample collection, time since last meal, and time since last nap were collected at the beginning of the lab visit at 12 months.

Analytic Plan

Preliminary analyses

Prior to the primary analyses, descriptive statistics and correlations among all study variables were examined using SPSS version 25. It should be noted that correlated indicators are not a prerequisite for LPA (Muthén, 2007).

Primary analyses

Figure 5 depicts the latent class model of maternal sensitivity to be estimated using Mplus version 8.2 (Muthén & Muthén, 1998-2017) and includes the distal outcome (i.e., cortisol activity) predicted from the latent class variable.

Profiles of maternal sensitivity. To address the first research question (i.e., to explore whether there are distinct patterns of maternal sensitive behaviors), LPA was used to identify the number of latent profiles that best represent the data. LPA is a finite mixture modeling technique in which observed, continuous indicators are predicted by a single latent class variable (Masyn, 2013). Specifically, indicators of maternal sensitivity (i.e., acknowledging, imitating, elaborating, gaze, positive affect, vocal appropriateness, appropriate range of affect, consistency of style, resourcefulness, affectionate touch, enthusiasm, and supportive presence) will be predicted by the latent class. Missing data was treated as missing at random, and robust maximum likelihood estimation was used to account for missing data (Masyn, 2016).

Consistent with best practices (Masyn, 2013; Nylund, Asparouhov, & Muthén, 2007), the number of latent classes was determined by a number of indices and criteria. For example, relative fit (i.e., comparisons of one model to a model with fewer classes) was assessed using several fit indices, including Bayesian information criterion (BIC; Nylund et al., 2007), Lo Mendell Rubin Likelihood Ratio Test (LMR-LRT; Lo, Mendell, & Rubin, 2001), and parametric bootstrap likelihood ratio test (PBLRT; McLachlan & Peel, 2000). A lower BIC suggests better fit than latent class models with fewer classes (Nylund et al., 2007). With respect to LMR-LRT and PBRLT, a significant *p*-value indicates that the given latent class model has a significantly better fit than one with fewer classes (Nylund et al., 2007). Additionally, entropy (i.e., a measure of classification specification) was also considered during model selection. Entropy, which values range between 0 and 1, describes the extent of separation between classes (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993), with higher values indicating better separation between latent classes and values greater than .8 suggesting more distinct classes (Masyn, 2013). Currently, there is not a widely accepted index of absolute fit for latent profile models.

Connecting sensitivity profiles to infant stress physiology. To explore the utility of the maternal sensitivity profiles, the latent classes identified in the LPA were connected to a distal outcome using the BCH method (Asparouhov & Muthén, 2014). In simulation studies, the BCH method has been found to outperform traditional, 3-step methods of estimating the means of a distal outcome across latent classes (e.g., the DU3STEP and DE3STEP commands in Mplus; Bakk & Vermunt, 2015). Significance of mean differences in cortisol activity was estimated using a chi-square difference test.

Results

Descriptive statistics and preliminary analyses

Table 2 presents descriptive statistics for and bivariate correlations among all study variables. The majority of sensitivity indicators were within conventional benchmarks for skew and kurtosis (upper and lower bounds of 2 and 7, respectively; Chou & Bentler, 1995; Curran, West, & Finch, 1996), with the exception of imitating and elaboration. Both were positively skewed and leptokurtic. Beyond issues of nonnormality, imitating and elaborating exhibited a restricted range (1-2.5 and 1-2.88, respectively). Indicators that demonstrate low variability are not ideal for latent profile analysis because they do not provide enough information about individual differences to inform the formation of the profiles (Masyn, 2013). Imitating and elaborating are also part of an interaction pattern called the "acknowledging-imitating-elaborating chain" (Feldman, 1998, p. 5). These three behaviors are typically correlated. In the study sample, acknowledging demonstrated small to moderate, positive correlations with imitating (r[199] = .16, p = .03) and elaborating (r[199] = .19, p = .007). Therefore, imitation and elaboration were not included in subsequent analyses, and only acknowledging was retained for the latent class analysis.

Many of the sensitivity indicators were highly and significantly correlated (i.e., $r > .70$), raising concerns of multicollinearity. Enthusiasm was highly and positively correlated with positive affect (r[199] = .91, $p < .001$) and appropriate range of affect (r[199] = .79, $p < .001$). Appropriate range of affect and positive affect were also highly correlated (r[199] = .74, $p < .001$). Supportive presence was highly correlated with acknowledging (r[199] = .73, $p < .001$), appropriate range of affect (r[199] = .85, $p < .001$), resourcefulness (r[199] = .83, $p < .001$), and enthusiasm (r[199] = .74, $p < .001$). This is not unexpected, as the observational coding system includes maternal affect and verbalizations in the definition of supportive presence. Multicollinearity among indicators can create residual covariances, which may cause the BIC to suggest more latent classes than are appropriate (Muthén, 2013). Based on the results of the bivariate correlations, positive affect, enthusiasm, and supportive presence were not included in the latent profile analyses.

Cortisol sample means were examined for outliers (defined as more than three standard deviations above or below the mean). Five participants were identified as outliers, and their cortisol data was recoded as missing to be excluded from subsequent analyses. Cortisol samples at baseline, 0 minutes post-task, 20 minutes post-task, and 40 minutes post-task were all significantly and positively correlated. The correlation between baseline cortisol and cortisol reactivity (*r*[173] = 0, *p* = 1.00) and recovery (*r*[105] = 0, *p* = 1.00), respectively, is zero because the variability attributed to baseline cortisol was removed when calculating the residualized scores. Notably, the correlation between cortisol reactivity and recovery was also zero, *r*(105) = 0, *p* = 1.00. Cortisol reactivity and recovery were positively and significantly correlated ($r > .49$ with all other cortisol samples at 0, 20, and 40 minutes post-task with the exception of cortisol recovery and cortisol levels at 0 minutes post-task, *r*(100) = -.13, *p* = .20; see Table 2). During the 12-month lab visit, the majority of mothers reported that they had fed their infants within the last hour (31.6%), and the rest reported feeding their infants 1-2 hours ago (15.0%), 2-3 hours ago (25.7%), 3-4 hours ago (14.6%), and more than four hours ago (13.1%). Mothers also reported when their infants last slept, which ranged from 18 minutes to 12.92 hours (*M* = 4.22 hours; *SD* = 2.10 hours). None of these covariates were significantly correlated with the cortisol variables. Only one out of 72 total bivariate correlations among individual sensitivity indicators and cortisol measures emerged as significant: imitating was negatively correlated with cortisol 40-minutes post-task, *r*(76) = -.24, *p* = .04. Bivariate correlations among distal outcomes and latent class indicators are not a prerequisite for comparing means of distal outcomes among profiles, however, as the current study examines the combined contribution of maternal sensitivity indicators to cortisol reactivity and recovery, rather than the individual contribution of the indicators to reactivity and recovery.

Maternal sensitivity profiles

Based on descriptive and correlation analyses, latent classes predicted seven maternal sensitivity indicators: acknowledging, gaze, vocal appropriateness, appropriate range of affect, consistency of style, resourcefulness, and affectionate touch. A total of seven latent class models were estimated, beginning with a two-class model and increasing the number of classes with each subsequent model. Model estimation ended when the BIC increased from the seven- to eight-class solution, which informed the decision to stop estimating additional class solutions. The AIC, BIC, and SABIC all decreased with the addition of a latent class in subsequent models and are therefore not informative in model selection. Masyn (2013) recommends in cases such as these to plot the values of the BIC and identify the "elbow," similar to the use of scree plots for eigen values with exploratory factor analysis (EFA; p. 54). As shown in Figure 6, a distinct "elbow" emerges after the 5-class solution. Furthermore, the LMR-LRT and PBLRT become nonsignificant with the addition of a subsequent class from the five- to six-class solution, suggesting that the addition of classes beyond five classes does not improve model fit.

Both the 4- and 5-class solutions were well identified with good precision of classification for both models (e.g., entropy values > .92; see Table 3 for a full summary of fit indices). To consider the substantive interpretability of the candidate model solutions, the class results for both 4- and 5-class solutions were compared. Three profiles in the 4-class solution (see Figure 7) followed a predictable pattern: *High Sensitivity* (i.e., characterized by high mean scores on all sensitivity indicators), *Medium Sensitivity* (i.e., characterized by moderate scores on all sensitivity indicators), and *Low*

Sensitivity (i.e., characterized by low scores on all sensitivity indicators). The fourth profile—*Low Sensitivity: High Gaze and Predictability* —follows a unique pattern characterized by high gaze and consistency of style but low levels on all other indicators (i.e., acknowledging, vocal appropriateness, appropriate range of affect, resourcefulness, and touch). In the 5-class model (see Figure 8), another pattern emerged which was similar in shape to *Low Sensitivity: High Gaze and Predictability* but differed in levels of acknowledging, vocal appropriateness, appropriate range of affect, and resourcefulness. To test whether the 5-class solution added substantive value beyond the 4-class solution, we tested each solution's utility in differentially predicting cortisol reactivity and recovery at 12 months. The 4- and 5-class solutions did not differentially predict the cortisol reactivity at 12 months, but differences emerged among the similarly patterned *High Sensitivity* and *Low Sensitivity: High Gaze and Predictability* Profiles between the 4- and 5-class solutions. Thus, we retained the 4-class solution based on a combination of model fit, parsimony, and substantive interpretability of the maternal sensitivity profiles (Masyn, 2013).

To validate the profiles, the BCH method was employed to compare means of each sensitivity indicator among the five profiles. Each indicator was separately entered as an auxiliary variable compared across profiles using chi-square difference tests (see Table 4 for full summary of results). The estimated means of each sensitivity indicator significantly differed among profiles in most cases with a few exceptions. When comparing sensitivity profiles on gaze, *Low Sensitivity: High Gaze and Predictability* (M = 4.52, SE = .13) did not significantly differ from *Medium Sensitivity* (M = 4.35, SE = .04; χ^2 = 1.62, p = .20) or *High Sensitivity* (M = 4.66, SE = .04; χ^2 = 1.17, p = .28). With respect to consistency of style, *High Sensitivity* (M = 4.88, SE = .02) did not significantly differ from *Low Sensitivity: High Gaze and Predictability* (M = 4.91, SE = .07; χ^2 = .15, p = .70). Concerning differences in mean levels of resourcefulness, only *Low Sensitivity* (M = 2.85, SE = .08) significantly from *Low Sensitivity: High Gaze and Predictability* (M = 2.80, SE = .14; χ^2 = .10, p = .76). All profiles significantly differed on mean levels of acknowledging, vocal appropriateness, and appropriate range of affect. Notably, touch did not significantly differ for any of the profiles. Table 5 presents the results of the equality of means tests of sensitivity indicators for the 5-class solution, with the notable difference being significant mean differences of affectionate touch between *Medium Sensitivity: High Gaze and Predictability* (M = 1.58, SD = .06) and *Low Sensitivity* (M = 1.91, SE = .12; χ^2 = 5.62, p = .02), *Medium Sensitivity* (M = 1.93, SE = .08; χ^2 = 10.57, p = .001), and *High Sensitivity* (M = 1.84, SE = .06; χ^2 = 8.71, p = .003).

Maternal sensitivity profiles and infant stress physiology

Prior to examining differences in cortisol activity among sensitivity profiles, raw cortisol means were first compared across profiles at baseline, 0 minutes post-task, 20 minutes post-task, and 40 minutes post-task using the BCH method (see Figures 10 and 11). For this series of models, the four cortisol samples were entered as auxiliary variables. Maternal sensitivity profiles from the 4-class solution did not significantly differ on mean levels of cortisol at baseline, 0, or 20 minutes post-task. However, one significant different emerged between the *Medium Sensitivity* (M = .17, SD = .03) and *Low Sensitivity: High Gaze and Predictability* Profiles (M = .32, SD = .04; χ^2 = 9.83, p = .002) at 40 minutes post-task.

The 5-class solution profiles did not significantly differ at baseline or 0 minutes post-task but yielded several differences at 20 and 40 minutes post-task. *Medium Sensitivity* (M = .46, SD = .11) and *Medium Sensitivity: High Gaze and Predictability* (M = .19, SD = .02) significantly differed in cortisol levels at 20 minutes post-task, χ^2 = 5.03, p = .03. At 40 minutes post-task, mean levels of cortisol for *Low Sensitivity: High Gaze and Predictability* (M = .13, SD = .008) were significantly lower than cortisol levels in *Medium Sensitivity* (M = .33, SD = .06; χ^2 = 12.86, p < .001), *Medium Sensitivity: High Gaze and Predictability* (M = .30, SD = .04; χ^2 = 17.77, p < .001), and *High Sensitivity* (M = .27, SD = .05; χ^2 = 8.69, p = .003). Mean levels of cortisol in *Low Sensitivity: High Gaze and Predictability* were also marginally lower than levels in the *Low Sensitivity* Profile (M = .28, SD = .08; χ^2 = 3.46, p = .06).

The BCH method was employed to compare the residualized scores of cortisol reactivity and recovery among the four maternal sensitivity profiles. The residualized scores of reactivity and recovery were entered as auxiliary variables and compared across profiles using chi-square difference tests (see Table 6 for full summary of results). None of the sensitivity profiles significantly differed on mean levels of cortisol reactivity. With respect to cortisol recovery, only *Low Sensitivity: High Gaze and Predictability* (M = -.08, SD = .04) significantly differed from *High Sensitivity* (M = .03, SD = .03; χ^2 = 4.47, p = .04).

Maternal sensitivity profiles and indices of risk

To further validate the maternal sensitivity profiles, the BCH method was employed to compare the 4- and 5-class solutions on other indices of risk: daily hassles, perceived stress, and depression. When comparing the 4-class solution on how often mothers experience daily hassles, the *Low Sensitivity: High Gaze and Predictability* Profile reported significantly more daily hassles (*M* = 58.83, *SE* = 3.22) compared to *High Sensitivity* (*M* = 46.72, *SE* = 2.04; χ^2 = 10.06, *p* = .002), *Medium Sensitivity* (*M* = 43.19, *SE* = 2.44; χ^2 = 14.92, *p* < .001), and *Low Sensitivity* (*M* = 42.70, *SE* = 4.61; χ^2 = 8.18, *p* = .004). The *High*, *Medium*, and *Low Sensitivity* Profiles did not significantly differ from one another. Regarding how much daily hassles are a hinderance or annoyance, the *Low Sensitivity: High Gaze and Predictability* Profile reported more daily hassles (*M* = 49.07, *SE* = 7.69) compared to *High Sensitivity* (*M* = 34.42, *SE* = 4.05; χ^2 = 3.39, *p* = .07), *Medium Sensitivity* (*M* = 34.87, *SE* = 2.36; χ^2 = 3.11, *p* = .08), and *Low Sensitivity* (*M* = 33.40, *SE* = 4.13; χ^2 = 3.22, *p* = .07). These relations were in the same pattern as how often mothers experience daily hassles and in the same direction, but the associations were marginally significant. With respect to perceived stress, mothers in the *Low Sensitivity: High Gaze and Predictability* Profile reported significantly higher stress (*M* = 6.26, *SE* = .42) compared to the *High Sensitivity* (*M* = 4.11, *SE* = .44; χ^2 = 12.69, *p* < .001) and *Medium Sensitivity* Profiles (*M* = 3.99, *SE* = .40; χ^2 = 15.32, *p* < .001). The profiles did not significantly differ on depression symptoms.

In the 5-class solution, regarding how often one experiences daily hassles, mothers in the *Medium Sensitivity* Profile (*M* = 59.42, *SE* = 4.26) reported significantly more frequent daily hassles compared to the *High Sensitivity* Profile (*M* = 42.76, *SE* = 4.65; χ^2 = 6.98, *p* = .008), *Medium Sensitivity: High Gaze and Predictability* Profile (*M* = 40.82, *SE* = 2.29; χ^2 = 14.83, *p* < .001), and *Low Sensitivity: High Gaze and Predictability* Profile (*M* = 46.88, *SE* = 2.12; χ^2 = 6.94, *p* = .008). Frequency of reported daily hassles was also higher for *Low Sensitivity: High Gaze and Predictability* than *Medium Sensitivity: High Gaze and Predictability*, but this difference is marginally significant (χ^2 = 3.72, p = .05). No significant differences emerged among profiles regarding how much of an annoyance daily hassles posed. With respect to perceived stress, mothers in the *Medium Sensitivity* Profile (M = 6.01, SE = .48) was significantly higher compared to *Medium Sensitivity: High Gaze and Predictability* (M = 3.71, SE = .47; χ^2 = 11.95, p = .001) and *Low Sensitivity: High Gaze and Predictability* (M = 4.14, SE = .45; χ^2 = 3.81, p = .004). When comparing profiles on depression symptoms, *Medium Sensitivity* demonstrated the lowest depression symptoms (M = 1.99, SE = .86) overall and marginally differed from *Low Sensitivity: High Gaze and Predictability* (M = 3.98, SE = .55; χ^2 = 3.81, p = .05) and *Medium Sensitivity: High Gaze and Predictability* (M = 3.88, SE = .76; χ^2 = 2.72, $p < .10$).

Discussion

Maternal sensitivity is often conceptualized and operationalized as a global construct, comprised of distinct, component behaviors that may have differential implications for infant's development. The current study sought to examine patterns of maternal sensitivity in low-income, Mexican American mothers at six months and connect maternal sensitivity profiles to infant stress physiology when infants were 12 months old. Results from the LPA revealed four distinct maternal sensitivity profiles that were meaningful in understanding infant's cortisol recovery but not cortisol reactivity. The four sensitivity classes also differed on multiple risk factors (i.e., frequency of daily hassles, perceived stress). Findings from this study suggest the utility in examining maternal sensitivity using person-centered approaches compared to traditional conceptualizations of maternal sensitivity to yield a deeper, more nuanced understanding of how sensitive maternal behavior may shape the emerging infant regulatory system.

Understanding distinct patterns of maternal sensitivity

The first research question examined whether there are unique combinations of sensitive maternal behaviors. Comparison of fit indices from the LPA determined that the addition of classes beyond five did not improve model fit. The five profiles that emerged were: (1) *High Sensitivity*; (2) *Medium Sensitivity*; (3) *Low Sensitivity*; (4) *Low Sensitivity: High Gaze and Predictability*; and (5) *Medium Sensitivity: High Gaze and Predictability*. The fifth profile was characterized by a similar pattern to *Low Sensitivity: High Gaze and Predictability*, differentiated only by mean levels of acknowledging, vocal appropriateness, appropriate range of affect, and resourcefulness. The utility of the profiles in differentiating between infant cortisol reactivity and recovery, as well as other indices of risk, were used to determine the final number of maternal sensitivity profiles. The 4-class solution helped distinguish significant differences among cortisol recovery between the *High Sensitivity* and *Low Sensitivity: High Gaze and Predictability* Profiles. These differences went away, however, with the addition of a fifth profile. When examining other indices of risk, the addition of a fifth maternal sensitivity profile also did not contribute to understanding differences in perceived stress, depression, or daily hassles. Therefore, the 4-class solution was retained for parsimony.

The first three profiles of *High*, *Medium*, and *Low Sensitivity* seemingly did not provide much information beyond what a composite provides, as each respective profile was characterized by high, medium, and low mean levels of sensitive behaviors. Previous work has found similar profiles (high, medium, and low levels) of maternal sensitivity using cluster analysis (e.g., Bornstein, Gini, Suwalsky, Putnick, & Haynes, 2006). However, a limitation of the study by Bornstein and colleagues (2006) is that the number of expected profiles were specified *a priori*, hindering the authors ability to detect other profiles of sensitivity in their sample. A further limitation of that study is that they examined a single, composite measure of sensitivity, and therefore they could not explore different combinations of the behaviors that underlie sensitivity in their measure (e.g., contingent responsiveness, appropriate affect, flexibility). The current study contributes new understanding to profiles or patterns of sensitive maternal behavior by identifying a fourth profile that did not confirm to uniform mean levels of high, medium, and low across all sensitivity behaviors.

The fourth sensitivity profile—*Low Sensitivity: High Gaze and Predictability*—was comprised of a unique pattern of sensitive maternal behaviors, characterized by high gaze and consistency of style (i.e., predictability) but low levels of acknowledging, vocal appropriateness, appropriate range of affect, resourcefulness, and touch. Specific symptoms associated with depression, such as flat affect, could help explain the behavioral features of this profile. However, reported depression in the *Low Sensitivity: High Gaze and Predictability* Profile was lowest among all profiles, although this difference was not significant. Underreporting of depressive symptomology may be an issue across the study sample, regardless of sensitivity profile membership. Scores greater than 12 or 13 on the EPDS indicate clinically significant levels of depression (Cox et al., 1987). Only 4.3% to 6.7% of mothers in the current study sample received scores greater than 12 or 13, respectively. The low levels of depressive symptoms reported in the current study sample, however, are consistent with research regarding

Mexican immigrant mental health. Compared to U.S.-born Mexican Americans, Mexican immigrants who have lived fewer than 13 years in the U.S. experience significantly lower levels of depression (Satcher, 2001). Sixty one percent of the sample had lived in the U.S. for 13 years or less that the time of data collection, which could help explain the low instances of depression. Another possible explanation is that mothers who experience more stress find it difficult to initiate and sustain engaging, complex behaviors, such as acknowledging and resourcefulness, which require more allocation of mental resources compared to looking behavior. Maternal stress has been shown to negatively predict mother-infant interaction quality (i.e., less sensitive and more controlling behavior) when infants were six months old (Muller-Nix et al., 2004). Indeed, mothers in the *Low Sensitivity: High Gaze and Predictability* Profile reported the highest mean levels of daily hassles (both frequency and how much they were bothered) and perceived stress.

The maternal sensitivity profiles that emerged in the current study are consistent with findings from previous work. One study examining impact of an intervention on a sample of lower-middle to low socioeconomic status, ethnically diverse mothers and infants used person-centered approaches to examine profiles of parenting behaviors (Guttentag, Pedrosa-Josic, Landry, Smith, & Swank, 2006). These authors used latent class analysis to derive parenting profiles comprised of responsiveness to signals, rich language input, maintaining infant's attentional focus, and warmth when infants were six months old. Guttentag and colleagues (2006) reported a low, medium, and high group, but they also identified a fourth, mixed profile characterized by low responsiveness to infant signals, high rich language input, moderate maintenance of attentional focus, and low warmth. Similar to the current study, the mixed profile was the least common profile, comprising approximately 6% of the pre-intervention study sample. Mothers in the mixed profile were significantly less likely to be White and were lower SES compared to mothers in other profiles. Psychopathology (i.e., depression, anxiety, and psychoticism) and social support, however, did not differentiate these parenting profiles. These findings are consistent with differences in risk factors among the four maternal sensitivity profiles in the current study. Although Guttentag and colleagues (2006) examined different sensitivity behaviors than in the current study, there is some overlap between their mixed profile and the current study's *Low Sensitivity: High Gaze and Predictability* Profile (i.e., moderate-high levels of attention, low responsiveness/engagement), providing evidence that this pattern of maternal caregiving behavior has been found in other samples, it is the least common parenting profile, and may be the highest risk parenting profile.

It is interesting and important to note that as part of the preliminary analyses, a composite score of maternal sensitivity was calculated, comprised of the seven sensitive maternal behaviors included in the final maternal sensitivity profiles. This composite score was not significantly correlated with any of the cortisol or risk variables. In fact, differences with respect to cortisol recovery, daily hassles, and perceived stress emerged only in comparison to the fourth profile (i.e., *Low Sensitivity: High Gaze and Predictability*), characterized by varying levels of sensitive maternal behaviors, rather than consistently high, medium, and low levels of sensitive maternal behaviors. The finding that the four maternal sensitivity profiles yielded significant differences with respect to cortisol recovery, daily hassles, and perceived stress provides compelling evidence for examining maternal sensitivity using more complex methodologies (e.g., person-centered approaches) to examine questions of the role of maternal sensitivity in emerging infant and child competencies. Although less common, maladaptive combinations of sensitivity behaviors may have meaningful implications for children's developmental competencies, but these nuances are not captured by broader measurement of maternal sensitivity (e.g., global measures, composite scores).

Differences in cortisol reactivity and recovery among sensitivity profiles

The second research question explored differences in infant stress physiology among patterns of maternal sensitivity. It was originally hypothesized that profiles characterized by broader sensitivity indicators, such as acknowledging and supportive presence, will be related to lower baseline cortisol levels and increased cortisol reactivity. Unexpectedly, no significant differences emerged for infant baseline cortisol or cortisol reactivity among the four maternal sensitivity profiles. One possible explanation is that not all infants in the study sample showed significant cortisol reactions to the interaction tasks (Luecken, Crnic, Gonzales, Winstone, & Somers, *in press*), which may have restricted the ability to detect differences in cortisol reactivity among sensitivity profiles. Although it was not expected that all infants have discrete cortisol reactions, it was expected that infants would vary in their cortisol response to the interaction tasks. The primary interest of the current study was not in how *much* infants respond at a given discrete point in time to a series of interaction tasks but in how infants *differ* in their reactivity and recovery depending on their caregiving experiences. Further, studies that yield lower-than-expected cortisol reactivity should not be discarded because stress physiology is complex and not only associated with elevations in cortisol (Gunnar & Vazquez, 2001).

Cortisol recovery, on the other hand, differed significantly between the *High Sensitivity* Profile and the *Low Sensitivity: High Gaze and Predictability* Profile. Infants in the *High Sensitivity* Profile increased in cortisol more than expected (M = .03, SD = .03), whereas infants in the *Low Sensitivity: High Gaze and Predictability* Profile decreased more in cortisol following the interaction tasks than expected (M = -.08, SD = .04). Blair and colleagues (2006) described differences in patterns in cortisol at six months at baselines, peak, and 40-minutes post at different levels of maternal sensitivity (i.e., high and low). The high sensitivity group of infants was characterized by a marked increase and subsequent decrease in cortisol in response to mild, everyday stressors. The low sensitivity group lacked a cortisol reaction and exhibited a continued decrease in cortisol following the tasks. This extended cortisol decrease during recovery is consistent with the pattern of decrease for infants in the *Low Sensitivity: High Gaze and Predictability* Profile. Notably, the pattern of cortisol recovery in the low sensitivity group by Blair and colleagues (2006) was not replicated in the current study's *Low Sensitivity* Profile, which was characterized by a steady increase in cortisol from baseline to 40 minutes post-task. Mean levels of sensitive behaviors in the *Low Sensitivity* Profile averaged around 3 and 3.5. When considered on a scale of 1 to 5, it is unclear whether the *Low Sensitivity* Profile really describes low maternal sensitivity. In contrast, the *Low Sensitivity: High Gaze and Predictability* Profile yielded scores for certain sensitive behaviors in the 2 to 2.5 range. It is possible that the *Low Sensitivity: High Gaze and Predictability* Profile is more similar to traditional conceptualizations of low sensitivity in other studies (e.g., Blair et al., 2006), whereas the *Low Sensitivity* Profile may be more comparable to moderate sensitivity.

Initial hypotheses predicted that profiles characterized by affectionate touch would be associated with greater infant cortisol recovery, as maternal touch has been shown in previous studies to attenuate cortisol responses in infants (Feldman et al., 2010). Mean levels of touch in the current study, however, were unexpectedly low ($M = 1.81$, $SD = .48$). It could be that although sensitive caregiving in Mexican culture typically emphasize touch (Tamis-LeMonda, Song, Leavell, Kahana-Kalman, & Yoshikawa, 2012), the measure used to evaluate affectionate touch did not adequately capture typical touch practices in the study sample. During the 6-month home visit, infants were placed in an infant seat to facilitate completing the interaction tasks (e.g., teaching, peekaboo). The structure of the home visit facilitated distal parenting practices—which describe face-to-face contact and object stimulation—rather than proximal parenting practices—characterized by body contact and stimulation (e.g., holding and rocking). Observational coding of touch also implicitly emphasized distal parenting practices. The CIB coding manual provides the following examples of affectionate touch: kissing, hugging, fondling, loving pokes, caressing, etc. (Feldman, 1998). Most behaviors (e.g., loving pokes, fondling) are categorically distal practices, whereas other behaviors that could conceivably be described as proximal practices (e.g., hugging) may have been inhibited by the structed format of the home visit. It may be that in general, mothers from Hispanic cultures may perform proximal parenting practices at a higher rate compared to European American groups (Keller et al., 2009), and the observational system used to code touch practices did not capture proximal aspects of touch.

In sum, some of the hypotheses posed regarding patterns of sensitive maternal behaviors were supported by the findings in the current study, but others were not. No differences emerged among the three sensitivity profiles that followed uniformly high, medium, and low levels of sensitive behaviors (i.e., *High*, *Medium*, and *Low Sensitivity* Profiles). It may be that although mean level differences in sensitivity behaviors (e.g., vocal appropriateness, resourcefulness) were significant among profiles, these differences were not great enough to be meaningful for infants' stress physiology.

Limitations

Several limitations of the current study should be considered. Although a substantial number of individual component behaviors were considered for the current study, only seven could be included in the final LPA. Many of the coded sensitive maternal behaviors were excluded due to issues of variability and multicollinearity, but some of these behaviors (e.g., imitation) may have contributed to explicating differences in cortisol reactivity and recovery among infants in the current study. For example, maternal imitation may promote mother-infant synchrony (Van Puyvelde, Loots, Gillisjans, Pattyn, & Quintana, 2015), which has been shown to promote infant cortisol regulation following a stressful task (Feldman et al., 2010)). Similarly, although it was possible to include touch in the LPA, the low occurrence of this behavior in the study sample has important implications for interpreting the maternal sensitivity profiles and how they contribute to understanding infant cortisol reactivity and recovery.

Finally, the small class size of the fourth sensitivity profile—*Low Sensitivity: High Gaze and Predictability*—is a limitation. This profile consisted of nine mothers, just under 5% of the total sample. In a simulation study, Nylund colleagues (2007) reported that parameter coverage—or the ability of the models derived from the LPA to recover the population parameters—is low in simulation studies with small sample sizes (i.e.,

200) in small class sizes (i.e., 5%) and that coverage increases as class size increases. However, it is expected that the most at-risk profile—even in disadvantaged samples—will be small and less common compared to the sensitivity patterns that emerge. This has been the case in other studies as well (Guttentag et al., 2006). Further, the smallest class in the current study provided utility in explicating differences in maternal risk factors and infant cortisol recovery. Interpretability and utility of the profiles are arguably more important than class size, and even profiles with small class sizes should be examined for the usefulness in understanding developmental phenomena.

Future directions and conclusions

The current study demonstrated four distinct patterns of maternal sensitivity in a sample of low-income, Mexican American mothers and their infants. Future work should focus on replicating these patterns of sensitivity in socioeconomically and culturally diverse samples as well as connecting these sensitivity profiles to other developmental competencies to further validate the profiles. Additionally, a more thorough understanding of the demographic and risk factors associated with the *Low Sensitivity: High Gaze and Predictability* Profile could inform the recruitment of new study samples, oversampling for mothers who meet the criteria associated with this profile to better understand this sensitivity pattern and combat small class size.

Another area of future research should focus on identifying patterns of maternal sensitivity across different developmental periods and examining change in patterns across time. It would also be important to know whether maternal patterns of sensitivity are stable across infancy and toddlerhood, or whether mothers' transition from one profile to another as infants age. Future studies should also investigate factors that predict longitudinal transitions to identify protective factors to support transitions to higher sensitivity profiles and inform prevention and early intervention programs.

General Discussion

The ability to self-regulate is has been connected to multiple domains of health and wellness, including healthy social relationships, fewer behavioral problems, and academic success later in life (Calkins & Leerkes, 2010). The goal of this dissertation was to examine infant and maternal behaviors involved in emerging infant regulatory processes in at-risk, Mexican American families. This dissertation comprises two studies, the first of which examined the distinct contributions of infant and maternal gaze on infant dysregulation during multiple mother-infant interaction contexts. The second study connected patterns of sensitive maternal behaviors to infant stress physiology (i.e., cortisol reactivity and recovery). Although the two studies were similar in that they both examined the role of sensitive maternal behaviors on developing biological and behavioral regulatory processes, each study offers unique insights into the study of emerging self-regulation.

In the first study, infant gaze was consistently associated with lower dysregulation across interaction tasks, but the organizing role of maternal gaze varied by task. Although higher levels of maternal gaze were related to lower infant dysregulation during peekaboo, more maternal gaze during the teaching task was actually linked to higher infant dysregulation. Maternal sensitivity does not occur in isolation, and the meaning of individual maternal behaviors typically thought to be sensitive (e.g., gaze/joint attention) may change in certain interaction contexts. High levels of a specific sensitivity behavior in one interactional context may be adaptive and facilitate development, whereas the same behavior may become maladaptive in other situations (i.e., maternal gaze during the peekaboo versus teaching task). This study also examined the role of possible protective (i.e., cultural orientation, familism) and risk factors (e.g., depression, maternal stress) and found evidence to support that associations between risk and resilience factors could only be understood when also taking into account the specific task in which mothers and infants were engaged. Maternal caregiving behavior must be contextualized with respect to the cultural and interactional context to more fully understand how maternal sensitivity may facilitate or hinder infant regulatory development.

The second dissertation study approached maternal sensitivity in a slightly different way, examining whether different patterns of sensitive maternal behaviors emerged. Although the majority of mothers fell into an expected high, medium, or low category—profiles that do not lend much information beyond traditional conceptualizations of maternal sensitivity as global construct or composite measure—a fourth pattern emerged in which maternal sensitivity was characterized by high levels of gaze and consistency of style but low levels of all other behaviors (e.g., acknowledging, appropriate range of affect). This fourth profile, although it boasted the smallest class size, produced significant differences in maternal risk factors and infant stress functioning. When considered in the combination with other sensitive behaviors, high levels of maternal gaze constituted an index of risk. Examining maternal caregiving behaviors in the context of other maternal behaviors, rather than as an aggregate or global index, has critical implications for differentiating relations between maternal sensitivity and adaptive or maladaptive infant stress responding.

Both studies used person-centered methodologies to approach the question of how maternal caregiving may shape emerging biological and behavioral regulatory systems and contribute new understanding of the maternal caregiving behavior in multiple contexts. Considering specific maternal behavior in the context of infant behavior, culture, the demands of the mother-infant interaction, and other maternal behaviors can offer a more complete picture of emerging regulatory processes during infancy. Research that further unpacks the nuances of maternal sensitivity with respect to context can go far to enhancing scientific knowledge as well as informing targeted, strengths-based prevention and early intervention programs to promote healthy regulatory functioning early in life.

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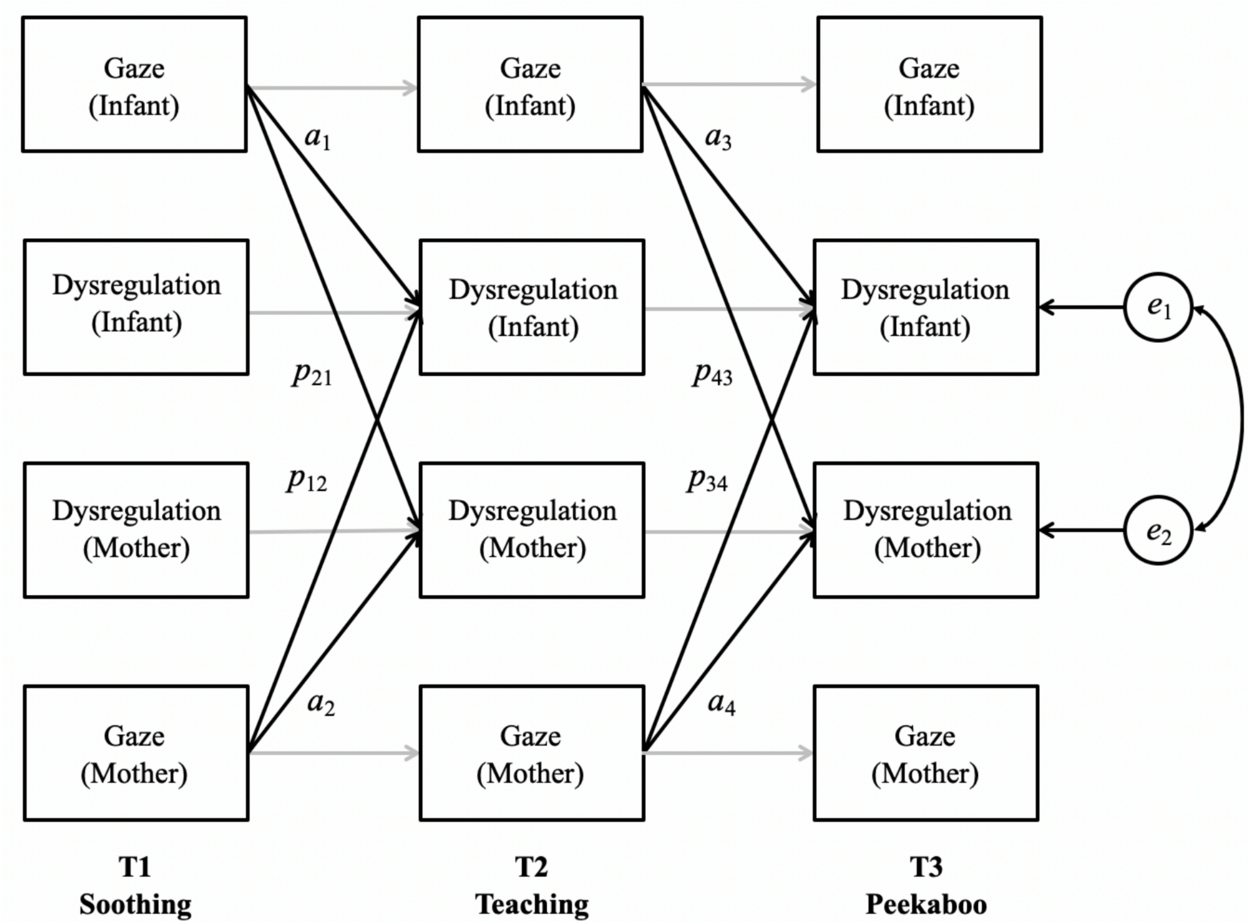

Figure 1. Proposed longitudinal actor partner interdependence model (APIM) examining the effect of gaze on dysregulation in mother-infant dyads. a_1 and a_3 represent the infant actor effect between T1 and T2 and between T2 and T3, respectively; a_2 and a_4 represent the mother actor effect between T1 and T2 and between T2 and T3, respectively; p_{21} and p_{43} represent the infant partner effect between T1 and T2 and between T2 and T3, respectively; p_{12} and p_{34} represent the mother partner effect between T1 and T2 and between T2 and T3, respectively. Covariances between exogenous variables (e.g., maternal gaze and infant gaze at T1) and disturbances of endogenous variables (e.g., maternal gaze and infant gaze at T2) will also be estimated but are not pictured in the figure.

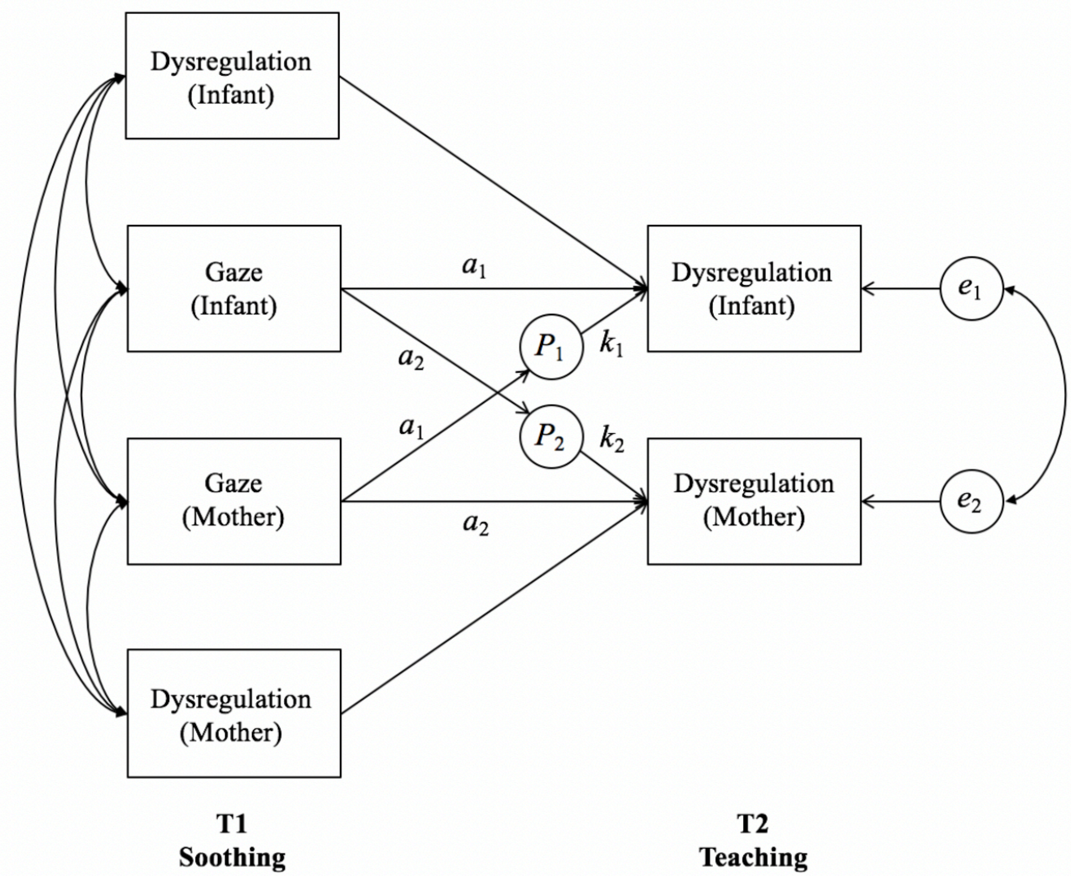

Figure 2. Part of the full APIM model with phantom variables (P_1 and P_2) used to estimate k_1 and k_2 (the ratio of the partner and actor effects between T1 and T2). Phantom variables (P_3 and P_4) will also be included to estimate k_3 and k_4 (the ratio of the partner and actor effects between T2 and T3; not pictured in this figure).

Table 1

Descriptive Statistics and Bivariate Correlations among Gaze and Dysregulation Variables for Mothers and Infants across Interaction Tasks (N = 199)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Infant gaze SO	-											
2. Maternal gaze SO	.35***	-										
3. Infant dysreg SO	-.08	-.06	-									
4. Maternal dysreg SO	-.03	-.28***	.05	-								
5. Infant gaze TE	.33***	.13	-.13†	-.07	-							
6. Maternal gaze TE	.23**	.40***	.04	-.29***	.38***	-						
7. Infant dysreg TE	-.04	.10	.51***	.02	-.32***	.08	-					
8. Maternal dysreg TE	.03	.01	.13†	.38***	-.22**	-.18*	.37***	-				
9. Infant gaze PB	.29***	.12	-.22**	-.07	.50***	.24**	-.25**	-.11	-			
10. Maternal gaze PB	.11	.42***	-.08	-.08	.19**	.45***	.01	-.08	.32***	-		
11. Infant dysreg PB	.05	.05	.41***	.10	-.18*	.03	.67***	.27***	-.40***	-.07	-	
12. Maternal dysreg PB	-.10	-.04	.18*	.28***	-.25***	-.20**	.31***	.56***	-.33***	-.18*	.38***	-
n	198	198	195	194	198	198	194	194	197	197	193	193
M	2.93	4.23	1.62	1.24	3.41	4.42	2.25	1.52	3.75	4.61	2.01	1.31
SD	1.01	.72	.86	.48	.90	.58	1.18	.84	.97	.48	1.28	.66
Min	1.0	1.5	1	1	1.0	2.0	1	1	1.0	3.0	1	1
Max	5.0	5.0	4	3	5.0	5.0	5	5	5.0	5.0	5	5
Skew	.17	-.90	1.17	1.92	-.45	-.90	.68	1.71	-.90	-.95	.97	2.69
Kurtosis	-.77	.72	.33	2.92	-.18	1.19	-.44	2.76	.65	.10	-.32	8.55

Note. SO = soothing task; TE = teaching task; PB = peekaboo task.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. $^{\dagger}p < .10$.

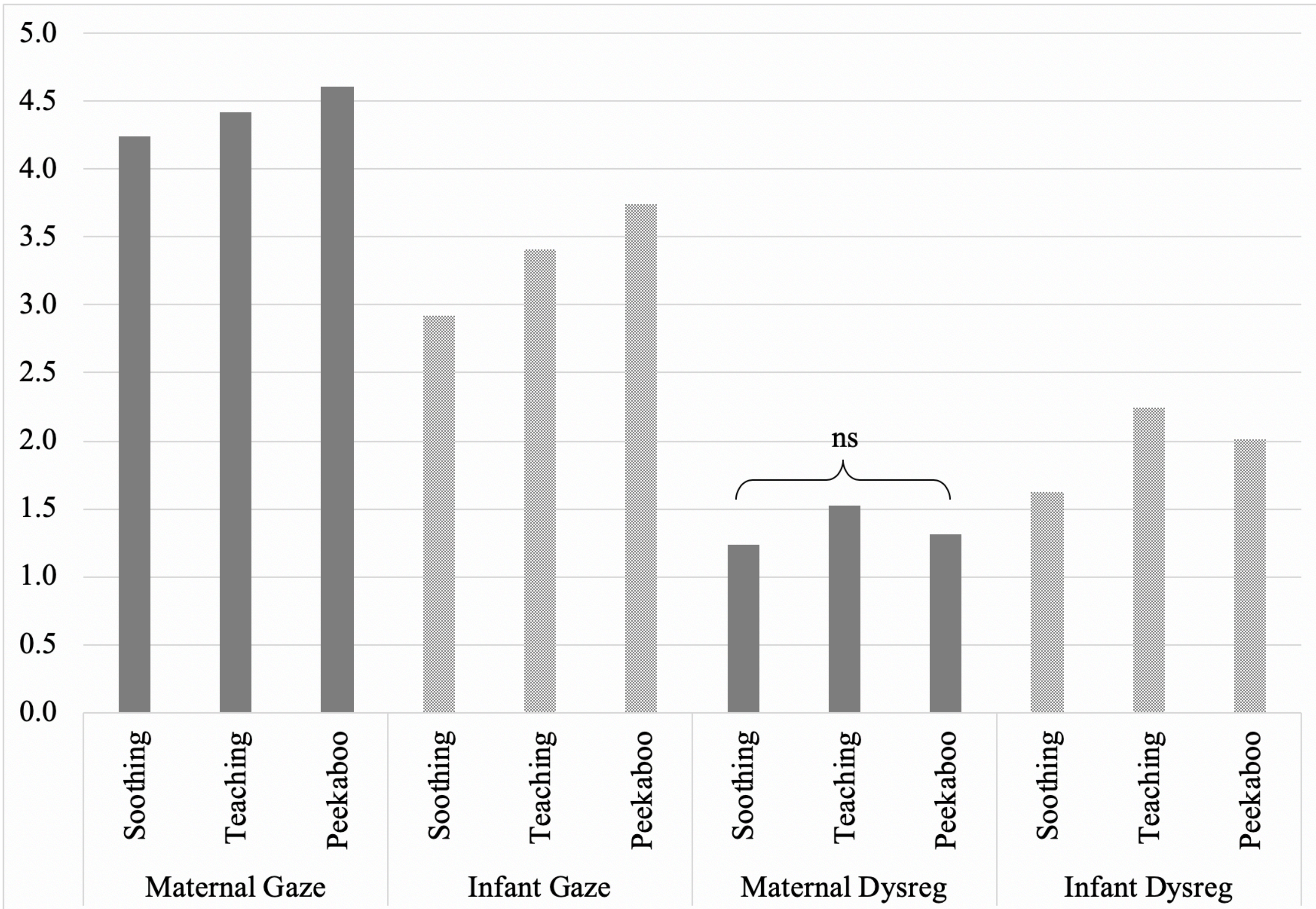

Figure 3. Means of gaze and dysregulation for infants and mothers within each interaction task. All means are significantly different from one another (within behavior and within and between subjects) at $p < .01$ with one exception: maternal dysregulation during soothing and peekaboo did not significantly differ, $t(191) = -1.34$, $p = .18$.

Table 2

Descriptive Statistics and Bivariate Correlations among Risk and Resilience Variables (N = 322)

	1	2	3	4	5	6	7	8	9
1. Anglo cultural orientation	-								
2. Mexican cultural orientation	$-.38^{***}$	-							
3. Familism: Support/ emotional closeness	.004	$.19^{**}$	-						
4. Familism: Obligations	-.04	$.09^{\dagger}$	$.65^{***}$	-					
5. Familism: Family as referent	$-.21^{***}$	$.27^{***}$	$.63^{***}$	$.67^{***}$	-				
6. Parenting daily hassles (how often)	.05	$.12^{\dagger}$	-.08	$-.12^{\dagger}$	$-.12^{\dagger}$	-			
7. Parenting daily hassles (how much)	.03	.05	-.07	-.03	-.08	$.76^{***}$	-		
8. Perceived stress	-.04	.001	$-.17^{*}$	-.02	-.06	$.29^{***}$	$.44^{***}$	-	
9. Maternal depression	.02	.07	-.04	-.006	-.09	$.48^{***}$	$.48^{**}$	$.48^{***}$	-
n	322	322	322	322	322	206	206	206	255
M	2.57	4.24	28.11	21.86	21.99	44.65	34.95	4.28	3.66
SD	.98	.62	2.87	2.69	2.94	14.75	14.08	2.84	4.34
Min	1.15	1.76	8	7	6	21	20	0	0
Max	4.85	5.00	30	25	25	90	78	12	22
Skew	.47	-1.34	-3.02	-1.30	-1.45	.65	1.18	.15	1.42
Kurtosis	-1.04	1.75	14.18	3.93	3.46	.04	.78	-.83	1.56

Note. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. $^{\dagger}p < .10$.

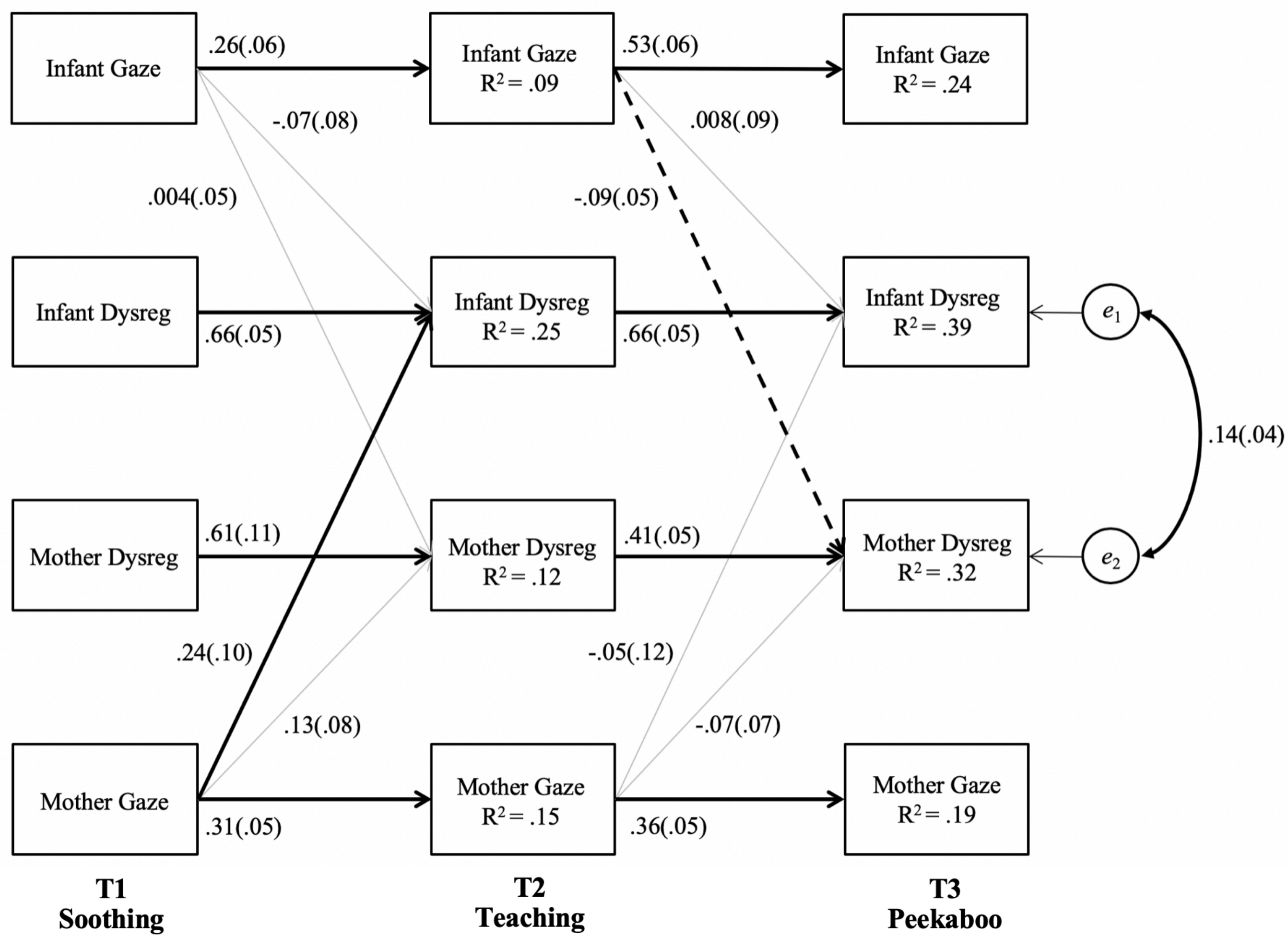

Figure 4. Longitudinal APIM. Unstandardized coefficients with standard errors in parentheses reported. Note that covariances among all co-occurring variables (i.e., during the soothing, teaching, and peekaboo tasks) were estimated but not reported because they are not central to the tested hypotheses. Bold lines indicate significance at $p < .05$. Dashed lines indicated significance at $p < .10$.

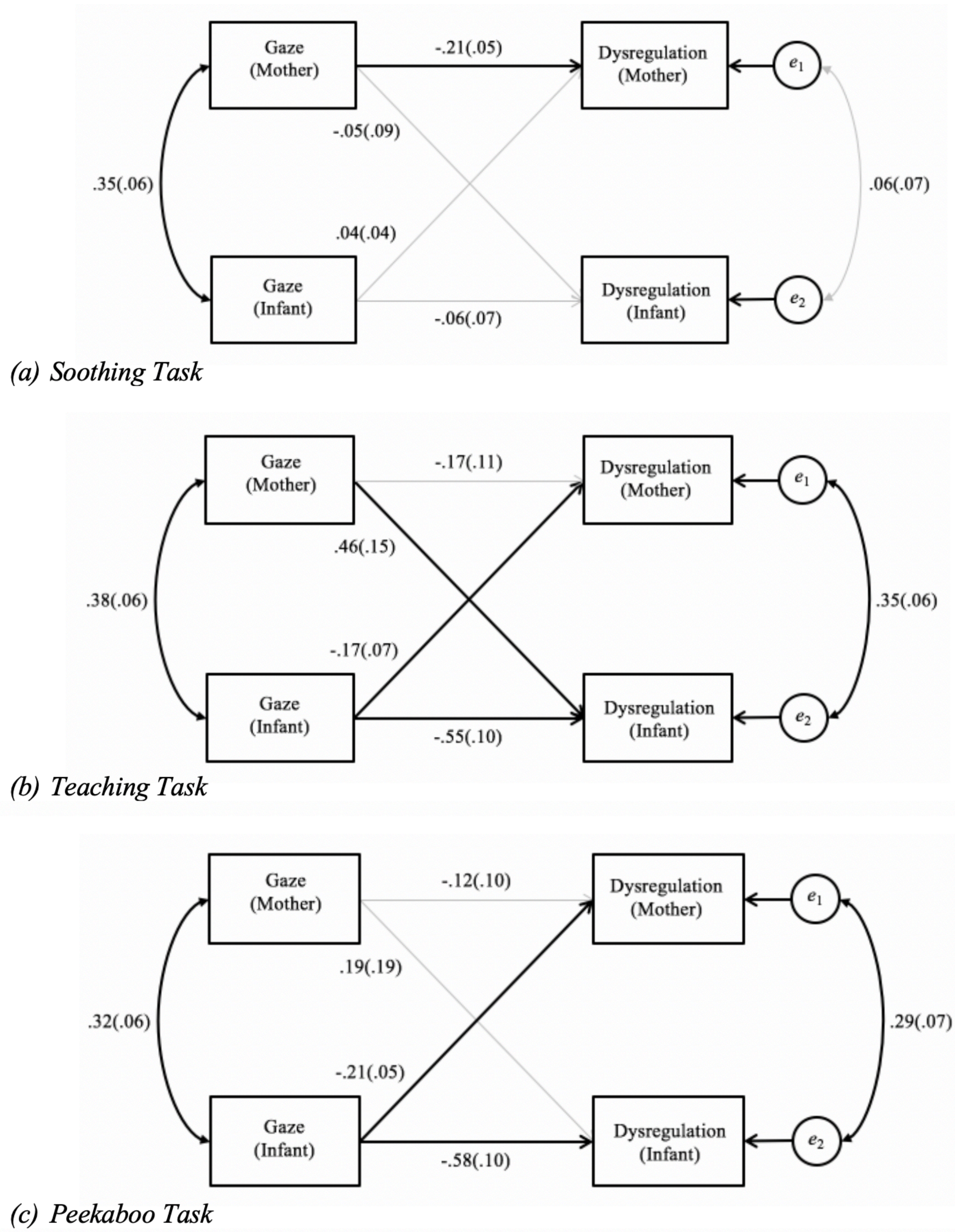

Figure 5. Within-task APIM. Unstandardized coefficients with standard errors in parentheses are reported. Standardized coefficients are reported for correlations among infant and mother gaze and infant and mother dysregulation, respectively, for interpretability. Bold lines indicate significance at $p < .05$.

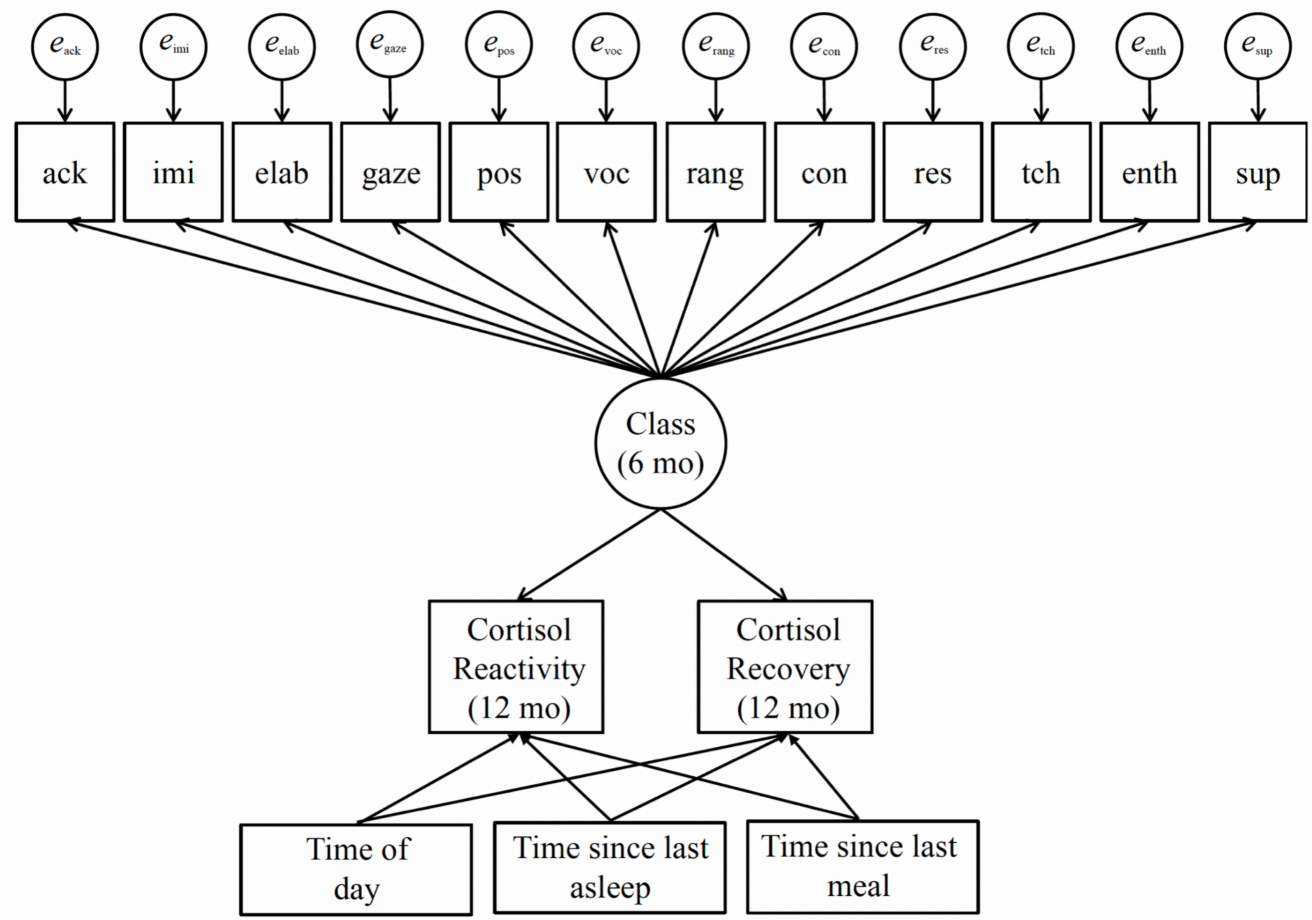

Figure 6. Proposed latent profile analysis (LPA) of maternal sensitivity at six months predicting infant cortisol activity at 12 months, controlling for cortisol covariates. Indicators include: ack = acknowledging; imi = imitating; elab = elaborating; gaze = gaze/joint attention; pos = positive affect; voc = vocal appropriateness; rang = appropriate range of affect; con = consistency of style; res = resourcefulness; tch = affectionate touch; enth = enthusiasm; sup = supportive presence.

Table 3

*Descriptive Statistics and Bivariate Correlations among Maternal Sensitivity Indicators and Cortisol Variables (*N = *322)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Sensitivity indicators																		
1. ack	-																	
2. imi	.16***	-																
3. elab	.19***	.62***	-															
4. gaze	.16***	.01	.02	-														
5. pos	.43***	.10	.08	.58***	-													
6. voc	.41***	.15*	.12	.33***	.63***	-												
7. rang	.68***	.03	-.03	.44***	.74***	.59***	-											
8. con	.12	-.04	-.18*	.62***	.55***	.23**	.50***	-										
9. res	.57***	.01	-.06	.50***	.70***	.57***	.82***	.59***	-									
10. tch	.09	.12	-.02	-.16*	-.03	-.01	-.03	-.15*	-.02	-								
11. enth	.51***	.06	.05	.54***	.91***	.69***	.79***	.50***	.76***	-.01	-							
12. sup	.73***	.06	.01	.39***	.68***	.54***	.85***	.42***	.83***	.02	.74***	-						
Stress outcomes																		
13. base	-.10	-.13	.004	.03	-.01	.03	.04	.003	.09	-.02	.01	.06	-					
14. post0	-.16†	-.13	-.04	.02	-.01	.04	-.03	-.002	.02	-.004	.00	-.04	.75***	-				
15. post20	.04	-.16	-.04	-.15	-.11	-.01	.001	-.18†	-.02	.03	-.10	-.009	.37***	.45***	-			
16. post40	-.10	-.24*	-.08	.02	.05	.11	.02	.008	.05	.03	.05	-.02	.36***	.63***	.74***	-		
17. react	-.11	-.07	-.12	-.02	-.02	.01	-.04	.02	-.05	.01	-.006	-.12	.00	.52***	.72***	.55***	-	
18. recov	.16	-.09	.08	.03	.10	.06	.13	.03	.03	.03	.11	.15	.00	-.13	.49***	.67***	.00	
n	199	199	199	199	199	199	199	199	199	199	199	199	179	178	134	113	173	105
M	3.58	1.12	1.11	4.41	4.24	3.86	4.03	4.52	4.02	1.81	4.04	4.01	.27	.28	.30	.29	.00	.00
SD	.58	.24	.26	.45	.61	.88	.64	.47	.67	.48	.70	.69	.33	.37	.35	.31	.31	.22
Min	1.75	1.00	1.00	3.13	1.75	1.00	2.00	3.13	2.25	1.00	1.50	2.00	.04	.04	.05	.04	-1.36	-.63
Max	5.00	2.50	2.88	5.00	5.00	5.00	5.00	5.00	5.00	3.75	5.00	5.00	2.51	2.57	2.46	2.64	2.04	1.26
Skew	-.41	3.17	4.21	-.66	-.81	-1.06	-.47	-.63	-.40	.88	-.56	-.39	3.61	4.04	3.47	4.51	2.42	16.12
Kurtosis	-.15	12.52	22.62	-.15	.98	.86	.04	-.69	-.43	1.28	.35	-.32	16.02	18.76	15.00	28.63	1.79	12.05

Note. Ack = acknowledging; gaze = gaze; vocal = vocal appropriateness; range = appropriate range of affect; con = consistency of style; res = resourcefulness; touch = affectionate touch; base = baseline cortisol; post0 = cortisol 0 minutes post task; post20 = cortisol 20 minutes post-task; post40 = cortisol 40 minutes post-task; react = residualized change score for cortisol reactivity; recov = residualized change score for cortisol recovery. *$p < .05$. *$p < .05$. **$p < .01$. ***$p < .001$. †$p < .10$.

Table 4

*Comparative Fit Indices for Latent Profile Analyses with Maternal Sensitivity Indicators at Six Months (*N *= 199)*

Models	AIC	BIC	SABIC	Entropy	LMR-LRT (p)	PBLRT (p)		
2-class	2123.51	2195.96	2126.26	0.85	357.62(.001)	349.48(.001)		
	C1=103	C2=96						
3-class	1935.80	2034.60	1939.55	0.92	203.71(.02)	199.01(.03)		
	C1=24	C2=95	C3=80					
4-class	1854.70	1979.85	1859.46	0.94	97.09(.02)	94.85(.03)		
	C1=17	C2=93	C3=9	C4=80				
5-class	1759.42	1910.92	1765.19	0.92	111.28(.03)	108.71(.03)		
	C1=8	C2=16	C3=57	C4=39	C5=78			
6-class	1721.81	1899.65	1728.58	0.93	53.61(.71)	52.37(.72)		
	C1=10	C2=17	C3=57	C4=33	C5=71	C6=12		
7-class	1689.61	1893.80	1697.38	0.94	48.20(.28)	47.09(.28)		
	C1=17	C2=8	C3=54	C4=5	C5=11	C6=34	C7=70	
8-class	1668.27	1898.79	1677.04	.92	37.34(.64)	36.48(.64)		
	C1=11	C2=14	C3=9	C4=26	C5=30	C6=40	C7=64	C8=5

Note. AIC = Akaike's Information Criterion; BIC = Bayesian Information Criterion; SABIC = Sample-size-adjusted BIC; LMR-LRT = Lo Mendell Rubin Likelihood Ratio Test; PBLRT = parametric bootstrap likelihood ratio test.

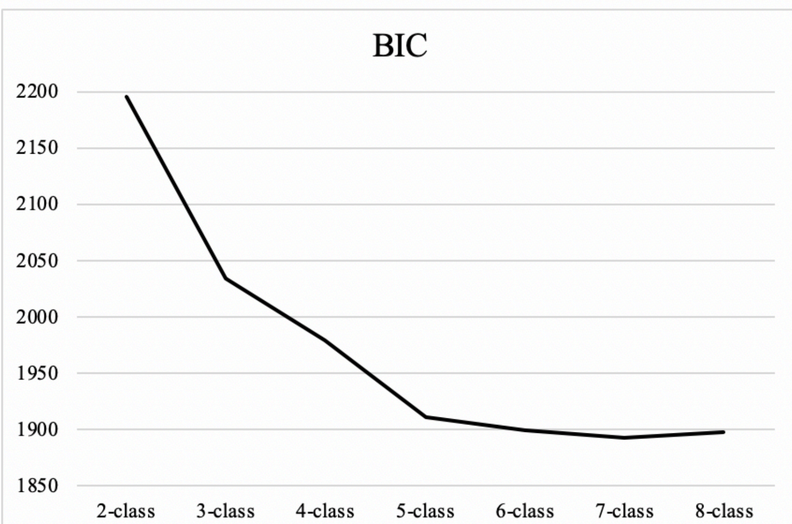

Figure 7. Plotted values of the Bayesian information criterion (BIC) for all estimated class solutions.

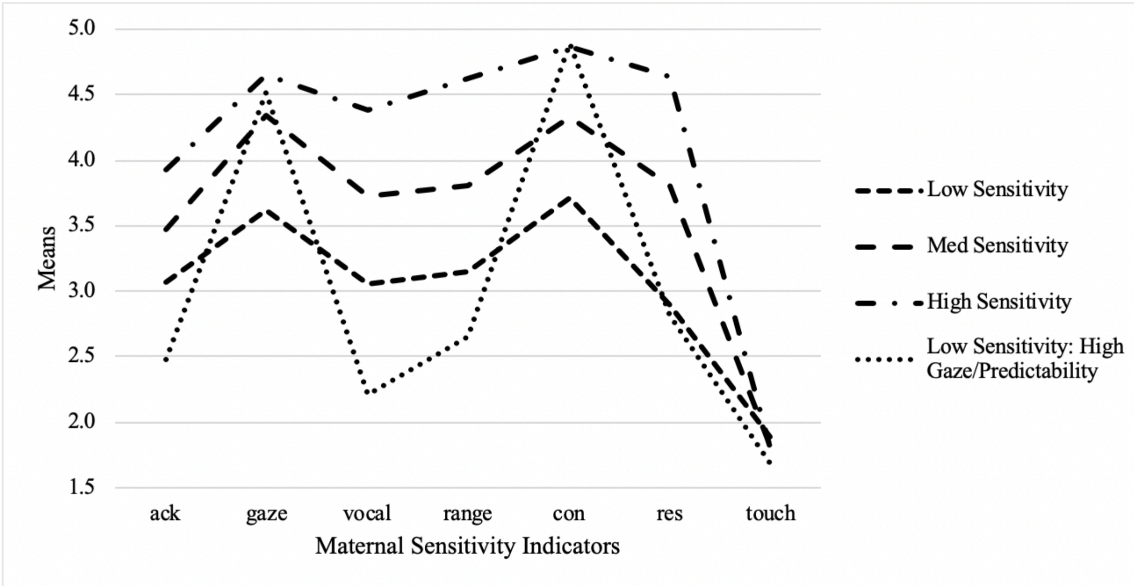

Figure 8. Plotted means of maternal behaviors for the 4-class solution for maternal sensitivity. Ack = acknowledging; gaze = gaze; vocal = vocal appropriateness; range = appropriate range of affect; con = consistency of style; res = resourcefulness; touch = affectionate touch. Class sizes for each profile: *Low Sensitivity* (*n* = 17); *Medium Sensitivity* (*n* = 93); *High Sensitivity* (*n* = 80); *Low Sensitivity: High Gaze and Predictability* (*n* = 9).

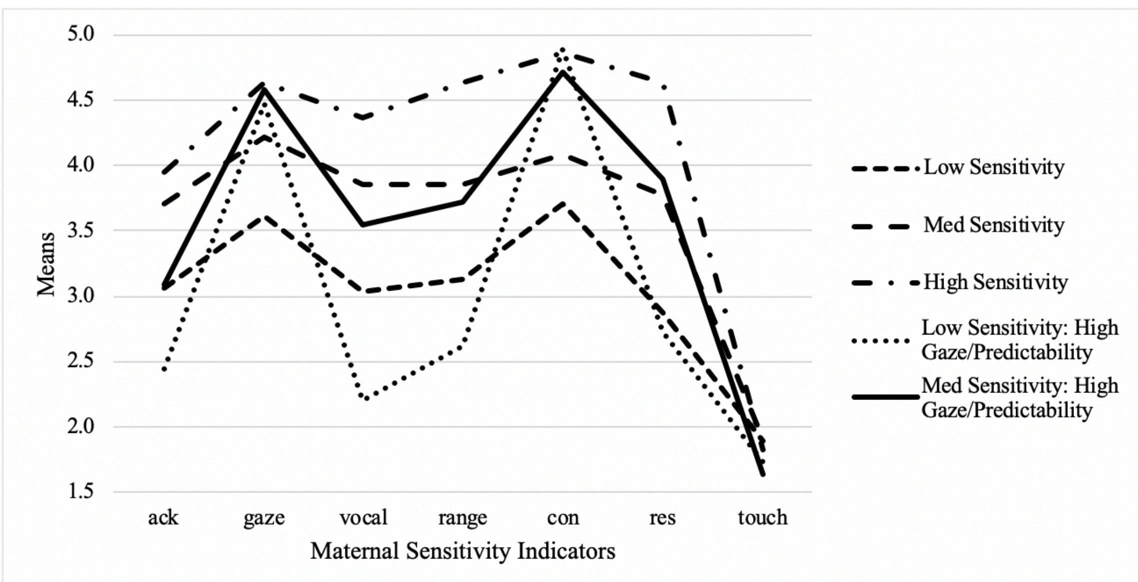

Figure 9. Plotted means of maternal behaviors for the 5-class solution for maternal sensitivity. Ack = acknowledging; gaze = gaze; vocal = vocal appropriateness; range = appropriate range of affect; con = consistency of style; res = resourcefulness; touch = affectionate touch. Class sizes for each profile: *Low Sensitivity* (*n* = 16); *Medium Sensitivity* (*n* = 57); *High Sensitivity* (*n* = 88); *Low Sensitivity: High Gaze and Predictability* (*n* = 8); *Medium Sensitivity: High Gaze and Predictability* (*n* = 39).

Table 5

*Equality Test of Means of Behavior Indicators among Maternal Sensitivity Profiles for the 4-Class Solution (*N = *199)*

	ack	gaze	voc	rang	con	res	tch
M(*SD*)							
1. *Low Sensitivity* (*n* = 17)	3.05(.08)	3.58(.08)	3.01(.15)	3.09(.09)	3.70(.07)	2.85(.08)	1.91(.12)
2. *Medium Sensitivity* (*n* = 93)	3.46(.05)	4.35(.04)	3.72(.07)	3.79(.03)	4.32(.04)	3.79(.03)	1.81(.05)
3. *High Sensitivity* (*n* = 80)	3.95(.05)	4.66(.04)	4.40(.09)	4.66(.04)	4.88(.02)	4.67(.04)	1.82(.06)
4. *Low Sensitivity: High Gaze and Predictability* (*n* = 9)	2.47(.13)	4.52(.13)	2.03(.28)	2.64(.14)	4.91(.07)	2.80(.14)	1.68(.15)
χ^2 test of significance							
Overall	169.21***	160.25***	113.03***	588.04***	352.31***	673.33***	1.44
1 v 2	17.43***	78.38***	18.75**	57.95**	55.57**	134.51***	.60
1 v 3	86.91***	157.50***	67.16***	278.60***	255.32***	494.73***	.42
1 v 4	13.83***	40.63***	6.59*	7.97**	153.08***	.10	1.40
2 v 3	43.53***	28.52***	35.17***	334.59***	129.87***	281.58***	.04
2 v 4	48.79***	1.62	28.55***	69.29***	54.95**	46.37***	.62
3 v 4	109.80***	1.17	58.22***	2026.27***	.15	162.93***	.77

Note. Ack = acknowledging; gaze = gaze; vocal = vocal appropriateness; range = appropriate range of affect; con = consistency of style; res = resourcefulness; touch = affectionate touch.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 6

*Equality Test of Means of Behavior Indicators Among Maternal Sensitivity Profiles for the 5-Class Solution (*N *= 199)*

	ack	gaze	voc	rang	con	res	tch
M(*SD*)							
1. *Low Sensitivity* (*n* = 16)	3.04(.08)	3.58(.08)	3.00(.15)	3.09(.09)	3.71(.07)	2.85(.07)	1.91(.12)
2. *Medium Sensitivity* (*n* = 57)	3.74(.06)	4.21(.05)	3.92(.07)	3.87(.04)	4.02(.03)	3.77(.04)	1.93(.08)
3. *High Sensitivity* (*n* = 78)	3.96(.05)	4.63(.04)	4.38(.09)	4.66(.03)	4.88(.02)	4.65(.04)	1.84(.06)
4. *Low Sensitivity: High Gaze and Predictability* (*n* = 8)	2.42(.14)	4.45(.13)	2.21(.31)	2.60(.15)	4.89(.08)	2.68(.10)	1.75(.15)
5. *Medium Sensitivity: High Gaze and Predictability* (*n* = 39)	3.03(.07)	4.62(.06)	3.46(.15)	3.69(.06)	4.79(.04)	3.89(.08)	1.58(.06)
χ^2 test of significance							
Overall	236.21***	175.19***	105.28***	641.10***	720.55***	794.38***	14.09**
1 v 2	47.06***	49.51***	31.51***	67.31***	15.94***	120.90***	.02
1 v 3	93.24***	143.48***	64.86***	287.94***	259.55***	490.46***	.29
1 v 4	14.91***	35.01***	5.29*	7.85**	133.02***	2.00	.63
1 v 5	.007	118.66***	4.69*	33.08***	172.50***	98.67***	5.62*
2 v 3	8.76**	44.87***	16.54***	262.40***	501.63***	265.30***	.94
2 v 4	77.63***	3.27†	29.21***	67.28***	113.17***	108.70***	1.06
2 v 5	52.16***	28.54***	7.20**	6.52*	196.32***	1.71	10.57**
3 v 4	110.67***	1.84	45.38***	179.35***	.03	361.12***	.26
3 v 5	110.04***	.02	27.68***	215.66***	3.38†	82.13***	8.71**
4 v 5	15.01***	1.51	12.86***	44.73***	1.36	95.68***	1.03

Note. Ack = acknowledging; gaze = gaze; vocal = vocal appropriateness; range = appropriate range of affect; con = consistency of style; res = resourcefulness; touch = affectionate touch.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. $^{\dagger}p < .10$.

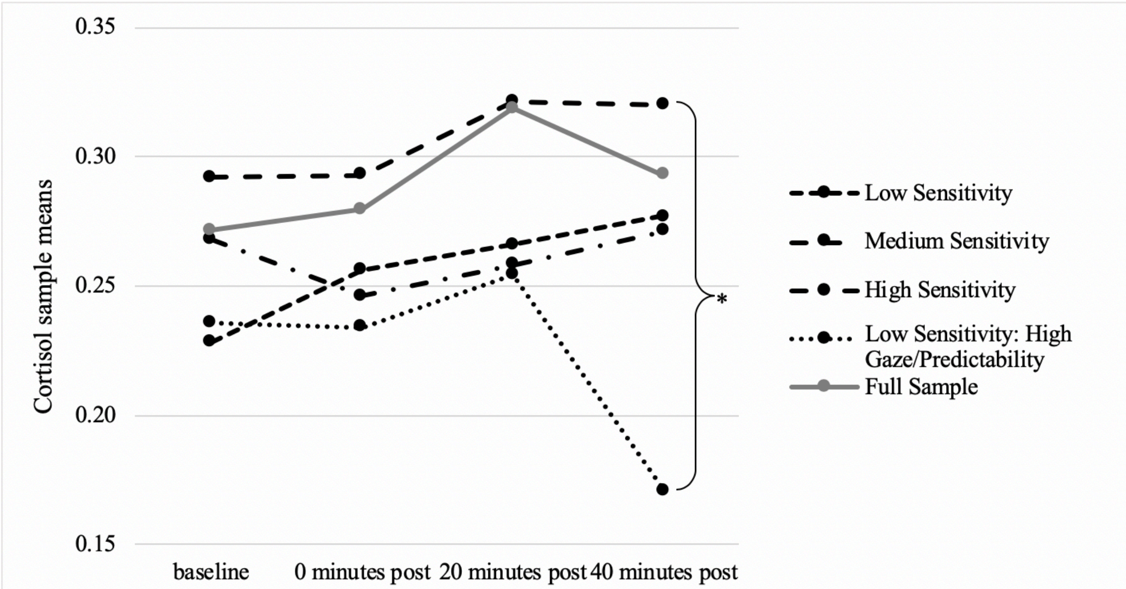

Figure 10. Plotted raw cortisol means at baseline, 0 minutes post-task, 20 minutes post-task, and 40 minutes post-task across maternal sensitivity profiles for the 4-class solution. The gray line represents the cortisol means for the full sample. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

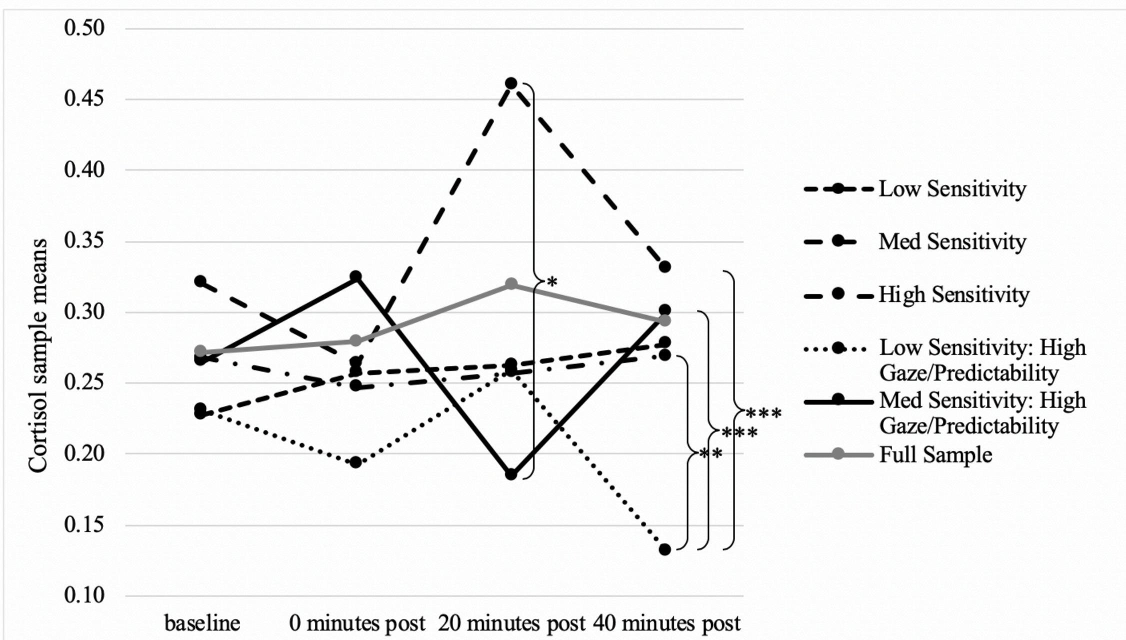

Figure 11. Plotted raw cortisol means at baseline, 0 minutes post-task, 20 minutes post-task, and 40 minutes post-task across maternal sensitivity profiles for the 5-class solution. The gray line represents the cortisol means for the full sample. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 7

*Compared Equality Tests of Means of Cortisol Reactivity and Recovery among the 4- and 5-Class Solutions for Maternal Sensitivity Profiles (*N *= 199)*

	4-class solution		5-class solution	
M(*SD*)	Reactivity	Recovery	Reactivity	Recovery
1. *Low Sensitivity* (*n* = 17/16)	-.03(.03)	.02(.08)	-.03(.03)	.02(.08)
2. *Medium Sensitivity* (*n* = 93/57)	-.01(.04)	-.02(.04)	-.03(.07)	.02(.05)
3. *High Sensitivity* (*n* = 80/78)	-.04(.02)	.03(.03)	-.04(.02)	.02(.03)
4. *Low Sensitivity: High Gaze and Predictability* (*n* = 9/8)	-.05(.06)	-.08(.04)	-.09(.06)	-.03(.02)
5. *Medium Sensitivity: High Gaze and Predictability* (*n* = -/39)			.01(.02)	-.05(.06)
χ^2 test of significance				
Overall	.58	4.71	3.84	3.19
1 v 2	.17	.28	.00	.004
1 v 3	.08	.009	.06	.001
1 v 4	.14	1.36	.99	.45
1 v 5			1.19	.58
2 v 3	.43	1.03	.01	.02
2 v 4	.40	.88	.46	.93
2 v 5			.26	.69
3 v 4	.05	4.67*	.78	2.07
3 v 5			2.06	1.14
4 v 5			3.84	3.19

Note. Cortisol reactivity was operationalized as the residualized score infant's peak cortisol value regressed on their baseline cortisol levels, controlling for covariates relevant to saliva collection (i.e., time of collection, time since last slept, time since last eaten). Cortisol recovery was calculated by regressing the infant's cortisol levels at 40 minutes post-task on their peak cortisol levels controlling for their baseline values and the aforementioned covariates.
*$p < .05$.

Table 8

Compared Equality Tests of Means of Risk Factors among the 4- and 5-Class Solutions for Maternal Sensitivity Profiles (N = *199)*

	4-class solution				5-class solution			
M(*SD*)	Daily Hassles (How Often)	Daily Hassles (How Much)	Perceived Stress	Depression	Daily Hassles (How Often)	Daily Hassles (How Much)	Perceived Stress	Depression
1. *Low Sensitivity* (*n* = 17/16)	42.70(4.61)	33.40(4.13)	4.29(1.18)	4.10(1.30)	42.76(4.65)	33.43(4.16)	4.30(1.19)	4.09(1.30)
2. *Medium Sensitivity* (*n* = 93/57)	43.19(2.44)	34.87(2.35)	3.99(.40)	3.40(.49)	40.82(2.29)	33.19(2.40)	3.71(.47)	3.88(.76)
3. *High Sensitivity* (*n* = 80/78)	46.72(2.04)	34.42(2.05)	4.11(.44)	4.02(.56)	46.88(2.12)	34.86(2.14)	4.14(.45)	3.98(.55)
4. *Low Sensitivity: High Gaze/ Predictability* (*n* = 9/8)	58.83(3.22)	49.07(7.69)	6.26(.42)	3.16(1.29)	59.42(4.26)	43.37(7.90)	6.01(.48)	1.99(.86)
5. *Medium Sensitivity: High Gaze/Predictability* (*n* = -/39)					49.95(5.90)	39.82(5.78)	4.83(.76)	3.13(.68)
χ^2 test of significance								
Overall	16.82**	3.58	19.34***	.91	15.96**	2.39	13.66**	4.57
1 v 2	.009	.09	.06	.24	.14	.003	.21	.02
1 v 3	.64	.05	.02	.003	.65	.09	.02	.01
1 v 4	8.18**	3.22†	2.48	.26	6.98**	1.24	1.79	1.82
1 v 5					.92	.80	.14	.43
2 v 3	1.17	.02	.04	.66	3.72†	.27	.43	.01
2 v 4	14.92***	3.11†	15.32***	.03	14.83***	1.52	11.95**	2.72†
2 v 5					1.91	1.02	1.40	.48
3 v 4	10.06**	3.39†	12.69***	.38	6.94**	1.08	8.14**	3.81†
3 v 5					.24	.64	.59	.92
4 v 5					1.67	.13	1.73	1.07

Note. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. $^{\dagger}p < .10$.

APPENDIX A

MPLUS SYNTAX FOR STUDY #1

```
TITLE:       APIM longitudinal model (mgaze unconstrained)

DATA:        FILE IS gazedys.dat;

VARIABLE:    NAMES ARE pid mgazeso mgazete mgazepb igazeso igazete igazepb
                  mdysso mdyste mdyspb idysso idyste idyspb slpso slpte
                  slppb awkso awkte awkpb;
             USEVARIABLES mgazeso mgazete igazeso igazete
                  mdysso mdyste mdyspb idysso idyste idyspb;
             MISSING ARE ALL (999);

MODEL:       !stability paths for mgaze
             mgazete ON mgazeso;
             !mgazepb ON mgazete;

             !stability paths for igaze
             igazete ON igazeso;
             !igazepb ON igazete;

             !stability paths for idys
             idyste ON idysso (1);
             idyspb ON idyste (1);

             !stability paths for mdys
             mdyste ON mdysso;
             mdyspb ON mdyste;

             !a1 path
             idyste ON igazeso;

             !p21 path
             mdyste ON igazeso;

             !a2 path
             mdyste ON mgazeso;

             !p12 path
             idyste ON mgazeso;

             !a3 path
             idyspb ON igazete;

             !p43 path
             mdyspb ON igazete;
```

```
!a4 path
mdyspb ON mgazete;

!p34 path
idyspb ON mgazete;

!Covariances at soothing time point not automatically estimated
mgazeso WITH igazeso mdysso idysso;
igazeso WITH mdysso idysso;
mdysso WITH idysso;

!Covariances at teaching time point not automatically estimated
mgazete WITH igazete mdyste idyste;
igazete WITH mdyste idyste;
mdyste WITH idyste;

OUTPUT:     sampstat stdyx residual modindices;
```

```
TITLE:      APIM model soothing task

DATA:       FILE IS gazedys.dat;

VARIABLE:   NAMES ARE pid mgazeso mgazete mgazepb igazeso igazete igazepb
                mdysso mdyste mdyspb idysso idyste idyspb slpso slpte
                slppb awkso awkte awkpb;
            USEVARIABLES mgazeso igazeso mdysso idysso;
            MISSING ARE ALL (999);

MODEL:      !a1 path
            idysso ON igazeso;

            !p21 path
            mdysso ON igazeso;

            !a2 path
            mdysso ON mgazeso;

            !p12 path
            idysso ON mgazeso;

            mgazeso WITH igazeso;

OUTPUT:     sampstat stdyx residual;
```

```
TITLE:      APIM model teaching task

DATA:       FILE IS gazedys.dat;

VARIABLE:   NAMES ARE pid mgazeso mgazete mgazepb igazeso igazete igazepb
                 mdysso mdyste mdyspb idysso idyste idyspb slpso slpte
                 slppb awkso awkte awkpb;
            USEVARIABLES mgazete igazete mdyste idyste;
            MISSING ARE ALL (999);

MODEL:      !a1 path
            idyste ON igazete;

            !p21 path
            mdyste ON igazete;

            !a2 path
            mdyste ON mgazete;

            !p12 path
            idyste ON mgazete;

            mgazete WITH igazete;

OUTPUT:     sampstat stdyx residual;
```

```
TITLE:      APIM model peekaboo task

DATA:       FILE IS gazedys.dat;

VARIABLE:   NAMES ARE pid mgazeso mgazete mgazepb igazeso igazete igazepb
                  mdysso mdyste mdyspb idysso idyste idyspb slpso slpte
                  slppb awkso awkte awkpb;
            USEVARIABLES mgazepb igazepb mdyspb idyspb;
            MISSING ARE ALL (999);

MODEL:      !a1 path
            idyspb ON igazepb;

            !p21 path
            mdyspb ON igazepb;

            !a2 path
            mdyspb ON mgazepb;

            !p12 path
            idyspb ON mgazepb;

            mgazepb WITH igazepb;

OUTPUT:     sampstat stdyx residual;
```

```
TITLE:      APIM model for soothing task (k ratio)

DATA:       FILE IS gazedys.dat;

VARIABLE:   NAMES ARE pid mgazeso mgazete mgazepb igazeso igazete igazepb
                 mdysso mdyste mdyspb idysso idyste idyspb slpso slpte
                 slppb awkso awkte awkpb;
            USEVARIABLES mgazeso igazeso mdysso idysso;
            MISSING ARE ALL (999);

ANALYSIS:   ESTIMATOR=ML;
            BOOTSTRAP=5000;

MODEL:      !a1 path
            idysso ON igazeso(a1);

            !a2 path
            mdysso ON mgazeso(a2);

            mgazeso WITH igazeso;
            mdysso WITH idysso;

             !kratio

            !P1
            P1 BY idysso*(k1);
            P1 ON mgazeso(a1);

            !P2
            P2 BY mdysso*(k2);
            P2 ON igazeso(a2);

            P1@0;
            P2@0;
            P1 WITH P2@0;

OUTPUT:     stand sampstat cinterval(bcbootstrap);
```

```
TITLE:      APIM model for teaching task (k ratio)

DATA:       FILE IS gazedys.dat;

VARIABLE:   NAMES ARE pid mgazeso mgazete mgazepb igazeso igazete igazepb
                mdysso mdyste mdyspb idysso idyste idyspb slpso slpte
                slppb awkso awkte awkpb;
            USEVARIABLES mgazete igazete mdyste idyste;
            MISSING ARE ALL (999);

ANALYSIS:   ESTIMATOR=ML;
            BOOTSTRAP=5000;

MODEL:      !a1 path
            idyste ON igazete(a1);

            !a2 path
            mdyste ON mgazete(a2);

            mgazete WITH igazete;
            mdyste WITH idyste;

            !kratio

            !P1
            P1 BY idyste*(k1);
            P1 ON mgazete(a1);

            !P2
            P2 BY mdyste*(k2);
            P2 ON igazete(a2);

            P1@0;
            P2@0;
            P1 WITH P2@0;

OUTPUT:     stand sampstat cinterval(bcbootstrap);
```

```
TITLE:       APIM model for peekaboo task (k ratio)

DATA:        FILE IS gazedys.dat;

VARIABLE:    NAMES ARE pid mgazeso mgazete mgazepb igazeso igazete igazepb
                 mdysso mdyste mdyspb idysso idyste idyspb slpso slpte
                 slppb awkso awkte awkpb;
             USEVARIABLES mgazepb igazepb mdyspb idyspb;
             MISSING ARE ALL (999);

ANALYSIS:    ESTIMATOR=ML;
             BOOTSTRAP=5000;

MODEL:       !a1 path
             idyspb ON igazepb(a1);

             !a2 path
             mdyspb ON mgazepb(a2);

             mgazepb WITH igazepb;
             mdyspb WITH idyspb;

             !kratio

             !P1
             P1 BY idyspb*(k1);
             P1 ON mgazepb(a1);

             !P2
             P2 BY mdyspb*(k2);
             P2 ON igazepb(a2);

             P1@0;
             P2@0;
             P1 WITH P2@0;

OUTPUT:      stand sampstat cinterval(bcbootstrap);
```

APPENDIX B

MPLUS SYNTAX FOR STUDY #2

```
TITLE:      Maternal sensitivity profiles 5 class-solution

DATA:       FILE IS matsenscort.dat;
            TYPE IS individual;

VARIABLE:   IDVARIABLE = pid;
            NAMES ARE pid ack3 imi3 elab3 gaze3 pos3
                  voc3 rang3 con3 res3 tch3 enth3 sup3
                  ack3fp imi3fp elab3fp gaze3fp pos3fp
                  voc3fp rang3fp con3fp res3fp tch3fp enth3fp
                  sup3fp ack3so imi3so elab3so gaze3so pos3so
                  voc3so rang3so con3so res3so tch3so enth3so
                  sup3so ack3te imi3te elab3te gaze3te pos3te
                  voc3te rang3te con3te res3te tch3te enth3te
                  sup3te ack3pb imi3pb elab3pb gaze3pb pos3pb
                  voc3pb rang3pb con3pb res3pb tch3pb enth3pb
                  sup3pb base post0 post20 post40 aucg;
            USEVARIABLES ack3 gaze3 voc3 rang3 con3 res3 tch3;
            MISSING ARE ALL (999);
            CLASSES = c(5);

ANALYSIS:   TYPE = MIXTURE;
            STARTS = 1000 100;
            LRTSTARTS = 0 0 100 20;

OUTPUT:     tech11 tech14;
```

```
TITLE:      Equality test of means for maternal sensitivity profile indicators for the 4-class
            solution

DATA:       FILE IS matsenscort_dup.dat;
            TYPE IS individual;

VARIABLE:   IDVARIABLE = pid;
            NAMES ARE pid ack imi elab gaze pos voc rang con
                    res tch enth sup ack1 imi1 elab1 gaze1 pos1 voc1
                    rang1 con1 res1 tch1 enth1 sup1 base post0 post20
                    post40 time lastslp lasteat react recov;
            USEVARIABLES ack gaze voc rang con res tch;
            MISSING ARE ALL (999);
            CLASSES = c(4); !change to 5 to estimate the 5-class solution

            !Duplicate variable for each indicator entered as an auxiliary. Otherwise, the LCA
            is estimated without that indicator.

            AUXILIARY = ack1 (BCH);
            AUXILIARY = gaze1 (BCH);
            AUXILIARY = voc1 (BCH);
            AUXILIARY = rang1 (BCH);
            AUXILIARY = con1 (BCH);
            AUXILIARY = res1 (BCH);
            AUXILIARY = tch1 (BCH);

ANALYSIS:   TYPE = MIXTURE;
            STARTS = 1000 100;
            LRTSTARTS = 0 0 100 20;

OUTPUT:     tech11 tech14;
```

```
TITLE:      Equality test of means for cortisol sample means among maternal
            sensitivity profiles for the 4-class solution

DATA:       FILE IS matsenscort.dat;
            TYPE IS individual;

VARIABLE:   IDVARIABLE = pid;
            NAMES ARE pid ack imi elab gaze pos voc rang con
                  res tch enth sup base post0 post20 post40
                  time lastslp lasteat react recov dhoft dhmuch pss depr;
            USEVARIABLES ack gaze voc rang con res tch;
            MISSING ARE ALL (999);
            CLASSES = c(4); !change to 5 to estimate the 5-class solution
            AUXILIARY = base (BCH);
            AUXILIARY = post0 (BCH);
            AUXILIARY = post20 (BCH);
            AUXILIARY = post40 (BCH);

ANALYSIS:   TYPE = MIXTURE;
            STARTS = 1000 100;
            LRTSTARTS = 0 0 100 20;

OUTPUT:     tech11 tech14;
```

```
TITLE:      Equality test of means for cortisol reactivity and recovery, and indices of risk
            among maternal sensitivity profiles for the 4-class solution

DATA:       FILE IS matsenscort.dat;
            TYPE IS individual;

VARIABLE:   IDVARIABLE = pid;
            NAMES ARE pid ack imi elab gaze pos voc rang con
                  res tch enth sup base post0 post20 post40
                  time lastslp lasteat react recov dhoft dhmuch pss depr;
            USEVARIABLES ack gaze voc rang con res tch;
            MISSING ARE ALL (999);
            CLASSES = c(4); !change to 5 to estimate the 5-class solution
            AUXILIARY = react (BCH);
            AUXILIARY = recov (BCH);
            AUXILIARY = dhoft (BCH);
            AUXILIARY = dhmuch (BCH);
            AUXILIARY = pss (BCH);
            AUXILIARY = depr (BCH);

ANALYSIS:   TYPE = MIXTURE;
            STARTS = 1000 100;
            LRTSTARTS = 0 0 100 20;

OUTPUT:     tech11 tech14;
```