Infant Temperamental Reactivity and Emerging Behavior Problems in a Mexican American Sample

by

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ABSTRACT

Clinically meaningful emotional and behavioral problems are thought to be present beginning in infancy, and may be reliably assessed in children as young as 12 months old. However, few studies have investigated early correlates of emotional and behavioral problems assessed in infancy. The current study investigates the direct and interactive contributions of early infant and caregiver characteristics thought to play an important role in the ontogeny of behavior problems. Specifically, the study examines: (1) the links between temperamental reactivity across the first year of life and behavior problems at 18 months, (2) whether children high in temperamental reactivity are differentially susceptible to variations in maternal sensitivity, (3) the extent to which child temperamental risk or susceptibility may further be explained by mothers' experiences of stressful life events (SLEs) during and before pregnancy. Data were collected from 322 Mexican American families during prenatal, 6-, 12-, 18-, and 24-week home interviews, as well as during 12- and 18-month lab interviews. Mother reports of SLEs were obtained between 23-40 weeks gestation; temperamental negativity and surgency at 6 weeks and 12 months; and internalizing and externalizing behaviors at 18 months. Maternal sensitivity during structured mother-infant interaction tasks at the 6-, 12-, 18-, and 24-week visits was assessed by objective observer ratings. Study findings indicated that maternal SLEs before birth were associated with more infant negativity across the first year of life, and that negativity in turn was associated with more internalizing problems at 18 months. Ecological stressors thought to be associated with sociodemographic risk factors such as low-income and ethnic minority status may begin to exert cascades of influence on children's developmental outcomes even before birth.

To my parents,

who dared to take on the important yet terrifying feat of pregnancy,

and the even more challenging task of parenting me.

And to all mothers who have been faced with

the dilemma of developing concern,

but not too much concern,

for infants' development even before birth.

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INTRODUCTION

The last several decades of research in developmental psychopathology have converged on the notion that psychopathology is the culmination of the history of transactions between child, parent, and other environmental characteristics that begin even before an individual is born (Sroufe, 2009). In fact, it is now well-established that the least favorable adjustment outcomes befall those who begin to show signs of problem behavior early in life and whose maladaptive behaviors persist over time and across interactions (Keenan, Shaw, Delliquadri, Giovannelli, & Walsh; Moffitt, 1993; Poehlmann, Burnson, & Weymouth, 2014). Correspondingly, much effort has been paid to identifying pathways that confer risk for behaviors problems emerging early on. Although children are not typically diagnosed with psychological or psychiatric disorders before age 2 years, clinically meaningful emotional and behavioral problems are thought to be present beginning in infancy (i.e., before age 2 years; Briggs-Gowan et al., 2013; Zeanah, 2009). Indeed, scholars have demonstrated that emotional and behavioral problems may be reliably assessed in children as young as 12 months old (see Bagner, 2013 for a review), and further that problems identified in infancy show stability through the preschool years (Briggs-Gowan, Carter, Bosson-Heenan, Guyer, & Horwitz, 2006; van Zeijl et al., 2006). Nonetheless, few studies have investigated correlates of emotional and behavior problems assessed in infancy.

Children's behavior problems are largely thought of as comprising two broad domains: externalizing and internalizing problems (Achenbach, 1966). Externalizing behaviors include outwardly directed behaviors such as aggression, impulsivity, hyperactivity, and noncompliance considered to be "in conflict with the environment"

(Achenbach, 1966, p. 10), and may precede the onset of oppositional defiance, conduct disorder, and other antisocial tendencies. Internalizing problems include inwardly directed behaviors such as excessive sadness, worry, and fear considered to be "in conflict with the self" (Achenbach, 1966, p. 10), and may develop into depression, anxiety, and other mood disorders.

One risk factor that has emerged consistently as a predictor of both internalizing and externalizing problems is temperamental reactivity. Temperamental reactivity is largely regarded as comprising two broadband dimensions – negativity and surgency, or negative and positive reactivity – both of which characterize predispositions to experience arousal more quickly, intensely and frequently than is considered situationally or socially appropriate. This heightened arousability in turn is believed to render highly reactive children particularly dependent on the quality of regulatory supports compared to their low reactive counterparts. Though numerous studies have linked negativity with increased risk for both internalizing and externalizing problems, relatively little is known about the extent to which its positive counterpart, surgency, directly or interactively influences problem behavior development.

Historical conceptualizations have largely interpreted the increased dependency of highly reactive children as a risk factor for maladjustment, in which children with dispositional risks (risk 1) are less resilient in the face of environmental adversity (risk 2) (i.e., dual risk model; Sameroff, 1983). In contrast, alternate theories have recently proposed that highly reactive children's heightened dependency may actually reflect their increased plasticity to both negative *and* positive environmental influence (e.g., differential susceptibility; Belsky, 1997). However, the extent to which dual-risk or

differential susceptibility processes better explain relations between temperamental reactivity and behavior problems remains to be clarified. Finally, though much attention has been paid to clarifying risk processes in the early postpartum environment, an emerging literature suggests that some of the risk processes may be the results of cascading influences set in motion even before infants are born. The current study investigates the extent to which transactions between child and caregiver characteristics across the prenatal and early postnatal environment contribute to the development of internalizing and externalizing problems.

Temperamental Reactivity and Child Adjustment

Temperamental reactivity reflects constitutional differences in children's emotional, motor, and attentional reactivity to the environment. Highly reactive children may be at greater risk for maladjustment given their tendencies to experience more intense arousal than is considered situationally or socially appropriate (Blair, Peters, & Granger, 2004; Bruce, Davis, & Gunnar, 2002), and to have more difficulty modulating that arousal (Bridgett et al., 2009; Kagan, 1989). Both dimensions of temperamental reactivity (i.e., negativity and surgency) may predispose risk for the development of internalizing and externalizing behavior problems.

Negativity encompasses general negative mood, fear, and anger responses, and presupposes risk both by implicating the relative frequency of the distress response and by creating more opportunities for negative responding by others (Belsky, 1997; Lee & Bates, 1985). In fact, negativity present as early as infancy has been linked to adjustment outcomes through middle childhood and even adulthood (Bohlin & Hagekull, 2009; Letcher, Smart, Sanson, & Toumbourou, 2009). Children higher in negativity are

particularly likely to perceive neutral events as threatening, and frequently experience heightened levels of physiological arousal (Gilissen, Koolstra, van Ijzendoorn, Bakermans-Kranenburg, & van der Veer, 2007; Marshall, Reeb, & Fox, 2009; Nakagawa & Sukigara, 2012). This heightened arousal may in turn compromise children's capacities to activate effective self-regulatory strategies in the face of distress (Calkins, Dedmon, Gill, Lomax, & Johnson, 2002; Kagan, 1989), and thus render highly reactive children particularly dependent on the presence of external regulatory supports. Indeed, highly negative children have been found to be particularly sensitive to variations in the quality of parenting behaviors that help to coregulate children's emotions and behaviors (Belsky, Hsieh, & Crnic, 1998; van Aken, Junger, Verhoeven, van Aken, & Deković, 2007). In a study that followed 125 boys from infancy to toddlerhood, Belsky and colleagues (1998) found that infants rated high in negativity were more than twice as likely to develop internalizing and externalizing behavior problems two years later when exposed to negative parenting practices compared to their low-negative counterparts (Belsky et al., 1998). Given tendencies to experience distress, decreased capacities for self-regulation, and increased dependence on the presence of quality regulatory support, negativity may represent an important risk factor for understanding the ontogeny of behavior problems.

Surgency encompasses elements of positive mood, impulsive approach, high intensity activity, and reward sensitivity, and has been implicated as both a risk and protective factor for the development of problem behaviors. For example, the positive mood associated with surgency is believed to serve a protective function that buffers against the deleterious influences of negative mood associated with the development of externalizing and especially internalizing problems (Gartstein, Putnam, & Rothbart,

2012). In contrast, the excitability associated with surgency increases children's proclivities for impulsive and high-intensity responding, both of which are characteristic of externalizing symptomatology (Rothbart, Derryberry, & Hershey, 2000). Although relatively little is known about the role surgency plays in the development of behavior problems, some evidence exists to suggest that both low *and* high surgency may differentially confer risk for internalizing or externalizing problems.

Children low in surgency are characterized by low positive mood, low approach tendencies, and low tolerance for high-intensity stimuli, and may be more likely to experience wariness, fear, or negative arousal generally. Perhaps related to their low approach tendencies, children rated as low in surgency are more likely to employ passive, avoidant coping strategies, which may in turn increase risk for internalizing distress (Lengua, Sandler, West, Wolchik, & Curran, 1999; Planalp & Braungart-Rieker, 2015). Though some studies have documented relations between low positive affect and internalizing distress in adolescent samples (e.g., Fox, Halpern, Ryan, & Lowe, 2010; Phillips, Lonigan, Driscoll, & Hooe, 2002), few studies have investigated their relations in earlier childhood. One study by Dollar and Buss (2014) found that toddlers who displayed less positive affect and fewer approach behaviors (i.e., characteristics of surgency) during threatening episodes were rated as higher in internalizing symptomatology two years later. Though this study could not rule out the possibility that behaviors they characterized as low positive affect and low approach were not better explained by fear responses (i.e., high negative affect and high inhibition), a study by Gartstein and colleagues (2012) likewise found that low surgency in toddlers and preschoolers was associated with concurrent internalizing problems even *after* partialling

out the effects of negativity. Low surgency may play a unique role in the development of internalizing problems over and above implied experiences of negativity, although this has not yet been fully demonstrated.

Children high in surgency may enjoy some protection from internalizing problems, but may also be at risk for a range of externalizing problems including aggression, inattention, risk-taking behaviors, unintentional self-injury, hyperactivity and other disruptive behavior problems (Berdan, Keane, & Calkins, 2008; Berry & Schwebel, 2009; Martel, Gremillion, & Roberts, 2012). Given their strong tendencies for approach, children high in surgency may be less likely to think and plan through their actions and more likely to act impulsively (Rothbart et al., 2000). These impulsive actions, in turn, may create more opportunities for experiencing anger and frustration by way of self- (e.g., initiation of complex activities, difficulty problem solving) and caregiver-imposed (e.g., limit setting) goal blockage (Calkins, 2009). Children high in surgency may also be more likely to become dysregulated in the face of these disappointments or challenges (Dennis, Hong, & Solomon, 2010; Stifter, Putnam, & Jahromi, 2008). For example, Dennis and colleagues (2010) found that preschoolers higher in surgency became more dysregulated and negatively labile when they were presented with challenging tasks compared to their low surgency counterparts. Finally, because children high in surgency are drawn to engage with many aspects of their environment, they may also have more difficulty filtering through irrelevant information and accordingly struggle more with problems of inattention (González, Fuentes, Carranza, & Estévez, 2001).

Another possibility is that relations between surgency and behavior problems may better be understood if its interaction with negativity is also considered. In spite of

conceptual postulations that the different dimensions of temperament may interact with one another to magnify or buffer against risks for problem behaviors, surprisingly few studies have examined interactions between negativity and surgency. In one study that did, Dougherty and colleagues (2010) found that children who were rated both low in positive emotionality and high in negativity at age 3 years evidenced the most increases in depressive symptoms at age 10. Similarly, Lonigan and colleagues (2003) found that fourth to eleventh graders' who self-identified as low in positive affect and high in negative affect were more likely to report feelings of anxiety and depression seven months later. In contrast, Gartstein and colleagues (2012) found that preschoolers rated as higher in negativity were more likely to develop internalizing behavior problems when they were also rated as higher in surgency compared to when they were rated low in surgency. Further attention to the interaction between negativity and surgency may lend important information about relations between temperamental reactivity and behavior problems.

Reactivity, Maternal Sensitivity, and Child Adjustment

Whereas predispositions to experience arousal may increase risk for poor adjustment, environmental factors including parenting behaviors may mitigate or exacerbate those risks. In particular, caregiver sensitivity has been identified as one of the most important caregiver characteristics during the early childhood period for predicting later adjustment outcomes (De Wolff & van Ijzendoorn, 1997). *Sensitivity* has been defined as the caregiver's availability, attentiveness, and responsiveness to infant cues according to the infant's age appropriate growth needs (Ainsworth, Blehar, Waters, & Wall, 1978). Sensitive caregivers who recognize and respond appropriately to infant

distress cues help to co-regulate highly reactive infants' heightened emotional and physiological arousal states.

In a study examining infant physiological (i.e., cortisol) reactivity and regulation in response to a mild stressor (i.e., routine bathing by their mothers) in three-month-old infants, Albers and colleagues (2008) found that infants showed increases in physiological arousal during bathing but that infants with sensitive mothers were able to recover more quickly. Similarly, Gunnar and colleagues (1992) found that 9-month-old infants provided with sensitive, responsive babysitters during mother separation episodes experienced fewer increases in physiological arousal compared to infants whose babysitters ignored them unless they cried. Beyond effects of caregiver sensitivity to immediate experiences of arousal, consistently sensitive interactions over time may even re-program infants' physiological stress response in a way that reduces infants' overall experiences of distress (Gunnar & Donzella, 2002). In fact, caregiver sensitivity has been found to predict reductions in infants' negativity *and* surgency over time (Blandon, Calkins, Keane, & O'Brien, 2010; Braungart-Rieker, Hill-Soderlund, & Karrass, 2010). In a study that examined the trajectory of temperamental negativity from 4 to 16 months, Braungart-Rieker and colleagues (2010) found that infant negativity was related to increasing levels of negative affect during frustration tasks, but that infants whose mothers were rated as more sensitive showed slower increases in negativity over time. Similarly, Blandon and colleagues (2010) found that maternal positive parenting (i.e., warmth, positive affect, and sensitivity) predicted decreasing trajectories of surgency across child ages 4 to 7 years.

Maternal sensitivity has also emerged as a consistent predictor of reduced externalizing problems through adolescence (Feldman, 2010; Miner & Clarke-Stewart, 2008; NICHD Early Child Care Research Network, 2003). For example, Feldman (2010) found that children who consistently received lower levels of maternal sensitivity across each of six time points from 3 months to 13 years were more likely to report higher levels of emotional and behavioral disturbance at 13 years. Fewer studies have investigated contributions of maternal sensitivity to internalizing problems, but similar, albeit less consistent findings suggest that maternal sensitivity is associated with fewer internalizing problems (Kok et al., 2013; Meins, Centifanti, Fernyhough, & Fishburn, 2013; van der Voort et al., 2014).

Differential Susceptibility or Dual-Risk?

Extant research that has examined relations between child reactivity and behavior problems has largely assumed a dual-risk (DR) framework, wherein child reactivity (risk 1) is believed to increase susceptibility to the negative influences of environmental adversity (risk 2) (Sameroff, 1983). For example, Belsky and colleagues (1998) found that although infant negative emotionality at 10 months of age did not significantly contribute to the presence of child behavior problems at 3 years, it did interact with lower quality parenting to significantly predict child behavior problems. Furthermore, whereas parenting accounted for as much as 27% of the variance in child behavior problems for children identified as high in negative emotionality, it accounted for only 4% of the variance for children identified as low in negative emotionality. From the perspective of dual-risk and diathesis stress frameworks, these child characteristics are believed to be

markers of *risk* that render children particularly susceptible to the negative effects of parenting.

However, in recent years, scholars have begun to question whether these "risk" designations accurately represent the nature of child characteristics. Instead, some have speculated that child proclivities for emotional and physiological arousal may instead reflect child *plasticity* to negative *and* positive environmental influence (Differential Susceptibility Hypothesis; Belsky, 1997; Biological Sensitivity to Context; Boyce & Ellis, 2005). Drawing from insights in evolutionary theory, Belsky (1997) has suggested that because the adverse child outcomes (e.g., aggression) typically associated with behavioral reactivity may be adaptive in certain contexts (e.g., in inner-city environments in which self-defense may be necessary), promulgation of characteristics that confer plasticity to a range of environmental contexts would be evolutionarily sensible. Moreover, if a wide range of behaviors may be advantageous depending on the child's environment and if a range of environments exists, then it could actually be highly adaptive for a child to possess plastic characteristics that modulate child functioning in response to warm or hostile experiences during the early childhood years (Belsky, 1997).

In contrast, child characteristics that have typically been viewed as conferring "resilience" may actually represent rigidity to environmental context, such that children with such resilient characteristics would look similar in contexts of unsupportive parenting as they would in contexts of supportive parenting. In the frame of the differential susceptibility hypothesis then, children with plasticity characteristics would be capable of both the worst adjustment (in terms of psychological functioning, but not in terms of evolutionary fitness) in response to negative parenting practices and also the best

adjustment in response to positive parenting practices compared to their resilient counterparts.

Insofar as plasticity markers may be characteristics that render children particularly sensitive to environmental influence, it seems sensible to conjecture that predispositions for reactivity (i.e., heightened arousal in response to the environment) may well be reflections of child plasticity. Indeed, some evidence has emerged to suggest that children high in negativity exhibit the most and fewest externalizing behavior problems under conditions of unsupportive and supportive caregiving environments, respectively (Bradley & Corwyn, 2008; Pluess & Belsky, 2009, 2010). For example, a series of studies conducted through the NICHD Study of Early Child Care and Youth Development (SECCYD) yielded findings supportive of the notion that children with a "difficult" temperament style (characterized in large part by high levels of negativity) in infancy exhibit the most and fewest externalizing behavior problems in middle childhood in response to low and high quality caregiving (i.e., maternal sensitivity; Bradley & Corwyn, 2008; childcare quality; Pluess & Belsky, 2009, 2010) compared to their "easy" counterparts. At least one study has considered surgency as a possible marker of differential susceptibility. Cipriano and Stifter (2010) found that more exuberant 2-year-olds exhibited the most and least effortful control at age 4.5 years when mothers engaged in higher and lower levels of positive behavior support, respectively, compared to their low reactive and inhibited counterparts. It is conceivable that the heightened sensitivity to environmental conditions implicated by reactivity, and not only negative reactivity, is what renders children differentially susceptible to their environments, although this remains to be explicated.

Prenatal Programming of Infant Susceptibility Factors

Dodge and Pettit (2003) have suggested that the developmental story of problem behaviors begins with biological predispositions present at or near birth. One factor that has been identified as a risk factor for offspring development is maternal stress during pregnancy. Indeed, mothers' reports of stress, anxiety and depression during pregnancy have been linked to child negative mood, oppositional, aggressive and hyperactive behavior problems at child ages two, four and six years even after controlling for infant birth outcomes, socioeconomic disadvantage, maternal postnatal anxiety and depression (Gutteling et al., 2005; O'Connor, Heron, Golding, & Glover, 2003). The process by which maternal stress during pregnancy impacts infant developmental outcomes has been described as "fetal programming", where exposure to maternal stress during the sensitive period of development is believed to result in structural or functional changes in the fetus that persist throughout life (Seckl, 2001). One hypothesis that may explain relations between maternal prenatal stress and behavior problems is that exposure to maternal stress programs infants' tendencies for reactivity (Pluess & Belsky, 2011).

Continuing to extend upon evolutionary foundations of differential susceptibility, Pluess and Belsky (2011) have suggested that insofar as conditions of the prenatal environment (i.e., maternal health) may serve as a proxy for the conditions of the postnatal environment (i.e., ease of access to psychological or physical resources), exposure to adverse prenatal environments (i.e., maternal stress) may result in the programming of child characteristics that increase evolutionary fitness (i.e., child plasticity). Indeed, a number of studies have linked maternal prenatal stress to negativity and to generally difficult temperament styles. For example, Zuckerman and colleagues

(1990) found that infants whose mothers reported higher levels of depressive symptomatology during pregnancy tended to cry more during a post-delivery physical examination and also to be less responsive to pediatricians' attempts at soothing. Similarly, Huizink and colleagues (2002) found that mother reports of moderately high levels of perceived stress during pregnancy predicted infant difficult temperament style (i.e., high negative mood, withdrawal, high intensity behaviors, irregular infant states) in their three-month-old infants. Furthermore, the effects of maternal prenatal stress, anxiety, and depression have been found to predict infant negative emotionality through age 5 (Martin, Noyes, Wisenbaker, & Huttunen, 1999), even after controlling for maternal postnatal mood (Huot, Brennan, Stowe, Plotsky, & Walker, 2004; McGrath, Records, & Rice, 2008).

Very few studies have considered possible influences of maternal prenatal stress on surgency, and few or no studies have examined whether temperamental characteristics resultant of maternal prenatal stress may predict differential susceptibility to the postnatal environment. One study that did consider the influences of maternal prenatal stress on infant surgency found that mother reports of prenatal stress were associated with more negativity, but not surgency, 6 months later (Pesonen, Räikkönen, Strandberg, & Järvenpää, 2005); of note, mother reports of prenatal stress were obtained retroactively shortly after delivery. This contrasts with findings reported by Lin, Crnic, Luecken, and Gonzales (2014), in which maternal prenatal stress was associated with more infant negativity and surgency at 6 weeks. The current study extends previous findings by exploring whether infant reactivity attributable to prenatal stress is differentially susceptible to postnatal influence (Pluess & Belsky, 2011).

High-Risk Context

Mexican American youths are more likely to engage in risky behaviors; to experience less academic achievement, more emotional problems, and more health problems; and to be involved more often in the criminal justice system compared to their Caucasian counterparts (Cauce, Cruz, Corona, & Conger, 2011; Gross, Sambrook, & Fogg, 1999), and yet less is known about processes that influence socioemotional development in Mexican American children than most other ethnic groups (Carlo & de Guzman, 2009). In concert with suggestions that both minority and low-income status may exacerbate risk for behavior problems (Corwin et al., 2013; Kohen, Brooks-Gunn, Leventhal, & Hertzman, 2002), the current study's sample of low-income, Mexican American families represents an ideal context for investigating the complex, transactional interactions that link MPS to the development of internalizing and externalizing problems.

Moreover, Mexican American mothers are believed to experience a health disparity, with disproportionately higher rates of postpartum distress compared to their Caucasian counterparts (Gress-Smith, Luecken, Lemery-Chalfant, & Howe, 2012), and thus may also experience higher rates of prenatal stress. And yet, the influence of prenatal stress on child developmental outcomes in Mexican Americans is unclear. In fact, some studies that have examined the links between prenatal stress and infant birth outcomes in Mexican Americans have even found that Hispanic infants exposed to prenatal stress actually experience superior birth outcomes compared to their Caucasian counterparts (Jahromi, Umaña-Taylor, Updegraff, & Lara, 2012). Many of these studies speculate about the possible presence of an "epidemiological paradox", in which cultural ties buffer against the negative influences of prenatal stress on infant birth outcomes. However, one

of the few studies that has examined the influence of maternal distress to infants' later adjustment suggests that the deleterious effects of fetal exposure to maternal distress may still be present (Field et al., 2002). Comparing pre- and post-partum influences of maternal prenatal depression on newborn physiological and behavioral regulation in Hispanic and Black mothers, Field and colleagues found that although Hispanic infants evidenced more signs of physiological (i.e., higher dopamine and lower cortisol levels) and behavioral (i.e., more regulated sleep patterns) regulation postpartum, they showed more signs of risk for poor regulatory development in-utero (i.e., more fetal activity) than their Black counterparts. However, whether or not these risks observed prenatally has implications for postpartum adjustment is still largely unknown.

Current Study

The current study investigates the extent to which child dispositional characteristics may directly or interactively influence the development of early internalizing and externalizing behaviors, as well as whether those dispositional characteristics may be associated with maternal stress during or immediately preceding the prenatal period. The current study has four specific aims: (1) To clarify the nature of relations between temperamental reactivity at 6 weeks and behavior problems at 18 months, (2) to investigate whether maternal sensitivity across the first year of life moderates the relations between early reactivity and later behavior problems, (3) to examine the extent to which child susceptibility for behavior problems may be explained by exposure to stressful life events during pregnancy or proximal to conception and (4) to consider findings within the context of two competing frameworks: dual-risk and differential susceptibility.

Aim 1. Relations between Temperamental Reactivity and Early Behavior Problems. The current study will investigate the direct and interactive effects of negativity and surgency on the development of internalizing and externalizing problems. Higher negativity is hypothesized to predict higher levels of internalizing and externalizing problems. Higher surgency is hypothesized to exert an average (main) effect on externalizing (more externalizing problems), but not internalizing problems. Instead, surgency will interact with negativity to predict internalizing problems, such that children low in surgency and high in negativity will have the most internalizing problems.

Aim 2. Interactions between Temperamental Reactivity and Maternal Sensitivity. The current study will examine whether maternal sensitivity moderates the relation between temperamental reactivity and behavior problems. Maternal sensitivity is hypothesized to interact with negativity in a manner consistent with the differential susceptibility hypothesis, such that children high in negativity will exhibit the most and fewest behavior problems under conditions of low and high maternal sensitivity, respectively; children low in negativity and surgency will exhibit moderate levels of behavior problems regardless of maternal sensitivity. Maternal sensitivity is likewise expected to interact with surgency to predict the most and fewest externalizing problems. Given that low surgency reflects low reactivity to environmental conditions, no relations are expected to emerge between maternal sensitivity and surgency in the prediction of internalizing problems. The current study will also explore a 3-way interaction between negativity, surgency, and maternal sensitivity. However, because these analyses are exploratory, no specific hypotheses regarding expected findings are made.

Aim 3. Influence of Prenatal Stress on Infant Susceptibility Characteristics. The current study extends previous findings by Lin and colleagues (2014) in which prenatal stress was associated with higher levels of negativity and surgency. Relations between maternal stress and behavior problems, and the extent to which temperamental reactivity may mediate those relations, will be explored. Maternal stress is hypothesized to predict higher levels of internalizing and externalizing problems at 18 months, but those relations are expected to be partially mediated by negativity and surgency.

METHODS

Participants

The current study included data collected from a larger prospective longitudinal study, Las Madres Nuevas. Participants were 322 mother-infant dyads from low-income, Mexican American families recruited through a health clinic in the southwestern United States. Of women who were eligible, 56% agreed to schedule a home visit, at which time informed consent was obtained. Eligibility criteria included fluency in either Spanish or English, self-identification as Mexican American, anticipated delivery of a singleton (based on ultrasound results). Low-income status was determined by eligibility for Medicaid or Federal Emergency Services coverage, or self-reported annual income below $25,000. Attrition through the 18-month period is approximately 7% (n=22). Demographic characteristics are displayed in Table 1. At the time of enrollment, mothers were on average 28 years old and had completed 10 years of education. Most mothers were born in Mexico (86%), spoke in Spanish as their primary language (82.2%), and had

been living the U.S. for 12 years (range 0-32). Most mothers were unmarried but living with a romantic partner (48%), had an annual household income of $10,001-15,000 (27%) to support 4 people.

Procedures

Participation in the study involved one prenatal home visit (23-40 weeks gestation), four home visits during the first six postpartum months (6, 12, 18, and 24 weeks), and laboratory visits at 12 and 18 months. Data collection time points were corrected for infant gestational age when infants were born prior to 37 weeks gestation (*n*= 10; one infant was born at 26 weeks, and 9 were born at 36 weeks. Because there was no evidence that any of the infants suffered health problems or were outliers, all infants were retained for analyses). LMN employs a planned missingness design (Graham, Taylor, Olchowski, & Cumsille, 2006); all participants were expected to complete the prenatal, 6-week, and 12-month interviews, but each participant was randomly assigned to miss one of the data collection points at 12-, 18-, or 24-weeks. Data in planned missingness designs are systematically missing completely at random (MCAR; Rubin, 1976). This design allows the opportunity to collect data from more participant families by allowing fewer data collections while only minimally affecting power (Graham et al., 2006). The current study corrected for planned missingness using full information maximum likelihood (FIML; Allison, 2003).

Home and Laboratory Visits. Interviews were completed in participants' homes (prenatal, 6, 12, 18, and 24 months) or in the laboratory (12, 18 months) in mothers' choice of Spanish (82% at the prenatal visit) or English (18%). Questions were read aloud to reduce error variance due to participant literacy. Mothers were also given visual

aids with written and graphic descriptions of item response choices. Interviews were scheduled for approximately 2.5 hours, and women were paid for their participation.

Interaction tasks. Observational data were obtained from structured mother-infant interactions during the 12-, 18-, and 24-week home visits and were recorded with two high-definition cameras for later coding.

Measures

Maternal Stress. Mothers' self-reports of stressful life events (SLEs) were obtained using 13 items from the Pregnancy Risk Assessment Monitoring System (CDC: Centers for Disease Control and Prevention, 2009-2011) during the prenatal home visit. Scores were formed by summing the count of SLEs (out of 13) that mothers reported experiencing in the last 12 months. Sample items include "You moved to a new address" (endorsed by 44.7% of mothers), "Your husband or partner lost his job" (33.5%), and "You had a lot of bills you couldn't pay" (33.2%). These items have demonstrated good concurrent and predictive validity (e.g., Nkansah-Amankra, Luchok, Hussey, Watkins, & Liu, 2010).

Infant Temperamental Reactivity. Maternal ratings of infant temperamental reactivity were obtained at the 6-week and 12-month time point using the negativity and surgency dimensions of the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003). Three of the original 40 items comprising the surgency dimension were omitted due to programming errors (items 28-30) that affected the 6-week time point only. Mothers' ratings of infant temperament at 6 weeks were significantly correlated with later ratings at 12 months (negativity, r=.23, p=.002; surgency, r=.16, p=.03). Composite

negativity and surgency scores were formed by averaging dimension scores at the 6-week and 12-month time points to reflect temperamental reactivity across the first year of life.

Maternal Sensitivity. Maternal sensitivity was assessed during naturalistic mother-infant interactions video recorded at the 12-, 18-, and 24-week time points using the Coding Interactive Behaviors coding system (CIB; Feldman, 1998). Twenty maternal behaviors were rated on a 5-point scale by teams of coders, 11 of were averaged to form a composite maternal sensitivity score following Feldman (1998): acknowledging, parent gaze, positive affect, vocal appropriateness, appropriate range of affect, resourcefulness, affectionate touch, and parent supportive presence. A composite maternal sensitivity score was computed by averaging ratings of maternal sensitivity across each of the time points to serve as a proxy for maternal sensitivity across the first year of life. Observer ratings of maternal sensitivity at all time points were significantly correlated with ratings at each of the other time points (*r*'s ranged from .24 to .45). Coders were trained to 85% agreement within +/- 1 point; inter-rater reliability for the CIB system across the Free Play, Soothing, Teaching, and Peek-A-Boo tasks was 91.4%. Four interaction sequences were chosen to provide optimal opportunities to observe maternal sensitivity:

- *Free Play (5 minutes)*. This is meant to be an unstructured "warm up" context during which the mothers were instructed to play with their infants as they usually would when alone.
- *Soothing (3 minutes)*. Following a frustrating Arm Restraint task in which mothers were asked to hold infants' arms/hands down while the interviewer enticed infants' with a colorful book, mothers were asked to soothe their infants as they usually would.

- *Teaching Task (5 minutes).* Mothers were provided with a set of objects and were asked to teach their infants a particular skill or task. Tasks were selected from the Mental Scale of Bayley Scales of Infant Development III (Bayley, 1993) and reflect skills one to two months beyond the infant's capabilities, creating a context for both mother and infant to experience mild frustration or challenge.
- *Peek-A-Boo (3 minutes)*. Mothers were given a shield and asked to play peek-a-boo with their infants as they usually would when they play together alone. This task is typically an engaging and positive experience and provides a context for co-regulation of positive affect in the dyad.

Early Behavior Problems. Mother-reports of child internalizing and externalizing behavior problems were obtained using the Brief Infant-Toddler Social and Emotional Assessment (BITSEA; Briggs-Gowan, Carter, Irwin, Wachtel, & Cicchetti, 2004) during the 18-month lab visit. The BITSEA has demonstrated good test-retest reliability and interrater agreement and has been validated for use with children ages 12-36 months.

Data Analytic Plan

Covariates. Demographic information and infant birth outcomes were considered as possible covariates in the present study. Demographic information was obtained prenatally either during recruitment or at the prenatal home interview. Infant birth outcomes (gestational age, birth weight, 5-minute APGAR, and gender) were obtained from hospital birth records. The criterion established pre-hoc for covariate inclusion was that variables that were significantly correlated with both independent and dependent variables would be controlled for in study analyses.

Missing data handling. Following recommendations in Enders (2010), an inclusive analysis strategy was employed, and potential auxiliary variables were identified. Auxiliary variables are variables that are ancillary to the specific aims of the current study but potential correlates of missingness and/or of key study variables with missingness. Including auxiliary variables in models reduces bias in parameter estimates and increase power (Collins, Schafer, & Kam, 2001). Binary missing data indicators were coded for all key study variables (0=observed; 1=missing). Demographic variables and variables that were thought to be theoretically related to key study variables with missing data (i.e., observer ratings of infant, mother, and dyadic dysregulation at 12, 18, and 24 weeks; internalizing and externalizing problems at 12 months) were correlated with key study variables and their binary missing data indicators to identify possible auxiliary variables. Variables were entered as auxiliary variables if the strength of their correlation with key study variables or missingness for key study variables was $r \geq .30$.

Hypothesis Testing. Hypotheses were tested with a path analysis model using structural equation modeling (SEM) in Mplus 6.2 (Muthén & Muthén, 2010). All continuous variables were centered and all categorical variables were be dummy coded to reduce nonessential multicollinearity (Cohen, Cohen, West, & Aiken, 2003). To test the general fit of the proposed conceptual model, a χ^2 test of fit and a root mean square error of approximation (RMSEA) were be calculated. Indirect (mediated) effects of prenatal stress on temperamental reactivity and behavior problems were assessed using the MODEL INDIRECT command.

RESULTS

Preliminary Analyses

Descriptive information about key study variables is presented in Table 1. On average, mothers reported having experienced 2-3 SLEs within the 12 months preceding the prenatal interview (range = 1-11 events). Over 85% of mothers reported having experienced at least 1 SLE, and over 63% reported having experienced at least 2 SLEs (compared to 42.1% and 32.6%, respectively, in a national sample of 23,795 mothers; Kitsantas, Gaffney, & Cheema, 2012). Mothers' reported on average higher levels of surgency than negativity. On average, infants were rated as exhibiting behaviors characteristic of temperamental surgency between half and less than half of the time, and exhibiting behaviors characteristic of negativity rarely or less than half the time. Observer ratings of maternal sensitivity indicated that mothers were on average moderately sensitive. Finally, mean levels of internalizing and externalizing behavior problems were reflective of mothers' reports that their infants exhibited as few as 1-2 symptoms often or as many as 3-4 symptoms some of the time.

Relations between demographics, health-related variables, infant temperament, maternal sensitivity, and early behavior problems were tested using Pearson correlations (see Table 2). Mothers who were older, married or living with a romantic partner, and had higher annual incomes reported fewer SLEs and were rated higher on maternal sensitivity than their counterparts. Mothers who were born outside of the US and preferred to speak in Spanish also reported fewer SLEs. Infant male gender was associated with more externalizing behaviors. Because no demographic or infant health-

related variables were significantly correlated with both independent and dependent variables, no covariates were included in analyses.

Associations between potential auxiliary variables and key study variables and their binary missing data indicators were tested using Pearson correlations. The following variables were correlated with key study variables with missingness at $r \geq .30$ and thus were included as auxiliary variables in analyses: mother dysregulation at 12 weeks (with maternal sensitivity at 18 weeks, r=-.49), mother dysregulation at 18 weeks (with maternal sensitivity at 12 weeks and 24 weeks, rs = -.34, -.38, respectively; and infant surgency at 12 months, r=-.30), and internalizing problems at 12 months (with internalizing at 18 months, r=.34). None of the potential auxiliary variables were correlated with the binary missing data indicators.

Model Results

The full SEM model examined the direct paths between prenatal stress and early internalizing and externalizing problems at 18 months, as well as the indirect pathways flowing through infant temperamental reactivity (see Figure 1). Goodness of fit tests indicate that the model fit well: $\chi 2$ (5) = 5.33, p = .38; RMSEA=0.01; CFI = 1.00; SRMR = 0.02.

Relations between temperamental reactivity and early behavior problems. Model results indicate that negativity (NEG) was significantly correlated with surgency (r=.53, p<.001) and the negativity x surgency interaction (NEGxSUR; r=-.13, p=.02); and that surgency (SUR) was significantly correlated with NEGxSUR (r=-.26, p<.001). Externalizing problems was significantly correlated with internalizing problems (r=.42, p<.001). Examination of paths linking NEG, SUR, and NEGxSUR with internalizing and

externalizing problems indicate that negativity was significantly associated with more internalizing, but not externalizing problems. Neither surgency nor NEGxSUR were significantly associated with internalizing (SUR, *B*=-0.08, *SE*=.09, *p*=.33; NEGxSUR, *B*=-0.07, *SE*=.08, *p*=.37) or externalizing problems (SUR, *B*=-0.02, *SE*=.09, *p*=.80; NEGxSUR, *B*=-0.04, *SE*=.08, *p*=.58).

Interactions between temperamental reactivity and maternal sensitivity. Model results indicate that maternal sensitivity (MS) was significantly correlated with MSxSUR (*r*=-.18, *p*=.001) and MSxNEGxSUR (*r*=.38, *p*<.001); MSxNEG with MSxSUR (*r*=.44, *p*<.001) and MSxNEGxSUR (*r*=-.29, *p*<.001); and SURxMS with MSxNEGxSUR (*r*=-.35, *p*<.001). Neither the maternal sensitivity main effect, nor any of its related interactions was significantly associated with internalizing (MS, *B*=-0.06, *SE*=.08, *p*=.46; MSxNEG, *B*=-0.12, *SE*=.08, *p*=.12; MSxSUR, *B*=0.05, *SE*=.09, *p*=.57; MSxNEGxSUR, *B*=-0.03, *SE*=.08, *p*=.72); or externalizing problems internalizing (MS, *B*=0.03, *SE*=.08, *p*=.72; MSxNEG, *B*=0.02, *SE*=.08, *p*=.81; MSxSUR, *B*=0.10, *SE*=.09, *p*=.28; MSxNEGxSUR, *B*=0.04, *SE*=.09, *p*=.62).

Influence of Maternal Stress on Infant Susceptibility Characteristics. Maternal stress was significantly and positively related to infant negative reactivity, but not to surgency. Given findings that paths linking maternal stress with negativity, and negativity with internalizing problems, the indirect effect of prenatal stress on internalizing problems through negativity was assessed. Results indicated a statistically significant indirect effect at the $p = .05$ level (95% CI [.005, .063]).

DISCUSSION

The current study investigated the extent to which infant and maternal factors present during pre- and postnatal periods may contribute to the development of early behavior problems. Specifically, the study examined the direct and interactive contributions of infant temperamental reactivity and maternal sensitivity to early internalizing and externalizing behaviors, and the extent to which variability in temperamental reactivity could be explained by maternal stress during and immediately preceding the prenatal period. Study findings were suggestive that infants whose mothers reported more SLEs during pregnancy or proximal to conception were higher in negativity during the first year of life, which in turn increased risk for internalizing problems at 18 months.

Temperamental Reactivity and Behavior Problems

The first study aim was to clarify the direct and interactive effects of negativity and surgency on internalizing and externalizing problems. In partial support of study hypotheses, negativity across the first year of life was associated with more internalizing, but not externalizing behaviors at 18 months, whereas surgency was associated with neither internalizing nor externalizing behaviors. The finding that negativity was associated with more internalizing behaviors is consistent with findings reported in literature (e.g., Gartstein et al., 2012; Gartstein, Slobodskaya, Kirchhoff, & Putnam, 2013; Keenan et al., 1998; Shaw, Vondra, Hommerding, Keenan, & Dunn, 1994). For example, one study that examined the associations between temperament in 317 infants (ages 3-12 months) and behavior problems when they were toddlers (18-32 months) and preschoolers (37-59 months), Gartstein and colleagues (2012) found that negativity in

infancy was associated with more internalizing problems in the toddler and preschool years. Moreover, closer examination of associations between the specific subscales comprised by negativity (i.e., shyness, frustration, sadness, discomfort, fear, and low falling rate of reactivity) indicated that each of the subscales was associated with more internalizing problems in the toddler and preschool years except for discomfort, which was not significantly predictive of preschoolers' internalizing behaviors. The current findings further extend upon extant literature by demonstrating the links between infant negativity and internalizing behavior with homogenous assessments of internalizing behaviors at 18 months.

The absence of a connection between negativity and externalizing behaviors was unexpected given their positive associations in literature (e.g., Bohlin & Hagekull, 2009; Edwards & Hans, 2015; Gartstein et al., 2012; Lipscomb et al., 2012), though notably such associations between negativity and internalizing problems have been demonstrated more consistently than with externalizing problems (Bohlin & Hagekull, 2009; Gartstein et al., 2012; Keenan et al., 1998; Shaw et al., 1994). In the same study by Gartstein and colleagues described earlier, infant negativity was associated with more externalizing problems in both the toddler and preschool years. However, closer examination of prediction by each of the specific subscales indicated that only three of the six subscales that form the negativity dimension (i.e., frustration, sadness, low falling rate of reactivity) were associated with externalizing behaviors. Forms of negative reactivity may have important implications for the development of externalizing problems, but links between broadband negativity and externalizing behaviors appear to be less robust. In another study by Keenan and colleagues (1998), infant difficult temperament at 18 months was

associated with internalizing, but not externalizing behaviors at 24 months, and difficult temperament at 24 months was associated with both internalizing and externalizing behaviors at 36 months. The authors speculated that the rates of comorbidity between internalizing and externalizing problems might be lower in earlier childhood and thus children might show differentiation between internalizing and externalizing problems earlier but not later in life. Identification of factors that preedict internalizing and externalizing behaviors in the early childhood period may lend important information about developmental processes that differentially influence problem behavior development.

The finding that surgency had neither direct nor interactive associations with internalizing or externalizing behaviors also contrasted with study hypotheses. Specifically, surgency was expected to exert an average (main) effect on externalizing behaviors (i.e., high surgency to predict more externalizing problems), and to interact with negativity to predict internalizing problems (i.e., low surgency to amplify and high surgency to buffer the associations between high negativity and more internalizing problems). One possible explanation may be that the true nature of connections between surgency and behavior problem development is more nuanced than originally hypothesized. For example, in considering that low surgency confers risk for internalizing problems, and that high surgency confers risk for externalizing problems, it is conceivable that surgency may exert a curvilinear effect on problem behavior development with moderate levels of surgency conferring optimal adjustment. However, because internalizing and externalizing problems have demonstrated high rates of comorbidity and correspondingly are not thought to be orthogonal (Bird, Gould, &

Staghezza, 1993), the quadratic effect of surgency is unlikely to provide adequate discrimination for the differential development of internalizing or externalizing behaviors. Nonetheless, such a model may be well suited for studies concerned with the prediction of general and/or comorbid problems.

Alternatively, some scholars have suggested that surgency may predict the type (i.e., internalizing or externalizing), but not the presence of behavioral problems. In a study of almost 3,000 Dutch 10- to 12-year-old adolescents, Oldehinkel and colleagues (2004) found that surgency (a composite based on factor analyses that included high-intensity pleasure, low shyness, and low fear) was a stronger predictor of the probability of internalizing or externalizing problems for children who had behavior problems (i.e., the conditional probability), and that negativity (a composite that included low effortful control, high frustration, and high fear) was a stronger predictor of the presence of behavior problems (i.e., absolute probability).

Another possible explanation may be that the broadband surgency dimension may be too inclusive to be meaningful for capturing internalizing and externalizing typologies. In the Gartstein et al., 2012 study described earlier, associations between the five subscales of surgency in infancy and behavior problems only emerged at both toddler and preschool ages between activity level and externalizing problems. In parallel with study hypotheses, associations between facets of surgency and internalizing problems were more nuanced. Sociability was associated with fewer internalizing problems in toddler, but not preschool years, and high-intensity pleasure was significantly associated with internalizing problems in the preschool, but not toddler years; no associations were observed between impulsivity or positive anticipation in infancy and later behavior

problems. Contributions of subscales comprised by surgency may provide more explanatory power in the prediction of behavior problems than the broadband surgency dimension affords. Furthermore, it may be important to consider possible interactions between surgency subscales. One study that considered the interactive effects of approach and positive affect assessed at 24 months on behavior problems in Kindergarten, Dollar and Buss (2014) found that children rated high in approach exhibited more externalizing problems when they were high in positive affect. In contrast, children rated high in approach exhibited fewer internalizing problems when they were low in positive affect. Examinations of intra-dimension interactions may provide more meaningful information about child dispositional contributions early problem behavior development.

A final consideration with regard to the absence of associations between surgency and behavior problems is that variations in sociocultural expectations for children's behaviors may color the extent to which surgent characteristics are perceived as desirable or not (Putnam, 2012). Berdan and colleagues (2008) found that surgency was associated with peer nominations of children's "wild" behavior for Kindergarten girls, but not for boys, suggesting that children may have different expectations about behaviors considered to be appropriate for boys and for girls. In another study that compared positive emotionality (i.e., a component of surgency) in Chinese and U.S. samples of school-age children, Zhou and colleagues (2009) found that parent- and teacher-reports of children's high positive emotionality was associated with externalizing problems in Chinese, but not American children. The authors speculated that the divergent cultural values of inhibited emotional expression and self-containment in Chinese culture and of exuberance and high affect in Western culture might explain differential prediction. Of

interest, low surgency was found to be associated with higher internalizing problems in both samples, which Zhou and colleagues (2009) interpreted to implicate low positive affect as a universal risk factor for internalizing problems. The extent to which surgency is associated with externalizing and internalizing behaviors may be moderated by culturally-influenced perceptions about children's desirable and undesirable characteristics.

Cultural preferences for certain child characteristics may also bias parents' reports of children's temperament. In a study that compared temperamental characteristics of American 20-month-olds of Latin American (i.e., predominantly of Argentinian, Columbian, and Peruvian descent), Japanese American, and European American descent, Bornstein and Cote (2009) found that Latina and Japanese mothers reported higher levels of toddlers' positive affect and pleasure/interest than European American mothers, but that the differences became non-significant after controlling for mothers' scores on a social desirability scale. The extent to which families endorse cultural values unique to Mexican and Mexican American culture (e.g., of *marianismo*, in which self-silence and submission are valued in women; Piña-Watson, Castillo, Jung, Ojeda, & Castillo-Reyes, 2014), may influence caregiver perceptions and reports of child temperament and problematic behaviors and thus warrant further investigation.

Maternal Sensitivity and Child Risk for Behavior Problems

The second aim of the current study was to investigate whether maternal sensitivity in the first six postnatal months moderates the relations between temperamental reactivity and behavior problems. Maternal sensitivity was expected to interact with negativity in a manner consistent with the differential susceptibility

hypothesis, such that high negativity would be associated with the most and least internalizing and externalizing problems under conditions of high and low maternal sensitivity; low negativity was expected to predict moderate levels of behavior problems regardless of maternal sensitivity. It was also hypothesized that maternal sensitivity would interact with surgency in a manner consistent with the differential susceptibility hypothesis with respect to externalizing behaviors. Unexpectedly, maternal sensitivity produced neither direct nor interactive associations with internalizing or externalizing behaviors. Given the wealth of empirical evidence implicating the critical role of maternal sensitivity in problem behavior development, it seems unlikely that the null effects reflect the true relations between maternal sensitivity and early internalizing and externalizing behaviors.

One possible explanation may be that the key constituents of caregiver sensitivity may differ in Mexican American compared to in European American or other cultural groups. Though few, if any studies have considered the presence of cultural variations in the structure of maternal sensitivity in Mexican American sample (though some have discounted the possibility of true cultural variations; e.g., Mesman, van Ijzendoorn, & Bakermans-Kranenburg, 2012), some scholars have found that other aspects of parenting operate differently in Mexican American compared to Caucasian American samples. In particular, maternal intrusiveness and control, parenting behaviors typically considered to be insensitive in studies of predominantly White families, have been found to operate differently in Mexican American families (Halgunseth, Ispa, & Rudy, 2006; Howes & Obregon, 2009; Ispa et al., 2004). Similarly, a comparative study that examined observer ratings of maternal sensitivity in Mexican-heritage families, Howes and Obregon (2009)

found that the strength of maternal cultural ties (i.e. "cultural community participation") was associated with different levels and types (i.e., more or less sensitive) of maternal structuring, suggesting that maternal enculturation and/or acculturation may also influence the form and function of various parenting behaviors. Different parenting behaviors may exert unique effects on child adjustment across cultures. Ispa and colleagues (2004) found that whereas maternal intrusiveness was associated with poor adjustment for European American children, that the same negative associations were not observed for Mexican American children. Although Ipsa and colleagues also did not find a positive association between intrusiveness and positive child adjustment, it seems plausible to think that components largely thought to connote caregiver sensitivity may also operate differently across cultural groups. It may be important to clarify the role of various maternal behaviors in promoting child adjustment in Mexican American families.

The non-significant effects of maternal sensitivity in the current study may also have been attributable to measurement error. That is, findings from a number of studies have yielded relatively low rates of concordance between objective observer and parent- or self-reported behaviors (Achenbach, McConaughy, & Howell, 1987). Lorenz and colleagues (2007) have suggested that the low rates of concordance may be attributable in part to "context by measurement" confounds. Specifically, in considering low concordance between concurrent observational and self-report assessments of behavior, Lorenz and colleagues (2007) suggested that the narrow focus of observational ratings only on behaviors elicited by a specific task context (i.e., context-specific) assesses for a more narrow set of behaviors than is typically captured by questionnaires in which ratings are often based on a broader context (i.e., context-general). In fact, Lorenz and

colleagues (2007) tested this phenomenon by asking young adults to engage in a laboratory-based interaction with their romantic partner, and then contrasted observer ratings of participants' hostility with participants' self-reports of their own hostility during the interaction (i.e., context-specific) and hostility in the last month (i.e., context-general). Though the rates of concordance between observer ratings of participant hostility and participants' self-ratings of their own general hostility were low (r=.18), the concordance between observer ratings of participant hostility and participants' self-ratings of their task-specific hostility more than doubled (r=.46). Applied to the current study, it may be the case that the predictive strength of the observational assessments of maternal sensitivity was muted given its context-specific assessment. In other words, the interaction tasks during which maternal sensitivity was considered (i.e., free play, soothing, teaching, and peek-a-boo) may have been suboptimal contexts for approximating the variability in general levels of maternal sensitivity for the current sample.

Maternal Stress and Infant Adjustment

The third study aim was to examine whether variability in infants' temperamental risk or susceptibility for behavior problems may be attributable in part to exposure to maternal stress during pregnancy or proximal to conception. Maternal stress was expected to predict higher levels of negativity and surgency, and negativity and surgency were expected to mediate associations between maternal stress and later behavior problems. The finding that maternal stress was associated with more negativity was consistent with those reported in extant literature (Huizink et al., 2002), as well as with previously reported findings from the same sample in which a different form of prenatal

stress, culturally salient family stress was associated with infant negativity at 6 weeks (Lin et al., 2014). On the other hand, the absence of associations between SLEs and surgency contrasted with findings that family stress also predicted higher levels of 6-week surgency.

The differential prediction of the two stress measures within the same sample is not anomalous given suggestions that different forms of prenatal stress are thought to exert different effects on infant developmental outcomes (DiPietro, Novak, Costigan, Atella, & Reusing, 2006; Field et al., 2008; Lazinski, Shea, & Steiner, 2008). However, other important distinctions between the two stress measures may lend important insight about the true nature of relations between maternal stress and infant reactivity. First, the family stress subscale of the Hispanic Stress Inventory (Cervantes, Padilla, & Salgado de Snyder, 1990) is thought to be particularly poignant for capturing maternal stressors not otherwise captured by scales developed for primarily White samples (Goodkind, Gonzales, Malcoe, & Espinosa, 2008), and thus may lend more predictive power for detecting modest associations with infant outcomes.

Second, for both SLEs and family stress, scores reflected a count of stressors that mothers reported experiencing either in the last 12 (SLEs) or 3 months (family stress). Thus, SLEs would have captured stressors mothers experienced at any point in pregnancy or possibly even before pregnancy. In contrast, mothers' reports of family stressors would have been limited to stressors experienced in the second and third trimesters (except for two participants, whose prenatal visits were completed at 23 and 24 weeks gestation). Scholars have underscored the importance of timing effects of maternal stressors during and before pregnancy on infant developmental outcomes, though much remains to be

clarified regarding the timing for which experiences of maternal stress are most influential. For example, scholars have independently declared that maternal stress or distress occurring during the days preceding conception (Precht et al., 2007), early (Lazinski et al., 2008), and late pregnancy (Rice, Jones, & Thapar, 2007) are of greatest consequence for infant developmental outcomes.

A last important difference between assessments of maternal SLEs and family stressors is that there was less variability in the distribution of scores for family stressors, with over half of mothers endorsing zero of ten total possible stressors (compared to 14% of mothers endorsing zero of thirteen total possible SLEs). It may be the case that mothers who *did* endorse family stressors experienced heightened levels of stress compared to those who did not. In this case, differential prediction by SLEs and family stress may reflect the presence of a threshold effect in which, for example, associations between family stress and surgency emerge only after a minimum threshold of stress has been reached. Further clarification about unique timing and typological effects of maternal stress on infant temperament may help clarify the true nature of associations between maternal stress and infants' subsequent proclivities for reactivity.

The finding that the maternal stress and negativity associations emerged with different forms of maternal stress suggests that the true relations between maternal stress and negativity may be relatively robust. That is, links between maternal stress and negativity may be less sensitive to the timing and typological effects of maternal stress, and may emerge at relatively low thresholds of stress. On the other hand, the fickle connections between maternal stress and surgency are suggestive that their relations are subject to the specificity of timing, typology, and thresholds of maternal stress. However,

these suggestions remain to be scrutinized in greater depth. Finally, the finding that maternal stress exerted a significant indirect effect on negativity and subsequent internalizing problems extends findings of previous studies that have drawn links between prenatal stress and infant negativity (Davis et al., 2007), prenatal stress and behavior problems (Calkins et al., 2002), and negativity and behavior problems (Gartstein et al., 2012) by considering their longitudinal associations within the same study. Importantly, the presence of a significant indirect effect is supportive of the notion that relations between maternal stress and children's adjustment are attributable in part to the effects of maternal stress on children's proclivities for reactivity.

Dual-Risk and Differential Susceptibility Models of Infant Reactivity

The final study aim was to consider findings in the context of dual-risk and differential susceptibility frameworks. In the current study, the finding that negativity appeared to exert a direct, but not an interactive effect on internalizing behaviors ostensibly implies a dual-risk model in which high negativity confers risk for internalizing problems. However, the non-significant associations between maternal sensitivity and child adjustment observed in the current study preclude the current study's suitability for contrasting differential susceptibility and dual-risk effects. That is, insofar as differential susceptibility and dual-risk explanatory models differ in their conceptions about how child characteristics moderate the effects of environmental factors (e.g., maternal sensitivity) on adjustment, attempts to compare the two models in the absence of significant environmental effects are inane.

Study Limitations

Although the study had multiple design and methodological strengths, the study was not without limitations. As described earlier, although the use of objective observer ratings of behavior (i.e., of maternal sensitivity) is generally thought to be a methodological strength, the context-specific assessment of maternal sensitivity may have inadvertently reduced the statistical power for detecting true associations between maternal sensitivity and context-general behaviors (i.e., temperament, behavior problems). On the other hand, the use of maternal reports as sole sources of context-general behaviors (i.e., temperament, behavior problems) may have been susceptible to reporter bias. For example, one study by Mäntymaa and colleagues (2006) found that maternal mental health and distress accounted for up to 24% of variance in maternal ratings of infant difficulty. Notably, the construct of infant "difficulty" employed by Mäntymaa and colleagues largely overlaps with infant negativity in its assessment of infant negative emotionality and slow recovery from distress, but differs importantly in that it also encompasses caregivers' *subjective experiences* about how difficult infants are to manage. The assessment of infant negativity employed in the current study contrarily asked mothers to report on discrete infant behaviors observed in the last two weeks, and thus may have been less susceptible to reporting bias. Additionally, the use of repeated measurements of infant negativity spanning nearly a one-year period may have been more robust against biases introduced by less pervasive fluctuations in maternal mental health. It is plausible nonetheless that maternal distress associated with mothers' experiences of SLEs may have colored maternal perceptions of infant negativity, and thus

that associations between SLEs and infant negativity or infant negativity and internalizing behaviors were attributable to their underlying associations with maternal well-being. A final limitation was that the current study did not include a control for maternal postnatal SLEs, and thus could not rule out the possibility that apparent associations between maternal SLEs during or before pregnancy and infant negativity and internalizing problems were actually attributable to mothers' and/or children's continued experiences of SLEs in the postnatal period. However, studies that have similarly considered associations between prenatal stress and infant temperament or behavior problems have found that the relations hold even after controlling for postnatal stress (Betts, Williams, Najman, Scott, & Alati, 2014; Davis et al., 2007; O'Connor, Heron, Golding, Beveridge, & Glover, 2002).

Summary and Conclusions

The current study is among the first to examine the mediating role of negativity in understanding the connection between prenatal stress and child behavior problem, and lends evidence supportive of the notion that maternal stress before birth may exert cascades of influence on child adjustment. That these findings emerge in parallel with the observation that approximately twice as many mothers from the current sample of low-income, Mexican American women reported experiencing SLEs as did urban mothers from a national, population-based sample comprised predominantly of highly educated White women (Kitsantas et al., 2012) is unsurprising, yet alarming. In other words, sociodemographic factors such as low-income and ethnic minority status appear to pose risks not only for individual wellbeing, but also for the generational translation of risk to deleterious child adjustment outcomes. Such relations provide further impetus for

continued efforts to support preventative and early interventions that seek to reduce the impact of sociodemographic disparities on child developmental outcomes. In particular, targeted efforts to promote maternal mental health before and throughout pregnancy, as well as supplemental support for families of dispositionally challenging infants, may be particularly poignant.

The current study also draws attention to a few key conceptual issues that remain to be clarified. Although the current study did not find evidence to suggest that surgency exerts a direct or indirect effect on behavior problem development, previous studies investigating surgency's contributions have yielded mixed or complex findings suggests that the true nature of associations may be more nuanced. On the other hand, it may also be important to scrutinize the extent to which socially mediated constructs and processes (e.g., surgency, maternal sensitivity) considered to be meaningful in predominantly White samples are relevant for study within Mexican American samples. Finally, further juxtapositions of the differential effects of maternal stressors on infant developmental outcomes may lend important insights about the typological and chronological mechanisms through which such stressors may influence infant development.

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APPENDIX

TABLES AND FIGURES

Table 1. Descriptive Information

	Mean (SD); range
Mother Characteristics	
Age at Prenatal Visit (years)	27.83 (6.47); 18-42
Country born (% US)	13.80%
Years in US at Prenatal Visit	11.92 (5.97); 0-32
Preferred Language (% Spanish)	82.20%
Marital Status (% Married or Living together)	77.50%
Level of Education (% High school diploma)	41%
Income (Median)	$10,001 - $15,000
# people supported by income	4.33 (1.99); 1-14
Infant Characteristics	
Gender (% female)	54.10%
Gestational Age	39.31 (1.42); 26-42
Birth weight (grams)	3390.78 (466.48); 1190 - 4935
5-minute APGAR	8.91 (.50); 4-10
Key Study Variables	
Maternal Stress (prenatal)	2.72 (2.42); 0-11
Negativity (6 weeks, 12 months)	2.75 (0.71); 0.60-4.76
Surgency (6 weeks, 12 months)	3.25 (1.13); 0.21-6.38
Maternal Sensitivity (12, 18, 24 weeks)	3.22 (0.32); 2.18 - 3.93
Internalizing behaviors (18 months)	3.22 (2.01); 0-10
Externalizing behaviors (18 months)	3.41 (2.35); 0-12

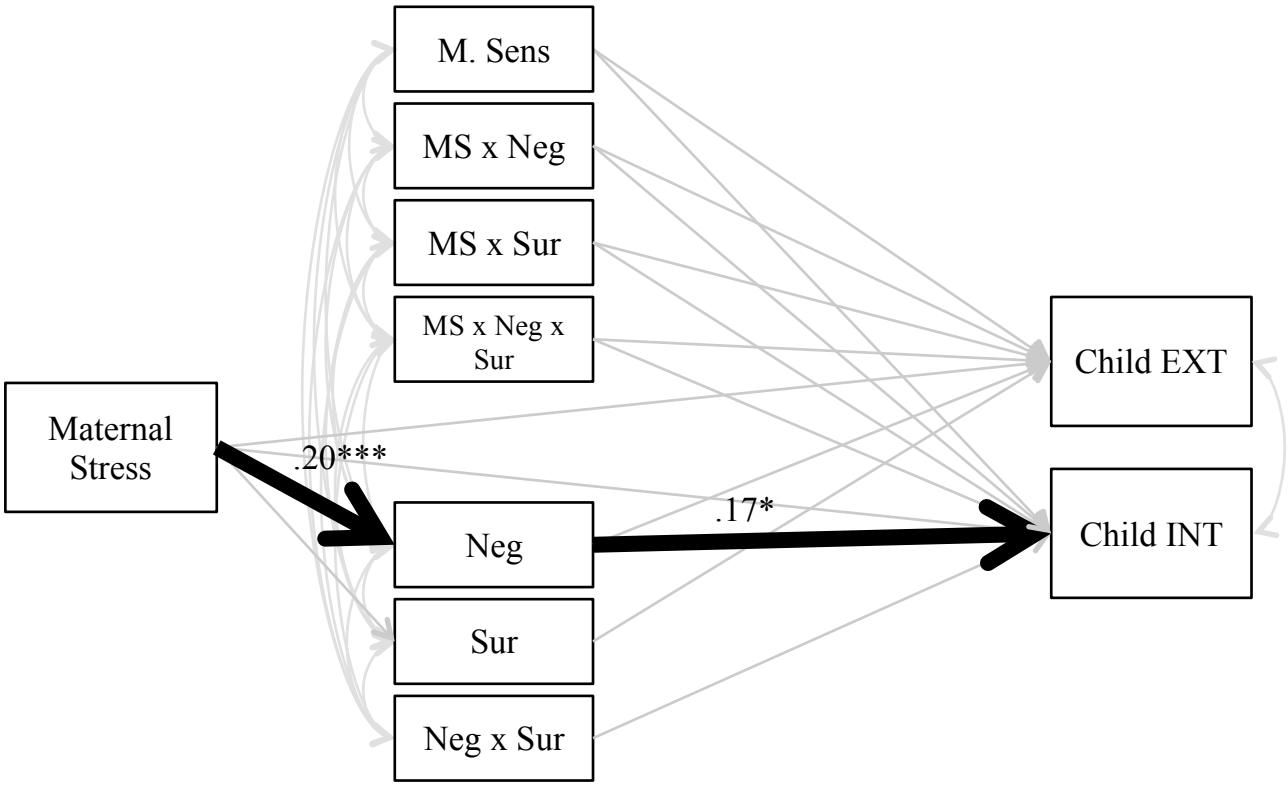
Note. Means and SD on variables with missing data calculated using FIML

Table 2. Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mother Characteristics																
1. Age (prenatal)	-															
2. Country born[a]	**.33**	-														
3. Preferred Language[b]	**.37**	**.68**	-													
4. Marital Status[c]	**-.14**	**-.15**	**-.17**	-												
5. Level of Education	**-.28**	**-.19**	**-.24**	-.01	-											
6. Annual household income	.06	-.05	-.10	**-.18**	**.24**	-										
7. # people supported by income	**.20**	.05	**.15**	-.04	**-.19**	.02	-									
Infant Characteristics																
8. Gender[d]	.07	.08	-.05	-.07	.00	.06	-.03	-								
9. Gestational Age	-.09	.01	.04	-.05	-.01	-.03	-.03	.06	-							
10. Birth weight (grams)	**.16**	.10	.07	-.09	**-.12**	-.05	.06	.03	**.50**	-						
11. 5-minute APGAR	.05	.06	**.18**	-.04	-.06	-.02	.02	-.05	-.07	-.05	-					
Key Study Variables																
12. Maternal stress	**-.15**	**-.18**	**-.23**	**.42**	.09	**-.15**	-.05	-.03	-.03	-.02	-.02	-				
13. Negativity	-.04	-.07	-.07	-.01	.05	.06	-.08	.01	-.04	-.03	-.02	**.19**	-			
14. Surgency	.03	.03	-.02	.01	.03	.02	-.04	.06	.02	-.03	.01	.08	**.54**	-		
15. Maternal Sensitivity	**.19**	.10	.07	**-.14**	.10	**.19**	-.04	.11	-.09	-.05	-.10	-.04	-.01	.07	-	
16. Externalizing behaviors	-.08	-.02	-.05	-.01	.03	.11	-.01	**-.15**	-.05	.05	.06	.05	.03	.01	.05	-
17. Internalizing behaviors	.07	.02	.02	.03	-.08	-.01	-.06	.01	-.11	.02	.00	.04	.12	.01	-.07	**.41**

Note. Pairwise deletion was used; n's ranged from 230 to 322. [a]0=US, 1=Other. [b]0=English, 1=Spanish. [c]0=Married/Living Together, 1=Other. [d]0=boy, 1=girl. Bolded/colored values indicate that correlations are statistically significant at $p \leq .05$

Figure 1. Model Results



Note. Only statistically significant standardized coefficients are reported to aid readability. Alpha significance is notated as follows: † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.