HHS Public Access

Author manuscript

Dev Psychol. Author manuscript; available in PMC 2018 June 01.

Published in final edited form as:

Dev Psychol. 2017 December ; 53(12): 2245–2260. doi:10.1037/dev0000391.

Ontogeny of Emotional and Behavioral Problems in a Low-Income, Mexican American Sample

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Abstract

Clinically meaningful behavior problems are thought to be present beginning in the early toddler years, yet few studies have investigated correlates of behavior problems assessed before age 2 years. The current study investigated 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 examined: (a) the links between infant temperamental reactivity and toddler behavioral symptoms, (b) whether maternal sensitivity moderated associations between temperamental reactivity and behavioral symptoms, (c) whether variability in temperamental reactivity was explained by exposure to maternal stressful life events (SLEs) in utero, and (d) whether child sex moderated these pathways. Data were collected from 322 low-income, Mexican American families. Mother reports of SLEs were obtained between 23 and 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 a 12-month visit was assessed by objective raters. Results indicated that significant paths linked maternal prenatal SLEs with 6-week negativity, 6-week negativity with 12-month negativity, and 12-month negativity with 18-month behavioral symptoms. Sex-specific effects were also observed. Maternal SLEs were directly associated with internalizing behaviors for girls only. Surgency and maternal sensitivity moderated the associations of negativity with subsequent externalizing behaviors for girls only. Results suggest that ecological stressors associated with sociodemographic risk factors such as low-income and ethnic minority status begin to exert cascades of influence on children's developmental outcomes even before birth.

Keywords

prenatal stress; temperament; behavioral problems; maternal sensitivity; sex differences

The last several decades of research in developmental psychopathology have converged on the notion that psychopathology is the culmination of the history of transactions among 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 outcomes befall those who begin to show signs of problem behavior early in life and whose

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Supplemental materials: http://dx.doi.org/10.1037/dev0000391.supp

maladaptive behaviors persist over time and across interactions (Moffitt, 2006). In spite of evidence that clinically significant internalizing and externalizing behaviors may present in the early toddler years (i.e., before age 2 years; Briggs-Gowan et al., 2013; Zeanah, 2009), few studies have investigated the correlates of behavioral symptoms observed before age 2. Although understanding about processes contributing to maladjustment is of particular relevance for vulnerable populations for whom health disparities are especially prevalent, relatively little is known about the extent to which the hazards associated with family impoverished or ethnic minority status may begin to exert cascades of influence on children's socio-emotional developmental processes as early as pregnancy. The current study investigated the extent to which transactions between child and caregiver characteristics across the prenatal and postnatal environments contribute to early internalizing and externalizing behaviors in a sample of low-income, Mexican Americans.

Temperamental Reactivity, Caregiver Coregulatory Behaviors, and Adjustment

One factor that has emerged consistently as a predictor of children's emotional and behavioral problems is temperamental reactivity. Both negativity and surgency dimensions of temperamental reactivity have been implicated in the development of emotional and behavioral problems (Gartstein, Putnam, & Rothbart, 2012). Children higher in negativity are particularly likely to perceive neutral events as threatening, frequently experience heightened levels of physiological arousal, employ less effective self-regulatory strategies in the face of distress, and rely more on caregiver coregulatory supports to modulate arousal (Belsky, Hsieh, & Crnic, 1998; Calkins, Dedmon, Gill, Lomax, & Johnson, 2002; Nakagawa & Sukigara, 2012).

In contrast to negativity, the associations between surgency and behavior problems are less clear. On the one hand, the positive mood associated with surgency is thought to protect against the deleterious influences of negative mood associated with externalizing and especially internalizing problems (Gartstein et al., 2012). Furthermore, high approach tendencies associated with surgency may increase tendencies to employ active coping strategies, which may in turn decrease risk for internalizing distress (Lengua, Sandler, West, Wolchik, & Curran, 1999; Planalp & Braungart-Rieker, 2015). On the other hand, the excitability associated with surgency may heighten tendencies for impulsivity, high-intensity actions, and dysregulation that precipitate externalizing behaviors (Stifter, Putnam, & Jahromi, 2008). One possibility is that associations between surgency and behavior problems may be better understood when considering surgency by negativity interactions. Although few studies have considered interactions between negativity and surgency, those that have yield mixed findings about whether high negativity and low (Dougherty, Klein, Durbin, Hayden, & Olino, 2010; Lonigan, Phillips, & Hooe, 2003) or high surgency (Gartstein et al., 2012) confer the most risk for internalizing behaviors. Furthermore, whereas most studies examining associations between temperament and behavior problems have tended to focus on toddler temperament, less is known about the ways in which infant temperament contributes to problem behavior development. Understanding about the influences of

negativity, surgency, and their interactions across infancy may lend important insight into the ontogeny of behavior problems.

The heightened arousability associated with temperamental reactivity may render children high in reactivity particularly dependent on caregiver coregulatory behaviors such as caregiver sensitivity. Indeed, repeated interactions with sensitive caregivers has been found to mitigate children's trajectories of negativity (Braungart-Rieker, Hill-Soderlund, & Karrass, 2010) and surgency over time (Blandon, Calkins, Keane, & O'Brien, 2010). Maternal sensitivity has also emerged as a consistent predictor of reduced externalizing and internalizing problems through adolescence (e.g., Miner & Clarke-Stewart, 2008; van der Voort et al., 2014). Given the mitigating effect of maternal sensitivity on temperamental reactivity and behavioral problems, maternal sensitivity may offset risk associations between temperamental reactivity and behavioral problems. In spite of suggestions that developmental processes precipitating problem behavior development may differ in mainstream (i.e., samples of predominantly middle socioeconomic status, White families) compared with racially and socioeconomically disadvantaged samples (e.g., Degnan, Almas, & Fox, 2010), there remains a dearth of studies investigating socioemotional developmental processes in vulnerable samples. The current study seeks to reduce this gap in literature by investigating the nature of associations between temperamental reactivity, maternal sensitivity, and behavioral symptoms in a low-income, Mexican American sample.

Prenatal Programming of Temperamental Reactivity

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 2, 4, and 6 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 children's developmental outcomes has been described as "fetal programming," in which exposure to maternal stress during the sensitive period of development is believed to result in structural and functional changes in the fetus that persist throughout life (Seckl, 2001). A number of studies have linked maternal prenatal stress to temperamental reactivity through age 5 (e.g., Martin, Noyes, Wisenbaker, & Huttunen, 1999), even after controlling for maternal postnatal mood (e.g., Huot, Brennan, Stowe, Plotsky, & Walker, 2004), though studies have tended to focus mostly on negativity and less on surgency. In spite of documented associations between prenatal stress and temperament, temperament and behavior problems, and prenatal stress and behavior problems, few or no studies have examined their associations *within the same study*.

A previous study by our group (Lin, Crnic, Luecken, & Gonzales, 2014) that did examine associations between maternal pre-natal stress and surgency found that maternal prenatal stress was associated with more negativity *and* surgency at 6 weeks. These findings contrast with those reported in two other studies in which maternal distress was associated with negativity but not surgency (Nolvi et al., 2016; Pesonen, Räikkönen, Strandberg, & Järvenpää, 2005). Notably, the study by Lin and colleagues (2014) examined the influence of a culturally salient form of prenatal stress for which a postnatal control was not also

available (i.e., “family stress” subscale of the Hispanic Stress Inventory, Cervantes, Padilla, & Salgado de Snyder, 1990), which precluded the capacity to rule out that associations between prenatal stress and temperamental reactivity were not better accounted for by postnatal exposure to maternal stress. Scholars have found that different forms of prenatal stress may contribute unique variance to children’s developmental outcomes, though the mechanisms underlying these differences is unclear (see Lazinski, Shea, & Steiner, 2008 for a review). The current study attempted to replicate earlier findings using a form of prenatal stress for which a postnatal control was available, and which also captured stressors occurring across pregnancy (compared with in the last trimester).

The current study also considered whether prenatal stress was differentially associated with earlier compared later manifestations of temperamental reactivity. Specifically, given findings that temperament becomes increasingly stable across infancy (Lemery, Goldsmith, Klinnert, & Mrazek, 1999), some scholars have hypothesized that the neurobiological systems underlying temperament may become more fully expressed over time and across development (e.g., Nigg, 2006). Although prenatal stress and distress have been linked to temperament at various time points spanning the first few days postpartum (i.e., infant neurobehavior; e.g., Hernández-Martínez, Arija, Balaguer, Cavallé, & Canals, 2008) to 5 years (e.g., Martin et al., 1999), little is known about whether the influence of prenatal stress may differentially manifest over time. Indeed, the few studies that have considered differential associations between prenatal stress and temperament across time-points within the same study have yielded discrepant findings about whether prenatal stress is more strongly associated with earlier (Huizink, Robles de Medina, Mulder, Visser, & Buitelaar, 2002) or later manifestations of temperament (Martin et al., 1999). The current study investigated whether prenatal stress exerts direct or indirect effects on 6-week and 12-month temperamental reactivity.

Child Sex and Emerging Behavior Problems

The current study also considered whether child sex influenced the course of problem behavior development. Boys have consistently been found to be at greater risk of early externalizing problems compared with girls (e.g., Miner & Clarke-Stewart, 2008), and are suspected to be more vulnerable to environmental and dispositional risk factors present in infancy (Shaw, Keenan, & Vondra, 1994). Perhaps related, some sex differences in temperament have also been documented in infancy, with boys exhibiting higher activity level and stronger approach tendencies and girls exhibiting more behavioral inhibition and perceptual sensitivity (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Kivijärvi, Räihä, Kaljonen, Tamminen, & Piha, 2005). Studies considering associations between infant temperament and subsequent behavioral problems have yielded mixed findings, with some finding stronger associations for boys (Shaw, Keenan et al., 1994), some finding stronger associations for girls (Pitzer, Esser, Schmidt, & Laucht, 2009), and others still finding minimal differences between boys and girls (Olson, Bates, Sandy, & Lanthier, 2000).

Socioemotional Developmental Processes in Disadvantaged Populations

Mexican Americans are among the fastest growing ethnic minority groups in the United States, and Hispanic children are now estimated to comprise at least a quarter of all children living in the United States (Murphey, Guzman, & Torres, 2014). As such, evidence that Mexican Americans also experience disproportionately more health disparities, including elevated rates of poverty, decreased access to health care, and heightened rates of postpartum and thus likely prenatal stress, is particularly concerning (Gress-Smith, Luecken, Lemery-Chalfant, & Howe, 2012; Murphey et al., 2014). Although poverty and ethnic minority status are known to exacerbate risk for both prenatal stress as well as children's negative adjustment outcomes (e.g., Degnan, Almas, & Fox, 2010; Pitzer et al., 2009; Phelan, DiBenedetto, Paul, Zhu, & Kjerulff, 2015), relatively little is known about whether or how prenatal stress and children's adjustment may be related among Mexican Americans.

For example, although aspects of Mexican American culture may protect against the adverse influence of prenatal stress on infant birth outcomes (Luecken et al., 2013; Ruiz, Hamann, Mehl, & O'Connor, 2016), prenatal stress exposure has nonetheless been found to compromise infants' stress reactivity and regulation and the subsequent caregiving environment (Luecken, MacKinnon, Jewell, Crnic, & Gonzales, 2015). Likewise, although some scholars have found evidence suggestive that Mexican American children's social skills may rival those of their socioeconomically advantaged, White counterparts (Guerrero et al., 2013), others have found that impoverished Latino children may nonetheless be equally susceptible to the influence of poverty on heightened rates of behavioral symptoms (e.g., Holtz, Fox, & Meurer, 2015). Finally, whereas cross-cultural studies yield evidence suggestive that temperament may confer differential risk for children's adjustment across cultures (e.g., Gartstein, Slobodskaya, Kirchhoff, & Putnam, 2013), few or no studies have investigated their associations in Mexican American samples. The current study investigates the complex, transactional interactions that link maternal prenatal stress to the development of internalizing and externalizing symptoms in an impoverished, Mexican American sample.

Current Study

The current study investigated the extent to which child dispositional characteristics directly or interactively influence the development of early internalizing and externalizing behaviors, as well as whether those dispositional characteristics are linked with maternal stress during or immediately preceding the prenatal period. The study had four specific aims: (a) to replicate previously documented associations between prenatal stress and temperamental reactivity using a form of prenatal stress that also allowed for a postnatal control, (b) to further extend those findings by examining whether prenatal stress also exerted direct or indirect influences on 12-month temperamental reactivity and whether 12-month temperamental reactivity in turn mediates associations between prenatal stress and toddler behavioral symptoms, (c) to clarify the nature of direct and interactive effects of temperamental reactivity on behavioral symptoms at 18 months, and (d) to investigate whether maternal sensitivity moderates the associations between temperamental reactivity and behavioral symptoms. Finally, given suggestions that processes precipitating

internalizing and externalizing problem development may vary for girls compared with boys, the possible presence of sex differences was also considered.

Given extant literature suggestive that maternal prenatal stress is significantly associated both with earlier and later manifestations of temperament, as well as literature suggestive that temperament shows modest stability across infancy, maternal prenatal stress was expected to exert a significant indirect effect on 12-month reactivity through 6-week reactivity. Nonetheless, because temperament shows only modest stability across infancy, only partial mediation was expected. Six-week and 12-month temperament in turn were likewise expected to partially mediate associations between maternal prenatal stress and behavioral symptoms at 18 months. More specifically, consistent with findings from extant literature, higher negativity was hypothesized to predict higher levels of internalizing and externalizing behaviors. Similarly, higher surgency was hypothesized to predict higher levels of externalizing, but not internalizing behaviors. Instead, surgency was expected to interact with negativity to predict internalizing behaviors consistent with findings by Lonigan, Phillips, and Hooe (2003) and Dougherty, Klein, Durbin, Hayden, and Olino (2010), such that children low in surgency and high in negativity would have the most internalizing behaviors. Maternal sensitivity was hypothesized to dampen associations between temperamental reactivity and behavioral symptoms, such that children high in negativity were expected to exhibit fewer internalizing and externalizing behaviors under conditions of high maternal sensitivity compared to their low negativity counterparts.

Method

Participants

Participants included 322 mothers and their infants. Mothers were recruited from a hospital-based prenatal clinic in the southwestern United States that serves low-income women from the surrounding community. Eligibility criteria included (a) self-identification as Mexican or Mexican American, (b) fluency in either Spanish or English, (c) mother's age 18 years or older, (d) low-income status (eligibility for Medicaid or Federal Emergency Services coverage, or self-reported annual income below $25,000), and (e) anticipated delivery of a singlet baby with no prenatal evidence of serious health or developmental problems. 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 13 years (range 0–33). Mothers were most often unmarried but living with a romantic partner (48%), and had an annual household income of $10,001–$15,000 (27%) to support four people.

Recruitment and Retention

Mothers presenting at the health clinic for prenatal care appointments were approached by a bilingual, female interviewer who explained the study and assessed eligibility. Of women who were eligible, 56% agreed to a home visit between 23 and 38 weeks gestation (M = 35.4 weeks, SD = 2.5), during which informed consent for participation through the 12-month timepoint was obtained. Mothers were invited to continue to participate through the

24-month timepoint during or after the 12-month visit; a total of 273 mothers consented at this time. Among the 322 mothers who consented to the study at the prenatal visit, 310 (96%) completed a 6-week visit, 299 (93%) completed a 9-month phone call, 266 (84%) completed a 12-month visit, and 237 (74%) completed an 18-month visit. Attrition analyses indicated that mothers who were younger and U.S. born were more likely to miss the 12- and 18-month timepoints, and also that mothers who preferred to complete the interview in English were more likely to miss the 18-month timepoint. No other demographic or substantive differences were observed.

Procedure

Participation in the study involved one prenatal home visit (23–40 weeks gestation), a home visits at 6 weeks postpartum, a phone call at 9 months, 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 nine were born at 36 weeks). Although there was no evidence that any of the infants suffered health problems or were outliers, the final model was run with and without premature infants to ensure that the pattern of findings would not change.

Home and laboratory visits—Interviews were completed in participants' homes (prenatal, 6 weeks), on the phone (9 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 families were paid for their participation.

Interaction tasks—Observational data were obtained from semistructured mother–infant interactions during the 12-month lab visit and were recorded for later coding. Seven interaction sequences were chosen to provide optimal opportunities to observe maternal sensitivity: *free play,* an unstructured "warm up" context in which mothers were asked to play with their infants as they usually would; *clean-up*, in which mothers were asked to have their infants help clean up the toys; *bubbles*, a context that elicits dyadic coregulation of positive affect; and four *teaching tasks* of increasing difficulty in which mothers were asked to teach their infants skills at and above the infants' developmental capabilities (two tasks were above the infants' expected capabilities).

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 and 9-month phone call. Scores were formed by summing the count of SLEs that mothers reported experiencing in the last 12 months (since pregnancy, during the 9 month administration). Sample items include "You moved to a new address" (endorsed by 44.7% of mothers at the prenatal visit), "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 timepoint using the negativity and surgency dimensions of the Infant Behavior Questionnaire-R, Short Form (IBQ-R, short form; Gartstein & Rothbart, 2003; Putnam, Helbig, Gartstein, Rothbart, & Leerkes, 2014). Negativity comprised subdimensions assessing infants' fear, distress to limitations (i.e., anger/frustration), sadness, and low falling rate of reactivity. Surgency comprised subdimensions assessing infants' activity level, approach, smiling, and laughter, vocal reactivity, perceptual sensitivity, and high-intensity pleasure. Mothers were asked to rate whether they had observed their infants engaging in each of 65 behaviors (40 corresponding to surgency, 25 corresponding to negativity) in the last 2 weeks on a scale from 1 (*never*) to 7 (*always*), or to indicate if the items were not applicable. Three of the original 40 items comprising the surgency dimension (i.e., perceptual sensitivity subdimension) were omitted due to programming errors (items 28–30) at the 6-week timepoint only. Although the IBQ-R short form was designed for use with infants ages 3 to 12 months, its variations have been used successfully with neonates (i.e., IBQ, IBQ-R very short form; Putnam et al., 2014; Worobey, 1986), and the broad suprafactors have further been validated for use with very young infants in an even more abbreviated version of the IBQ-R short form (i.e., the IBQ-R very short form; range, 0–5 months, $M = 1.83$, $SD = 1.07$; Putnam et al., 2014). Cronbach's alpha for surgency at 6 weeks and 12 months was $\alpha = .87$ and $\alpha = .70$, respectively; negativity at 6 weeks and 12 months was $\alpha = .59$ ($\alpha = .72$ if remove falling rate of reactivity subscale; the subscale was dropped for 6-week negativity only) and $\alpha = .61$, respectively.

Maternal sensitivity—Maternal sensitivity was assessed during naturalistic mother–infant interactions video recorded at the 12-month visit using the Coding Interactive Behaviors coding system (CIB; Feldman, 1998). Of the 266 visits completed at the 12-month visit, observational data were available for 182 families (videos for 84 families were not available due to visits completed in the home or by phone, technical difficulties with recording equipment, etc.). Teams of coders were trained to 85% agreement within one point; the intraclass correlation coefficient for maternal sensitivity across each of the interaction tasks was .67. Twenty maternal behaviors were rated on a 5-point scale (1 = *low sensitivity*, 5 = *high sensitivity*), eight of which were averaged to form a composite maternal sensitivity score following Feldman (1998): acknowledging, parent gaze, positive affect, vocal appropriateness, appropriate range of affect, resourcefulness, praising, and parent supportive presence (elaborating and affectionate touch were dropped due to considerations about conceptual relevance, low interitem correlations, and decreased alpha scale reliability). Cronbach's alpha for maternal sensitivity was $\alpha = .87$.

Behavioral symptoms—Mother-reports of toddlers' internalizing and externalizing behaviors 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. The internalizing scale comprised items such as "cries or hangs onto you when you try to leave," "seems very unhappy, sad, depressed, or withdrawn," and "worries a lot or is very serious;" and the externalizing scale comprised items such as "hits, shoves kicks, or bites others," "purposely

tries to hurt you," "is restless and can't sit still." Cronbach's alpha for internalizing and externalizing behaviors for the current study was α = .56, and α = .67, respectively.

Covariates—Demographic information, infant birth outcomes, and maternal postnatal SLEs were considered as possible covariates in the present study. Demographic information (maternal age, language, country of origin, marital status, level of education, household income, and number of people supported by income) was obtained prenatally either during recruitment or at the prenatal home interview. Maternal Anglo American or Mexican American cultural orientation was also obtained prenatally using the Acculturation Rating Scale for Mexican Americans-II (ARSMA-II; Cuéllar, Arnold, & Maldonado, 1995). Infant birth outcomes (gestational age, birth weight, 5-min APGAR, days in hospital, and child sex) were obtained from hospital birth records. The criterion established prehoc for covariate inclusion was that any variables that were significantly correlated with any pair of independent and dependent variables would be adjusted 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 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 and substantive variables that were thought to be theoretically related to key study variables with missing data (i.e., observer ratings of maternal sensitivity as well as of infant, mother, and dyadic dysregulation at 12, 18, and 24 weeks; internalizing and externalizing behaviors 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 M*plus* 7.31 (Muthén & Muthén, 2010). Negativity, surgency, and maternal sensitivity were centered and categorical variables were dummy coded to reduce nonessential multicollinearity as well as to facilitate the interpretation of interaction effects (Cohen, Cohen, West, & Aiken, 2003). To test the general fit of the proposed conceptual model, a χ^2 test of fit, Comparative Fit Index (CFI), root mean square error of approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) were examined. Good fit was defined prehoc as χ^2 test probability> .05, CFI >.95, RMSEA < .06, and SRMR < .08 (Hu & Bentler, 1999). The presence of possible sex differences was tested by comparing model fit ($\chi^2_{\text{difference}}$test) for two multigroup models grouped by toddlers' female or male sex. In the first model, all specified paths were constrained to be equal. In the second model, all specified paths were freely estimated. Simple slopes for significant interaction effects were probed at one standard deviation above and below the mean of the moderator (e.g., maternal sensitivity) and levels of significance were evaluated at 95% confidence intervals using the Johnson-Neyman procedure in M*plus* (Clavel, 2015; Johnson & Neyman, 1936). Simple slopes were plotted at two standard deviations above and below

mean levels within the range of possible values for the independent variable (e.g., surgency) following recommendations by Roisman et al. (2012).

Results

Preliminary Analyses

Descriptive information about key study variables is presented in Table 1. On average, mothers reported having experienced two to three SLEs within the 12 months preceding the prenatal interview. Over 85% of mothers reported having experienced at least one SLE, and over 63% reported having experienced at least two SLEs (compared with 42.1% and 32.6%, respectively, in a national sample of 23,795 mothers; Kitsantas, Gaffney, & Cheema, 2012). At 6 weeks, mothers reported moderately low levels of surgency and negativity, which was more than one full point lower surgency but comparable negativity relative to the validation sample of 3- to 6-month-old infants from predominantly White, middle socioeconomic status families for the IBQ-R ($M_{surgency}$ = 3.97, SD = 0.57; $M_{negativity}$ = 2.55, SD = 0.67; Gartstein & Rothbart, 2003). At 12 months, mothers reported moderately high levels of surgency and moderate levels of negativity, which was about a half a point higher and lower, respectively, than for the 12- to 15-month-old infants from the same validation study described previously ($M_{surgency}$ = 4.78, SD = 0.55; $M_{negativity}$ = 3.04, SD = 0.63; Gartstein & Rothbart, 2003). Closer examination of subdimension means indicated the absence of statistically significant sex differences at the 6-week timepoint, and that girls exhibited slightly higher levels of fear only at the 12-month timepoint; no other sex differences emerged (see online supplementary Table 1). Mothers on average exhibited moderately high levels of sensitivity. Finally, mean levels of internalizing and externalizing behaviors suggested that toddlers exhibited on average as few as one to two symptoms often or as many as three to four symptoms some of the time, with boys displaying significantly more externalizing behaviors than girls.

Zero-order correlations between demographics, health-related variables, and substantive variables are presented by male and female sex in Table 2. Examination of covariate correlations in the full sample indicated that mothers who were older in age and higher in Mexican American orientation reported significantly fewer prenatal SLEs (age, r = −.15, p = .006; Mexican American orientation, r = .17, p = .002), and significantly more 12-month surgency (age, r = .17, p = .016; Mexican American orientation, r = .15, p = .051). Mothers' Mexican nativity and preference to conduct interviews in Spanish were significantly associated with fewer prenatal SLEs (Mexican Nativity, r = −.18, p = .001; Spanish preference, r = −.23, p < .001), and lower 6-week negativity (Mexican Nativity, r = −.17, p = .002; Spanish preference, r = −.12, p = .03) and surgency (Mexican Nativity, r = −.15, p = .001; Spanish preference, r = −.12, p = .03). Conversely, mothers' Anglo American orientation was associated with more maternal SLEs, r = .17, p .002, more 6-week surgency, r = .21, p < .001, and fewer internalizing behaviors, r = −.14, p = .05. Finally, maternal postnatal SLEs were significantly associated with maternal prenatal SLEs, r = .43, p < .001 as well as with more 6-week, r = .13, p = .03; and 12-month negativity, r = .33, p < .001. Thus, maternal age, nativity, language preference, Anglo American orientation, Mexican American orientation, and postnatal SLEs were included as covariates in analyses.

Model Results

The full SEM model examined the direct paths between prenatal stress and early internalizing and externalizing behaviors at 18 months, as well as the indirect paths through infant temperamental reactivity at 6 weeks and 12 months (see Figure 1).

Sex differences—Information about toddler sex was not available for one family, who thus was dropped from analyses. A chi square difference test comparing the fully constrained and freely estimated model indicated that the freely estimated model fit the data significantly better, $\chi^2_{\text{difference}}(64)=96.70$, p = .005. Because the freely identified model fit significantly better than the fully constrained model, paths from the fully constrained model were subsequently freed one by one to identify specific paths that were statistically different across sexes. Chi-square difference tests contrasting the fully constrained model with the models in which paths were freed one by one indicated that the following paths were significantly different: 12-month negativity and externalizing, $\chi^2_{\text{difference}}(1)=5.12$, p = .02; the surgency by maternal sensitivity interaction and externalizing, $\chi^2_{\text{difference}}(1)=14.25$, p < .001; maternal prenatal stress and internalizing, $\chi^2_{\text{difference}}(1)=5.27$, p = .02; 12-month negativity and internalizing, $\chi^2_{\text{difference}}(1)=6.25$, p = .01; mothers' preferred language and 12-month negativity, $\chi^2_{\text{difference}}(1)=3.74$, p = .05; maternal Mexican American orientation on 12-month negativity, $\chi^2_{\text{difference}}(1)=10.66$, p = .001; maternal postnatal stress and 12-month surgency, $\chi^2_{\text{difference}}(1)=4.13$, p = .04; mothers' nativity and 12-month surgency $\chi^2_{\text{difference}}(1)=4.24$, p = .04. No other paths were significantly different across sexes. Thus, these paths were freely estimated in the final model, and all other paths were constrained to be equal. The data were determined to fit the partially constrained model well: $\chi^2(72)$ = 74.54, p = .40; RMSEA = 0.02; CFI = 1.00; SRMR = 0.04. The final model was also run without toddlers who were born premature, and model results were unchanged. Results for the final model including all toddlers are presented in Figure 1.

Influence of maternal stress on infant susceptibility characteristics over time —In the model for both girls and boys, maternal prenatal SLEs were significantly associated with 6-week, but not 12-month negativity, and was not associated with surgency at either time point. Both 6-week negativity and surgency in turn were associated with 12-month negativity and surgency, respectively. Given significant paths linking maternal prenatal SLEs, 6-week negativity, and 12-month negativity, the statistical significance of the indirect effect was examined, and analyses indicated that it was not significant at the α = .05 level for girls or for boys, 95% CI [−.002, .018]. Maternal postnatal SLEs were significantly associated both with 6-week (girls, B = 0.13, SE = .07, p = .05; boys, B = 0.13, SE = .07, p = .05) and 12-month negativity (girls, B = 0.32, SE = .07, p < .001; boys, B = 0.35, SE = .08, p < .001), but not with surgency at either time point.

Maternal prenatal SLEs were also significantly associated with internalizing behaviors, but only for girls. Maternal postnatal SLEs were not significantly associated with internalizing or externalizing behaviors for girls or boys. Because the indirect effect of prenatal SLEs on 6-week and 12-month negativity was not statistically significant, the indirect effect of

prenatal SLEs on 6-week negativity, 12-month negativity, and behavioral symptoms was likewise determined to be nonsignificant.

Temperamental reactivity and early behavioral symptoms—In the model for girls, 12-month negativity was significantly associated with more externalizing, but not internalizing behaviors. In the model for boys, 12-month negativity was significantly associated with more internalizing, but not externalizing behaviors. Neither 12-month surgency nor its interaction with negativity was significantly associated with externalizing or internalizing behaviors for girls or boys.

Interactions between temperamental reactivity and maternal sensitivity—In both the models for girls and boys, the maternal sensitivity by surgency interaction was significantly associated with externalizing behaviors. Neither maternal sensitivity nor its interaction with negativity was significantly associated with internalizing or externalizing behaviors for girls or boys. Results of the simple slope analyses examining the maternal sensitivity by surgency interaction are presented in Figure 2; results of the Johnson-Neyman procedure are presented in online supplementary Figure 1. For girls, more surgency was significantly associated with more externalizing behaviors at low, but not mean or high levels of maternal sensitivity. For boys, more surgency was significantly associated with more externalizing behaviors at high levels of maternal sensitivity and with fewer externalizing behaviors at low levels of maternal sensitivity.

Post-Hoc Analyses Considering Temperamental Reactivity Subdimensions

Given evidence suggestive that distinct neurobiological systems may underlie the finer-grained dimensions of temperament even within the negativity and surgency suprafactors (e.g., distress to limitations has been tied to approach-related systems, whereas fear has been tied to withdraw-related systems; perhaps related, distress to limitations has been linked to externalizing behaviors, whereas fear has been linked to internalizing behaviors; see Rothbart, 2011 for a more complete discussion), post hoc analyses investigating the differential associations of reactivity subdimensions with maternal prenatal stress and behavioral symptoms were considered.

Maternal prenatal stress and reactivity subdimensions—A model in which maternal prenatal and postnatal stress were regressed on each of the subdimensions of negativity and surgency was run. Model results indicated a significant effect of more maternal prenatal stress on 6-week more distress to limitations ($B = 0.15$, $SE = .06$, $p = .02$), more fear ($B = 0.13$, $SE = .06$, $p = .03$), and more sadness ($B = 0.17$, $SE = .06$, $p = .005$). Maternal prenatal and postnatal stress were not significantly associated with any other reactivity subdimensions.

Reactivity subdimensions and behavioral symptoms—Post hoc analyses considered more specifically whether each of the subdimensions of negativity (i.e., distress to limitations, fear, sadness, falling rate of reactivity) and surgency (i.e., smiling and laughter, approach, activity level, high intensity pleasure, vocal reactivity, perceptual sensitivity) and a subset of their interactions contributed uniquely to internalizing and

externalizing behaviors for boys and for girls. In the overall model, each of the negativity and surgency subdimensions was regressed on internalizing and externalizing behaviors. Results indicated that more approach was associated with fewer internalizing behaviors for boys only ($B = -0.25$, $SE = .11$, $p = .02$). No other subdimensions were significantly associated with internalizing or externalizing behaviors.

The second subset of analyses considered interactions between a subset of negativity subdimensions (i.e., distress to limitations and fear) and their interactions with affective (i.e., smiling and laughter), motivational (i.e., approach), and intensity (i.e., activity level) components of surgency in association with internalizing and externalizing behaviors. First, distress to limitations, smiling, approach, activity level, and interactions among distress to limitations with each of the surgency subdimensions were mean centered and regressed on internalizing and externalizing behaviors. Approach again emerged as a significant predictor of internalizing behaviors for boys only ($B = -0.34$, $SE = .10$, $p = .001$). No other main or interactive effects were statistically significant at the $\alpha < .05$ level.

Finally, fear, smiling, approach, activity level, and interactions among fear with each of the surgency subdimensions were mean centered and regressed on internalizing and externalizing behaviors. For girls, the fear by smiling interaction was significantly associated with internalizing behaviors ($B = -0.30$, $SE = 0.10$, $p = .002$). Plots of results from the simple slopes and Johnson-Neyman procedures are presented in online supplementary Figures 2 and 3. Results indicated that fear was associated with more internalizing behaviors at low levels of smiling, but with fewer internalizing behaviors at very high levels of smiling (i.e., ≥ 1.5 *SD* above the mean). For boys, main effects emerged in which more approach was again associated with fewer internalizing behaviors ($B = -0.29$, $SE = 0.10$, $p = .005$), and more fear was associated with fewer externalizing behaviors ($B = -0.27$, $SE = 0.12$, $p = .02$). The fear by approach interaction was also significantly associated with both internalizing and externalizing behaviors (internalizing, $B = 0.23$, $SE = 0.10$, $p = .03$; externalizing, $B = 0.23$, $SE = 0.11$, $p = .04$). Plots of results from the simple slopes and Johnson-Neyman procedures are presented in online supplementary Figures 2 and 4. Results indicated that more fear was significantly associated with more internalizing problems at high, but not mean or low levels approach. Conversely, more fear was significantly associated with fewer externalizing problems at mean and low, but not high levels of approach. No other main or interactive effects were statistically significant at the $\alpha < .05$ level.

Discussion

The current study investigated the extent to which infant and maternal factors present during pre- and postnatal periods contribute to the development of early behavioral problems. Study findings suggested that exposure to SLEs during the prenatal period was associated with infant characteristics that conferred heightened susceptibility to behavioral symptoms in the early toddler years. Furthermore, risk processes contributing to internalizing and externalizing behavior development appeared to operate differently for boys and girls.

Maternal Stress and Behavioral Adjustment in the Early Toddler Years

Maternal stress was expected to predict higher levels of 6-week negativity and surgency, and 6-week negativity and surgency were expected to mediate associations between maternal stress and later manifestations of temperament. In partial support of study hypotheses, maternal stress was associated with more 6-week negativity, but not 6-week surgency; both of which demonstrated moderate stability through 12 months. However, in spite of significant paths linking maternal prenatal stress with 6-week negativity, and 6-week negativity with 12-month negativity, the indirect effect of maternal prenatal stress on 12-month negativity was not significant. In other words, maternal stress did appear to influence earlier manifestations of negativity, but those effects were not sustained across the first year of life.

First, the finding that maternal stress was associated with more negativity was consistent both with previously reported findings from the same sample (Lin et al., 2014; Luecken et al., 2015) as well as with those reported in extant literature (e.g., Huizink et al., 2002). Furthermore, post hoc analyses indicated that maternal prenatal stress was significantly associated with each of the finer-grained dimensions of negativity, suggesting that maternal prenatal stress may have influenced neurobiological systems underlying general negative emotionality rather than specific subcomponents thereof. However, the absence of associations between SLEs and surgency contrasted with previous findings that family stress also predicted higher levels of 6-week surgency. The differential prediction by 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 (Lazinski et al., 2008). Nonetheless, differences in the nature (i.e., culturally salient family stress vs. global stressors), timing (i.e., third trimester vs. duration of pregnancy), and thresholds of stress captured (i.e., less than half compared with 86% of mothers endorsing experiences of stress) between the two stress measures may lend important insight about the true nature of relations between maternal stress and infant reactivity.

We had previously speculated that the dual findings that maternal stress was associated both with negativity and surgency may have reflected its influence more broadly on a general reactivity component underlying both negativity and surgency (i.e., physiological stress dysregulation; Lin et al., 2014). Given findings that associations between maternal stress and negativity may be more robust (i.e., have emerged with greater consistency, including in the current sample) than with surgency, it may be the case that the previously observed associations between maternal stress and surgency were attributable to associations among surgency subcomponents and negativity. For example, although infant activity level is ultimately tied both to expressions of negative and positive affect, it is thought to be tied primarily to distress reactions early in life (i.e., before 2 months; Rothbart, Derryberry, & Hershey, 2000; Wolff, 1965). Of interest, exposure to maternal depression has also been tied directly to increased fetal activity in utero, and is hypothesized to exert its influence through its impact on the fetus' central nervous system (Dieter et al., 2001). Thus, it is conceivable that the observed associations were actually attributable to the effects of maternal prenatal stress on infant's general negative emotionality, which in turn also manifest as heightened activity and intensity. If so, factors associated with the typology, timing, or threshold of

family stress may have contributed to its stronger influences on the developing central nervous system. However, these suggestions remain to be scrutinized in greater depth.

Second, the finding that maternal prenatal stress was associated with 6-week negativity, but that those effects were not sustained across the first year of life contrasted with previous findings linking maternal prenatal stress to preschool temperament (Martin et al., 1999). Furthermore, evidence from the current study indicated that maternal postnatal stress accounted for significant variability in 12-month negativity, suggesting that possible postnatal influences on later manifestations of negativity may have outweighed earlier prenatal influences. Not all studies that have investigated the associations between prenatal stress and distress have included postnatal controls. Nonetheless, prenatal depression has been tied to negativity in 6-month-old infants even after partialing out the effects of postnatal depression (Huot et al., 2004). Prenatal stress may influence earlier, but not later displays of negative reactivity, suggesting that its influence on behavioral reactivity remains plastic and may even be subsidiary to postnatal reprogramming effects. Indeed, findings from animal studies have indicated that pre- and postnatal stress may exert opposing influences on offspring epigenetic changes, suggesting that postnatal stress may reprogram changes that emerge initially as a result of exposure to prenatal stress (Bale, 2015). Nonetheless, evidence for high rates of stability between prenatal and postnatal stress, associations between early infant negativity and decreased maternal postnatal well-being and subsequent parenting quality underscore that the influence of prenatal stress on infant development may be enduring beyond the transmission of its effects on earlier to later negativity (Luecken et al., 2015).

Maternal prenatal stress was also found to exhibit a significant direct effect on internalizing problems, though this association emerged for girls only. Interestingly, this is consistent with a series of findings and hypotheses by Sandman, Glynn, and Davis (2013) in which maternal psychosocial and psychophysiological stress is thought to heighten risk for fear and anxiety in girls only. Relatively few studies have examined sex differences associated with prenatal stress exposure, yet an emerging evidence base suggests that prenatal stress may impact development differently for males and females (e.g., Clifton, 2010; Sandman, Glynn, & Davis, 2013). Specifically, some evidence exists to suggest that male and female placentas may enact different strategies in the face of prenatal adversity, with male placentas prioritizing continued fetal growth at the expense of viability in response to subsequent prenatal insults, and female placentas limiting fetal growth in ways that promote viability in response to subsequent prenatal insults. The male strategy, which does not adapt development in accordance with the prenatal environment, is thought to result in immature physical and neuromuscular development, which in turn is thought to account for the heightened rates of neonatal mortality, heightened prevalence of neurodevelopmental disorders, yet larger body size at birth observed among males compared with females (Clifton, 2010; Sandman et al., 2013). In contrast, the female strategy, which has adapted its development in accordance with the adverse prenatal environment, is thought to result in relatively enduring changes to the central nervous system in ways that heighten fear-related responding (Sandman et al., 2013). In turn, the female placental strategy is thought to confer long-term risk for fear, worry, and anxiety across the life span.

Negative Reactivity and Behavioral Symptoms

In partial support of study hypotheses, infant negativity was associated with more internalizing and externalizing behaviors, though the associations differed for girls than for boys. The finding that negativity conferred risk for both internalizing and externalizing behaviors is consistent with findings reported in literature (e.g., Gartstein et al., 2012), and extends upon extant literature by demonstrating that links between infant negativity and behavioral symptoms are present as early as 18 months in a low-income, Mexican American sample.

Perhaps of greater interest, the differential associations of negativity with internalizing behaviors for boys and externalizing behaviors for girls was intriguing, especially given well-established findings regarding the heightened prevalence of externalizing behaviors in boys that emerges by the preschool years, and of internalizing behaviors in girls by adolescence (Keenan & Shaw, 1997). One possible explanation for the differential associations across sexes may simply be that negativity plays a different role in the emergence of early behavioral symptoms for boys than for girls. Although few studies have investigated the differential contributions of temperament to early behavioral symptoms in the early toddler years, it is possible that negativity may have distinct social and biological connotations across sexes, and that those differences are more pronounced earlier in development.

Socially, caregivers and peers have been found to be less accepting of boys' expressions of negative emotions, especially of fear and sadness, and thus to respond in ways that exacerbate risk for internalizing problems for boys but not for girls (Coplan, Closson, & Arbeau, 2007; Engle & McElwain, 2011). In contrast, parents have been found to be more supportive and encouraging of girls' expressions of fear and sadness, and thus may incidentally offset risk associations between negativity and internalizing behaviors for girls (Keenan & Shaw, 1997; Simpson & Stevenson-Hinde, 1985). Indeed, shyness has been linked to more internalizing problems for boys but not for girls (Coplan et al., 2007; Simpson & Stevenson-Hinde, 1985). Socialization efforts directed toward minimizing boys' negative emotionality may be particularly pronounced in Mexican American samples, within which culturally based gender norms for reduced negative emotionality in men may be particularly salient (Soto, Levenson, & Ebling, 2005). Indeed, Mexican American men have been found to self-report expending more effort toward negative emotional suppression compared with Mexican American women (Soto et al., 2005). Socially mediated gender expectations about boys' decreased negative emotionality may amplify risk for internalizing behaviors among dispositionally negative boys.

Conversely, some scholars have hypothesized that early externalizing behaviors may be more closely tied to biologically based diatheses such as negative reactivity in girls, but to environmental risks for boys (Keenan & Shaw, 1997). For example, Keenan and Shaw (1997) have proposed that because girls evidence faster rates of biological maturation than boys, that they may also show faster acquisition of social and emotional competencies that buffer against environmental risks for behavioral problems. However, because most girls demonstrate higher-than-average socioemotional competencies, girls who are more dispositionally (negatively) reactive may lag developmentally behind other nonreactive girls,

and developmental immaturity in turn may drive the observed associations between negativity and externalizing behaviors. In contrast, because boys develop more slowly generally, they may be more prone to externalizing behaviors even in the absence of dispositional negativity, thus diluting associations between negativity and externalizing. Indeed, some evidence exists to suggest that externalizing behaviors are more closely tied to negativity and developmental immaturity in girls and environmental risks in boys (Olson & Hoza, 1993; Shaw, Vondra, Hommerding, Keenan, & Dunn, 1994). The distinct biological and social ramifications of negativity on internalizing and externalizing behaviors may explain the differential associations observed across sexes.

Of interest, post hoc analyses considering the contributions of finer-grained dimensions did not find associations between specific subdimensions with internalizing or externalizing behaviors (with one exception, in which more fear was linked to more internalizing problems for boys, though these associations only emerged in the model considering associations between fear and its interactions with surgency subdimensions). The absence of significant subdimension effects on behavioral symptoms suggest that the observed associations between broadband negativity and behavioral symptoms were attributable to infants' general negative emotionality, and not to specific forms of negativity (Rothbart, 2011). This departs from findings that have emerged in other studies, in which subdimensions, especially fear and anger, have been tied to internalizing and externalizing behaviors, respectively (e.g., Lemery, Essex, & Smider, 2002). Nonetheless, it is consistent with suggestions that general negativity captures unique and meaningful variability in infants' stress reactivity that may further be rooted in shared neurobiological systems (e.g., the hypothalamic-pituitary-adrenal axis, autonomic nervous system, serotonergic system, etc.; see Rothbart, 2011, pp. 72–73 for a discussion).

Surgency and Behavioral Symptoms

In partial support of study hypotheses, surgency was not associated with more internalizing or externalizing behaviors. However, closer examinations of direct and interactive subdimension contributions in post hoc analyses revealed that components of surgency (i.e., approach, smiling, and laughter) interacted with fear to predict internalizing and externalizing behaviors. In other words, surgency played an important, but more nuanced role compared with negativity in the development of behavioral symptoms. Although the absence of broadband effects was different than initially hypothesized (surgency was expected to exert a main effect on externalizing behaviors and to interact with negativity to predict internalizing behaviors), it was not altogether surprising given extant findings that surgency evidences less consistent associations with externalizing behaviors compared to negativity (Gartstein et al., 2012), and nuanced associations with internalizing behaviors more generally (Dougherty et al., 2010; Oldehinkel, Hartman, De Winter, Veenstra, & Ormel, 2004).

For girls, smiling and laughter appeared to mitigate the effect of fear on internalizing behaviors, such that girls who were higher in fear appeared only to be at greater risk for internalizing behaviors if they were also low in smiling and laughter. These findings add to a growing body of literature suggestive that positive affect may offset the risk associations

between negativity and internalizing problems (Dougherty et al., 2010; Lonigan et al., 2003), and lend initial evidence that its protective effects may emerge beginning as early as the toddler years.

For boys, approach appeared to mitigate and exacerbate the contributions of fear both to the development of internalizing and externalizing behaviors. Specifically, strong approach tendencies appeared to protect against the development of internalizing behaviors for boys with mean or low levels of fear. In contrast, low approach tendencies appeared to magnify the associations between fear and externalizing behaviors for better and for worse, so that boys who were low in approach and low in fear exhibited the most externalizing behaviors, and boys who were low in approach and high in fear exhibited the fewest externalizing behaviors. The nature of associations between fear and approach with respect to internalizing behaviors was consistent with extant findings that strong approach tendencies are linked to lower risk for internalizing problems (Frick & Morris, 2004), as well as with findings that approach-related systems are disabled under conditions of high fear (Gray, 1991).

The associations among fear, approach, and externalizing behaviors was somewhat puzzling. Specifically, findings that low approach and low fear conferred the most risk for externalizing behaviors contrasted with extant findings tying approach to more impulsivity, decreased inhibitory control, and generally increased risk for externalizing behaviors (Rothbart, Ahadi, & Evans, 2000). It is conceivable that the apparently contradictory effects of approach on externalizing behaviors emerge when considering its influences in conjunction with fear. In fact, in at least one other study investigating the join contributions of approach- and fear-related tendencies (i.e., exuberance and fear/sadness), Garon and Moore (2006) found that preschoolers who were low in both fear/sadness and exuberance made choices corresponding to higher immediate rewards. In contrast, preschoolers who were high in fear/sadness and low in exuberance made choices corresponding to highest longer-term rewards. In other words, low exuberance appeared to correspond to poorer choices when preschoolers were also low in fear/sadness, but to better choices when preschoolers were high in fear/sadness. Though this hypothesis remains to be scrutinized in greater depth, it is also consistent with theories about optimal levels of stimulation (e.g., Eysenck, 1967; Strelau, 1996; see Rothbart, 2011 for a discussion), in which individuals are thought to counterbalance their dispositional proclivities for reactivity by engaging in more or fewer sensation-seeking behaviors. For example, these theories would propose that children low in dispositional reactivity (e.g., low fear and low activity) might externalize more in order to achieve more optimal levels of stimulation. In contrast, children with more balanced levels of dispositional reactivity (e.g., high fear and low activity) might externalize less in order to maintain their already optimal levels of stimulation.

Ecological and Sociocultural Influences on Temperamental Reactivity

Consistent with study hypotheses, the maternal sensitivity by surgency interaction was significantly associated with more externalizing, but not internalizing behaviors. However, of interest, the maternal sensitivity by surgency interaction had different implications for externalizing behaviors across sexes. For girls, maternal sensitivity operated in expected

ways by mitigating risk associations between high surgency and more externalizing behaviors. However, for boys, both combinations of high maternal sensitivity/high surgency and low maternal sensitivity/low surgency conferred risk for externalizing behaviors. This finding contrasted with hypotheses that maternal sensitivity would mitigate risk associations between surgency and high externalizing problems for both girls *and* boys.

One possible explanation that may account both for the sex differences and for the unexpected effects may be that variations in mothers' sociocultural expectations for children's behaviors may have colored their perceptions of surgency for boys compared with girls. Indeed, sociocultural evaluations of surgency have been found to bias parents' reports about the extent to which their children exhibit surgency (Bornstein & Cote, 2009). Specifically, Mexican immigrant parents have been found to rate their school-age children's positive behaviors more highly than negative behaviors, and especially to rate their sons as happier than their daughters in a manner consistent with cultural values emphasizing boys' warmth, affection, and kindness (Hossain, 2013; Mirandé, 2008). Thus, it is conceivable that mothers may have been more inclusive when considering behaviors thought to be related to surgency (e.g., perceiving neutral vocalizations as excited vocalizations) or overly emphasized the base rates of surgency-related behaviors for boys. This may in turn have contributed to a more amorphous category of surgency for boys compared with girls. Indeed, it seems interesting to note that sex differences were observed with respect to one of the culturally related covariates regressed on 12-month surgency, such that mothers who were born outside of the U.S. (i.e., in Mexico for all mothers but one, who was born in Canada) rated boys higher in surgency compared to girls. Nonetheless, this possibility is speculative and should be interpreted with caution.

Of interest, culturally tied sex differences also emerged with respect to 12-month negativity, such that mothers with stronger ties to Mexican culture (i.e., Spanish language preference, self-reported Mexican American cultural orientation) rated boys lower in negativity than they did girls. One possible explanation may have been that socioculturally based preferences about boys' and girls' emotional expressivity may have influenced mothers' proclivities to over- or underrate negativity in boys or girls. More specifically, some evidence suggests that negative emotional expressions may be perceived as less desirable among Mexican American men (Soto et al., 2005). Thus, it is conceivable that mothers may have minimized characteristics with undesirable (e.g., negativity in boys) and maximized those with desirable cultural implications (i.e., positivity in boys; however, see also Hossain, 2013).

A final possibility that may explain the unexpected pattern of findings with maternal sensitivity and reactivity, including findings that the maternal sensitivity by negativity interaction was not significantly associated with either internalizing or externalizing behaviors, is that parenting behaviors other than maternal sensitivity would have been more consequential for the development of behavioral symptoms. For example, some evidence exists to suggest, that among children who are more dysregulated (e.g., those who are temperamentally reactive), that positive parenting may be relatively inconsequential. Instead, among these children, negative parenting has been tied to increased problem behaviors, and parental control has been tied to decreased problem behaviors (Rothbart & Bates, 2006).

However, if this is the case, it is unclear why maternal sensitivity may have operated as expected in interactions with surgency to predict externalizing behaviors for girls, but operated in unexpected ways in all other cases. Therefore, these pattern of results that emerged should be taken with caution pending further investigation.

Study Limitations

Although the study had multiple design and methodological strengths, the study was not without limitations. First, as discussed previously, information about the timing of maternal experience of SLEs throughout pregnancy was not available, and thus precluded the capacity to examine the impact of prenatal stress exposure at different periods of fetal development. Related, because psychobiological assessments of maternal prenatal stress or fetal/placental conditions were not obtained, the current study could not speak to psychobiological mechanisms underlying prenatal and postnatal associations. Third, because the validity of the use of finer-grained dimensions has not been established for use with infants less than 2 months, results in post hoc analyses considering their associations with prenatal stress should be interpreted with caution. Fourth, assessments of temperament and behavior problems relied on the use of maternal reports, and thus may have been susceptible to maternal reporting bias. Similarly, because information about maternal temperament, personality, or genetic contributions was not available, the current study could not rule out the possibility that shared genes accounted for the associations between maternal prenatal stress and negativity or internalizing problems. Additionally, reliability for the internalizing behaviors variable at 18 months was low (α = .56) and could not be measurably improved. The low reliability suggests that the scale's constituent items did not always covary (e.g., children who were afraid of places, animals, or things did not also consistently have less fun than other children), and was likely attributable in part to limited variability for some of the items in the context of an already brief scale, and was better than reliability reported in one other study of Finnish infants and toddlers (Alakortes, Fyrstén, Carter, Moilanen, & Ebeling, 2015). However, as Alakortes, Fyrstén, Carter, Moilanen, and Ebeling (2015) noted, because few other studies have *reported* on the internal consistency of the internalizing domain, more studies are needed to clarify whether the low reliability reflects the brevity of the screener or true scale unreliability. As a final point, it should be noted that the current study only considered the extent to which associations between maternal stress and toddler behavioral symptoms were mediated by reactivity components of temperament. Maternal stress has also been linked to regulatory components of temperament (Bridgett, Burt, Edwards, & Deater-Deckard, 2015), which in turn are tied both to the reactivity components and behavioral symptoms examined in the current study.

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 behavioral symptoms, and lends evidence supportive of the notion that maternal stress before birth may have enduring implications for children's 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. 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 the need for further clarification about the extent and conditions under which surgency may influence problem behavior development. A number of scholars have raised the importance of looking beyond broadband dimensions of infant temperament (i.e., negativity and surgency) given the unique direct and interactive implications of their subcomponents. The point is well taken, as mounting evidence (including from the current study) points to their unique contributions to different developmental outcomes. Nevertheless, before we proceed with fine-grained examinations of interactions among individual temperament traits, it is important to make sure our examinations are theoretically grounded and practically significant.

Finally, the study underscores a need to examine the presence of sex differences in early pathways predicting problem behavior development, not only with respect to the unique sociocultural considerations (e.g., culturally mediated gender expectations) that may differentially color parent reports and interactions with girls and boys, but also with divergent developmental processes (e.g., the placenta) that may result in structural and functional differences in male and female neurological and central nervous system development.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This research was funded by the National Institute of Mental Health (R01 MH083173-01 and R01 MH083173-01A1S). We thank Kathryn Lemery-Chalfant and Kevin Grimm for their thoughtful feedback; the mothers and infants for their participation; Dean Coonrod and the Maricopa Integrated Health Systems for their assistance with recruitment; and the research team for their commitment and dedication to this project. Parts of this research were presented at the 2015 Society for Research in Child Development Biennial Meeting and the 2016 International Congress on Infant Studies.

References

Alakortes J, Fyrstén J, Carter AS, Moilanen IK, Ebeling HE. Finnish mothers' and fathers' reports of their boys and girls by using the Brief Infant-Toddler Social and Emotional Assessment (BITSEA). Infant Behavior and Development. 2015; 39:136–147. http://dx.doi.org/10.1016/j.infbeh.2015.02.016. [PubMed: 25827263]

Bale TL. Epigenetic and transgenerational reprogramming of brain development. Nature Reviews Neuroscience. 2015; 16:332–344. http://dx.doi.org/10.1038/nrn3818. [PubMed: 25921815]

Belsky J, Hsieh KH, Crnic K. Mothering, fathering, and infant negativity as antecedents of boys' externalizing problems and inhibition at age 3 years: Differential susceptibility to rearing experience? Development and Psychopathology. 1998; 10:301–319. http://dx.doi.org/10.1017/S095457949800162X. [PubMed: 9635226]

Blandon AY, Calkins SD, Keane SP, O'Brien M. Contributions of child's physiology and maternal behavior to children's trajectories of temperamental reactivity. Developmental Psychology. 2010; 46:1089–1102. http://dx.doi.org/10.1037/a0020678. [PubMed: 20822225]

Bornstein MH, Cote LR. Child temperament in three U.S. cultural groups. Infant Mental Health Journal. 2009; 30:433–451. http://dx.doi.org/10.1002/imhj.20223. [PubMed: 23264709]

Braungart-Rieker JM, Hill-Soderlund AL, Karrass J. Fear and anger reactivity trajectories from 4 to 16 months: The roles of temperament, regulation, and maternal sensitivity. Developmental Psychology. 2010; 46:791–804. http://dx.doi.org/10.1037/a0019673. [PubMed: 20604602]

Bridgett DJ, Burt NM, Edwards ES, Deater-Deckard K. Intergenerational transmission of self-regulation: A multidisciplinary review and integrative conceptual framework. Psychological Bulletin. 2015; 141:602–654. http://dx.doi.org/10.1037/a0038662. [PubMed: 25938878]

Briggs-Gowan MJ, Carter AS, Irwin JR, Wachtel K, Cicchetti DV. The brief infant-toddler social and emotional assessment: Screening for social-emotional problems and delays in competence. Journal of Pediatric Psychology. 2004; 29:143–155. http://dx.doi.org/10.1093/jpepsy/jsh017. [PubMed: 15096535]

Briggs-Gowan MJ, Carter AS, McCarthy K, Augustyn M, Caronna E, Clark R. Clinical validity of a brief measure of early childhood social-emotional/behavioral problems. Journal of Pediatric Psychology. 2013; 38:577–587. http://dx.doi.org/10.1093/jpepsy/jst014. [PubMed: 23603252]

Calkins SD, Dedmon SE, Gill KL, Lomax LE, Johnson LM. Frustration in infancy: Implications for emotion regulation, physiological processes, and temperament. Infancy. 2002; 3:175–197. http://dx.doi.org/10.1207/S15327078IN0302_4.

Centers for Disease Control and Prevention. (CDC). PRAMS: Pregnancy Risk Assessment Monitoring System: Phase 6 Core Questionnaire. Atlanta, GA: Centers for Disease Control and Prevention; 2009–2011. January 28, 2009 ed

Cervantes RC, Padilla AM, Salgado de Snyder N. Reliability and validity of the Hispanic Stress Inventory. Hispanic Journal of Behavioral Sciences. 1990; 12:76–82. http://dx.doi.org/10.1177/07399863900121004.

Clavel, F. Advanced topics: Plotting better interactions using the Johnson-Neyman technique in Mplus. 2015. Retrieved from https://clavelresearch.wordpress.com/2015/03/23/advanced-topics-plotting-better-interactions-using-the-johnson-neyman-technique-in-mplus/#MplusJN

Clifton VL. Review: Sex and the human placenta: Mediating differential strategies of fetal growth and survival. Placenta. 2010; 31:S33–S39. http://dx.doi.org/10.1016/j.placenta.2009.11.010. [PubMed: 20004469]

Cohen, J., Cohen, P., West, SG., Aiken, LS. Applied multiple regression/correlation analysis for the behavioral sciences. 3. Mahwah, NJ: Erlbaum Publishers; 2003.

Collins LM, Schafer JL, Kam CM. A comparison of inclusive and restrictive strategies in modern missing data procedures. Psychological Methods. 2001; 6:330–351. http://dx.doi.org/10.1037/1082-989X.6.4.330. [PubMed: 11778676]

Coplan RJ, Closson LM, Arbeau KA. Gender differences in the behavioral associates of loneliness and social dissatisfaction in kindergarten. Journal of Child Psychology and Psychiatry. 2007; 48:988–995. http://dx.doi.org/10.1111/j.1469-7610.2007.01804.x. [PubMed: 17914999]

Cuéllar I, Arnold B, Maldonado R. Acculturation Rating Scale for Mexican Americans-II: A revision of the original ARSMA Scale. Hispanic Journal of Behavioral Sciences. 1995; 17:275–304. http://dx.doi.org/10.1177/07399863950173001.

Degnan KA, Almas AN, Fox NA. Temperament and the environment in the etiology of childhood anxiety. Journal of Child Psychology and Psychiatry. 2010; 51:497–517. http://dx.doi.org/10.1111/j.1469-7610.2010.02228.x. [PubMed: 20158575]

Dieter JNI, Field T, Hernandez-Reif M, Jones NA, Lecanuet JP, Salman FA, Redzepi M. Maternal depression and increased fetal activity. Journal of Obstetrics & Gynaecology. 2001; 21:468–473. http://dx.doi.org/10.1080/01443610120072009. [PubMed: 12521799]

Dougherty LR, Klein DN, Durbin CE, Hayden EP, Olino TM. Temperamental positive and negative emotionality and children's depressive symptoms: A longitudinal prospective study from age three to age ten. Journal of Social and Clinical Psychology. 2010; 29:462–488. http://dx.doi.org/10.1521/jscp.2010.29.4.462.

Else-Quest NM, Hyde JS, Goldsmith HH, Van Hulle CA. Gender differences in temperament: A meta-analysis. Psychological Bulletin. 2006; 132:33–72. http://dx.doi.org/10.1037/0033-2909.132.1.33. [PubMed: 16435957]

Enders, CK. Applied missing data analysis. New York, NY: Guilford Press; 2010.

Engle JM, McElwain NL. Parental reactions to toddlers' negative emotions and child negative emotionality as correlates of problem behavior at the age of three. Social Development. 2011; 20:251–271. http://dx.doi.org/10.1111/j.1467-9507.2010.00583.x.

Eysenck, HJ. The biological basis of personality. Springfield, IL: Thomas; 1967.

Feldman, R. Coding interactive behaviors. Ramat-Gan, Israel: Bar-Ilan University, Department of Psychology and the Gonda Brain Sciences Center; 1998.

Frick PJ, Morris AS. Temperament and developmental pathways to conduct problems. Journal of Clinical Child and Adolescent Psychology. 2004; 33:54– 68. http://dx.doi.org/10.1207/S15374424JCCP3301_6. [PubMed: 15028541]

Garon N, Moore C. Negative affectivity predicts individual differences in decision making for preschoolers. The Journal of Genetic Psychology. 2006; 167:443–462. http://dx.doi.org/10.3200/GNTP.167.4.443-462. [PubMed: 17645233]

Gartstein MA, Putnam SP, Rothbart MK. Etiology of preschool behavior problems: Contributions of temperament attributes in early childhood. Infant Mental Health Journal. 2012; 33:197–211. http://dx.doi.org/10.1002/imhj.21312. [PubMed: 28520102]

Gartstein MA, Rothbart MK. Studying infant temperament via the revised infant behavior questionnaire. Infant Behavior and Development. 2003; 26:64– 86. http://dx.doi.org/10.1016/S0163-6383(02)00169-8.

Gartstein MA, Slobodskaya HR, Kirchhoff C, Putnam SP. Cross-cultural differences in the development of behavior problems: Contributions of infant temperament in Russia and U.S. International Journal of Developmental Science. 2013; 7:95–104.

Gray, JA. Explorations in temperament: International perspectives on theory and measurement. New York, NY: Plenum Press; 1991. The neuropsychology of temperament; p. 105-128.http://dx.doi.org/10.1007/978-1-4899-0643-4_8

Gress-Smith JL, Luecken LJ, Lemery-Chalfant K, Howe R. Postpartum depression prevalence and impact on infant health, weight, and sleep in low-income and ethnic minority women and infants. Maternal and Child Health Journal. 2012; 16:887–893. http://dx.doi.org/10.1007/s10995-011-0812-y. [PubMed: 21559774]

Guerrero AD, Fuller B, Chu L, Kim A, Franke T, Bridges M, Kuo A. Early growth of Mexican-American children: Lagging in preliteracy skills but not social development. Maternal and Child Health Journal. 2013; 17:1701–1711. http://dx.doi.org/10.1007/s10995-012-1184-7. [PubMed: 23149800]

Gutteling BM, de Weerth C, Willemsen-Swinkels SHN, Huizink AC, Mulder EJH, Visser GHA, Buitelaar JK. The effects of prenatal stress on temperament and problem behavior of 27-month-old toddlers. European Child & Adolescent Psychiatry. 2005; 14:41–51. http://dx.doi.org/10.1007/s00787-005-0435-1. [PubMed: 15756515]

Hernández-Martínez C, Arija V, Balaguer A, Cavallé P, Canals J. Do the emotional states of pregnant women affect neonatal behaviour? Early Human Development. 2008; 84:745–750. http://dx.doi.org/10.1016/j.earlhumdev.2008.05.002. [PubMed: 18571345]

Holtz CA, Fox RA, Meurer JR. Incidence of behavior problems in toddlers and preschool children from families living in poverty. The Journal of Psychology. 2015; 149:161–174. http://dx.doi.org/10.1080/00223980.2013.853020. [PubMed: 25511203]

Hossain, Z. Fathers' and mothers' perceptions of their children's psychosocial behaviors in Mexican immigrant families. In: Chuang, SS., Tamis-LeMonda, CS., editors. Gender roles in immigrant families. New York, NY: Springer Science + Business Media; 2013. p. 117-135.

Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling. 1999; 6:1–55. http://dx.doi.org/10.1080/10705519909540118.

Huizink AC, Robles de Medina PG, Mulder EJH, Visser GHA, Buitelaar JK. Psychological measures of prenatal stress as predictors of infant temperament. Journal of the American Academy of Child and Adolescent Psychiatry. 2002; 41:1078–1085. http://dx.doi.org/10.1097/00004583-200209000-00008. [PubMed: 12218429]

Huot, RL., Brennan, PA., Stowe, ZN., Plotsky, PM., Walker, EF. Negative affect in offspring of depressed mothers is predicted by infant cortisol levels at 6 months and maternal depression during pregnancy, but not postpartum. New York, NY: New York Academy of Sciences; 2004.

Johnson PO, Neyman J. Tests of certain linear hypotheses and their application to some educational problems. Statistical Research Memoirs. 1936; 1:57–93.

Keenan K, Shaw D. Developmental and social influences on young girls' early problem behavior. Psychological Bulletin. 1997; 121:95–113. http://dx.doi.org/10.1037/0033-2909.121.1.95. [PubMed: 9000893]

Kitsantas P, Gaffney KF, Cheema J. Life stressors and barriers to timely prenatal care for women with high-risk pregnancies residing in rural and nonrural areas. Women's Health Issues. 2012; 22:e455–e460. http://dx.doi.org/10.1016/j.whi.2012.06.003. [PubMed: 22841802]

Kivijärvi M, Räihä H, Kaljonen A, Tamminen T, Piha J. Infant temperament and maternal sensitivity behavior in the first year of life. Scandinavian Journal of Psychology. 2005; 46:421–428. http://dx.doi.org/10.1111/j.1467-9450.2005.00473.x. [PubMed: 16179024]

Lazinski MJ, Shea AK, Steiner M. Effects of maternal prenatal stress on offspring development: A commentary. Archives of Women's Mental Health. 2008; 11:363–375. http://dx.doi.org/10.1007/s00737-008-0035-4.

Lemery KS, Essex MJ, Smider NA. Revealing the relation between temperament and behavior problem symptoms by eliminating measurement confounding: Expert ratings and factor analyses. Child Development. 2002; 73:867–882. http://dx.doi.org/10.1111/1467-8624.00444. [PubMed: 12038557]

Lemery KS, Goldsmith HH, Klinnert MD, Mrazek DA. Developmental models of infant and childhood temperament. Developmental Psychology. 1999; 35:189–204. http://dx.doi.org/10.1037/0012-1649.35.1.189. [PubMed: 9923474]

Lengua LJ, Sandler IN, West SG, Wolchik SA, Curran PJ. Emotionality and self-regulation, threat appraisal, and coping in children of divorce. Development and Psychopathology. 1999; 11:15–37. http://dx.doi.org/10.1017/S0954579499001935. [PubMed: 10208354]

Lin B, Crnic KA, Luecken LJ, Gonzales NA. Maternal prenatal stress and infant regulatory capacity in Mexican Americans. Infant Behavior and Development. 2014; 37:571–582. http://dx.doi.org/10.1016/j.infbeh.2014.07.001. [PubMed: 25113917]

Lonigan CJ, Phillips BM, Hooe ES. Relations of positive and negative affectivity to anxiety and depression in children: Evidence from a latent variable longitudinal study. Journal of Consulting and Clinical Psychology. 2003; 71:465–481. http://dx.doi.org/10.1037/0022-006X.71.3.465. [PubMed: 12795571]

Luecken LJ, Lin B, Coburn SS, MacKinnon DP, Gonzales NA, Crnic KA. Prenatal stress, partner support, and infant cortisol reactivity in low-income Mexican American families. Psychoneuroendocrinology. 2013; 38:3092–3101. http://dx.doi.org/10.1016/j.psyneuen.2013.09.006.

Luecken LJ, MacKinnon DP, Jewell SL, Crnic KA, Gonzales NA. Effects of prenatal factors and temperament on infant cortisol regulation in low-income Mexican American families. Developmental Psychobiology. 2015; 57:961–973. http://dx.doi.org/10.1002/dev.21328. [PubMed: 26119970]

Martin RP, Noyes J, Wisenbaker J, Huttunen MO. Prediction of early childhood negative emotionality and inhibition from maternal distress during pregnancy. Merrill-Palmer Quarterly: Journal of Developmental Psychology. 1999; 45:370–391.

Miner JL, Clarke-Stewart KA. Trajectories of externalizing behavior from age 2 to age 9: Relations with gender, temperament, ethnicity, parenting, and rater. Developmental Psychology. 2008; 44:771–786. http://dx.doi.org/10.1037/0012-1649.44.3.771. [PubMed: 18473643]

Mirandé, A. Immigration and Latino fatherhood: A preliminary look at Latino immigrant and non-immigrant fathers. In: Chuang, SS., Moreno, RP., editors. On new shores: Understanding immigrant fathers in North America. Lanham, MD: Lexington Books; 2008. p. 217-230.

Moffitt, TE. Life-course-persistent versus adolescence-limited antisocial behavior. In: Cicchetti, D., Cohen, DJ., editors. Developmental psychopathology: Vol. 3. Risk, disorder, and adaptation. 2. Hoboken, NJ: Wiley; 2006. p. 570-598.

Murphey, D., Guzman, L., Torres, A. America's Hispanic children: Gaining ground, looking forward. 2014. Retrieved from Child Trends Hispanic Institute: https://www.childtrends.org/publications/americas-hispanic-children-gaining-ground-looking-forward/

Muthén, LK., Muthén, BO. Mplus User's Guide. 6. Los Angeles: Author; 2010.

Nakagawa A, Sukigara M. Difficulty in disengaging from threat and temperamental negative affectivity in early life: A longitudinal study of infants aged 12–36 months. Behavioral and Brain Functions. 2012; 8:40. http://dx.doi.org/10.1186/1744-9081-8-40. [PubMed: 22897933]

Nigg JT. Temperament and developmental psychopathology. Journal of Child Psychology and Psychiatry. 2006; 47:395–422. http://dx.doi.org/10.1111/j.1469-7610.2006.01612.x. [PubMed: 16492265]

Nkansah-Amankra S, Luchok KJ, Hussey JR, Watkins K, Liu X. Effects of maternal stress on low birth weight and preterm birth outcomes across neighborhoods of South Carolina, 2000–2003. Maternal and Child Health Journal. 2010; 14:215–226. http://dx.doi.org/10.1007/s10995-009-0447-4. [PubMed: 19184386]

Nolvi S, Karlsson L, Bridgett DJ, Korja R, Huizink AC, Kataja EL, Karlsson H. Maternal prenatal stress and infant emotional reactivity six months postpartum. Journal of Affective Disorders. 2016; 199:163–170. http://dx.doi.org/10.1016/j.jad.2016.04.020. [PubMed: 27107891]

O'Connor TG, Heron J, Golding J, Glover V. Maternal antenatal anxiety and behavioural/emotional problems in children: A test of a programming hypothesis. Journal of Child Psychology and Psychiatry. 2003; 44:1025–1036. http://dx.doi.org/10.1111/1469-7610.00187. [PubMed: 14531585]

Oldehinkel AJ, Hartman CA, De Winter AF, Veenstra R, Ormel J. Temperament profiles associated with internalizing and externalizing problems in preadolescence. Development and Psychopathology. 2004; 16:421–440. http://dx.doi.org/10.1017/S0954579404044591. [PubMed: 15487604]

Olson SL, Bates JE, Sandy JM, Lanthier R. Early developmental precursors of externalizing behavior in middle childhood and adolescence. Journal of Abnormal Child Psychology. 2000; 28:119–133. http://dx.doi.org/10.1023/A:1005166629744. [PubMed: 10834765]

Olson SL, Hoza B. Preschool developmental antecedents of conduct problems in children beginning school. Journal of Clinical Child Psychology. 1993; 22:60– 67. http://dx.doi.org/10.1207/s15374424jccp2201_6.

Pesonen AK, Räikkönen K, Strandberg TE, Järvenpää AL. Continuity of maternal stress from the pre- to the postnatal period: Associations with infant's positive, negative and overall temperamental reactivity. Infant Behavior and Development. 2005; 28:36–47. http://dx.doi.org/10.1016/j.infbeh.2004.09.001.

Phelan AL, DiBenedetto MR, Paul IM, Zhu J, Kjerulff KH. Psychosocial stress during first pregnancy predicts infant health outcomes in the first postnatal year. Maternal and Child Health Journal. 2015; 19:2587–2597. http://dx.doi.org/10.1007/s10995-015-1777-z. [PubMed: 26152890]

Pitzer M, Esser G, Schmidt MH, Laucht M. Temperamental predictors of externalizing problems among boys and girls: A longitudinal study in a high-risk sample from ages 3 months to 15 years. European Archives of Psychiatry and Clinical Neuroscience. 2009; 259:445–458. http://dx.doi.org/10.1007/s00406-009-0009-1. [PubMed: 19387718]

Planalp EM, Braungart-Rieker JM. Trajectories of regulatory behaviors in early infancy: Determinants of infant self-distraction and self-comforting. Infancy. 2015; 20:129–159. http://dx.doi.org/10.1111/infa.12068. [PubMed: 25685094]

Putnam SP, Helbig AL, Gartstein MA, Rothbart MK, Leerkes E. Development and assessment of short and very short forms of the infant behavior questionnaire-revised. Journal of Personality

Assessment. 2014; 96:445–458. http://dx.doi.org/10.1080/00223891.2013.841171. [PubMed: 24206185]

Roisman GI, Newman DA, Fraley RC, Haltigan JD, Groh AM, Haydon KC. Distinguishing differential susceptibility from diathesis-stress: Recommendations for evaluating interaction effects. Development and Psychopathology. 2012; 24:389–409. http://dx.doi.org/10.1017/S0954579412000065. [PubMed: 22559121]

Rothbart, MK. Becoming who we are: Temperament and personality in development. New York, NY: Guilford Press Publications; 2011.

Rothbart MK, Ahadi SA, Evans DE. Temperament and personality: Origins and outcomes. Journal of Personality and Social Psychology. 2000; 78:122–135. http://dx.doi.org/10.1037/0022-3514.78.1.122. [PubMed: 10653510]

Rothbart, MK., Bates, JE. Temperament. Hoboken, NJ: Wiley; 2006.

Rothbart, MK., Derryberry, D., Hershey, K. Stability of temperament in childhood: Laboratory infant assessment to parent report at seven years. Mahwah, NJ: Erlbaum Publishers; 2000.

Ruiz JM, Hamann HA, Mehl MR, O'Connor MF. The Hispanic health paradox: From epidemiological phenomenon to contribution opportunities for psychological science. Group Processes & Intergroup Relations. 2016; 19:462–476. http://dx.doi.org/10.1177/1368430216638540.

Sandman CA, Glynn LM, Davis EP. Is there a viability-vulnerability tradeoff? Sex differences in fetal programming. Journal of Psychosomatic Research. 2013; 75:327–335. http://dx.doi.org/10.1016/j.jpsychores.2013.07.009. [PubMed: 24119938]

Seckl JR. Glucocorticoid programming of the fetus; adult phenotypes and molecular mechanisms. Molecular and Cellular Endocrinology. 2001; 185:61–71. http://dx.doi.org/10.1016/S0303-7207(01)00633-5. [PubMed: 11738795]

Shaw DS, Keenan K, Vondra JI. Developmental precursors of externalizing behavior: Ages 1 to 3. Developmental Psychology. 1994; 30:355–364. http://dx.doi.org/10.1037/0012-1649.30.3.355.

Shaw DS, Vondra JI, Hommerding KD, Keenan K, Dunn M. Chronic family adversity and early child behavior problems: A longitudinal study of low income families. Journal of Child Psychology & Psychiatry. 1994; 35:1109–1122. http://dx.doi.org/10.1111/j.1469-7610.1994.tb01812.x. [PubMed: 7995846]

Simpson AE, Stevenson-Hinde J. Temperamental characteristics of three- to four-year-old boys and girls and child-family interactions. Journal of Child Psychology & Psychiatry. 1985; 26:43–53. http://dx.doi.org/10.1111/j.1469-7610.1985.tb01627.x. [PubMed: 3972930]

Soto JA, Levenson RW, Ebling R. Cultures of moderation and expression: Emotional experience, behavior, and physiology in Chinese Americans and Mexican Americans. Emotion. 2005; 5:154–165. http://dx.doi.org/10.1037/1528-3542.5.2.154. [PubMed: 15982081]

Sroufe LA. The concept of development in developmental psychopathology. Child Development Perspectives. 2009; 3:178–183. http://dx.doi.org/10.1111/j.1750-8606.2009.00103.x. [PubMed: 20161376]

Stifter CA, Putnam S, Jahromi L. Exuberant and inhibited toddlers: Stability of temperament and risk for problem behavior. Development and Psychopathology. 2008; 20:401–421. http://dx.doi.org/10.1017/S0954579408000199. [PubMed: 18423086]

Strelau J. The regulative theory of temperament: Current status. Personality and Individual Differences. 1996; 20:131–142. http://dx.doi.org/10.1016/0191-8869(95)00159-X.

van der Voort A, Linting M, Juffer F, Bakermans-Kranenburg MJ, Schoenmaker C, van Ijzendoorn MH. The development of adolescents' internalizing behavior: Longitudinal effects of maternal sensitivity and child inhibition. Journal of Youth and Adolescence. 2014; 43:528–540. http://dx.doi.org/10.1007/s10964-013-9976-7. [PubMed: 23828726]

Wolff PH. The development of attention in young infants. Annals of the New York Academy of Sciences. 1965; 118:815–830. http://dx.doi.org/10.1111/j.1749-6632.1965.tb40153.x. [PubMed: 5222680]

Worobey J. Convergence among assessments of temperament in the first month. Child Development. 1986; 57:47–55. http://dx.doi.org/10.2307/1130636. [PubMed: 3948594]

Zeanah CH. The importance of early experiences: Clinical, research and policy perspectives. Journal of Loss and Trauma. 2009; 14:266–279. http://dx.doi.org/10.1080/15325020903004426.

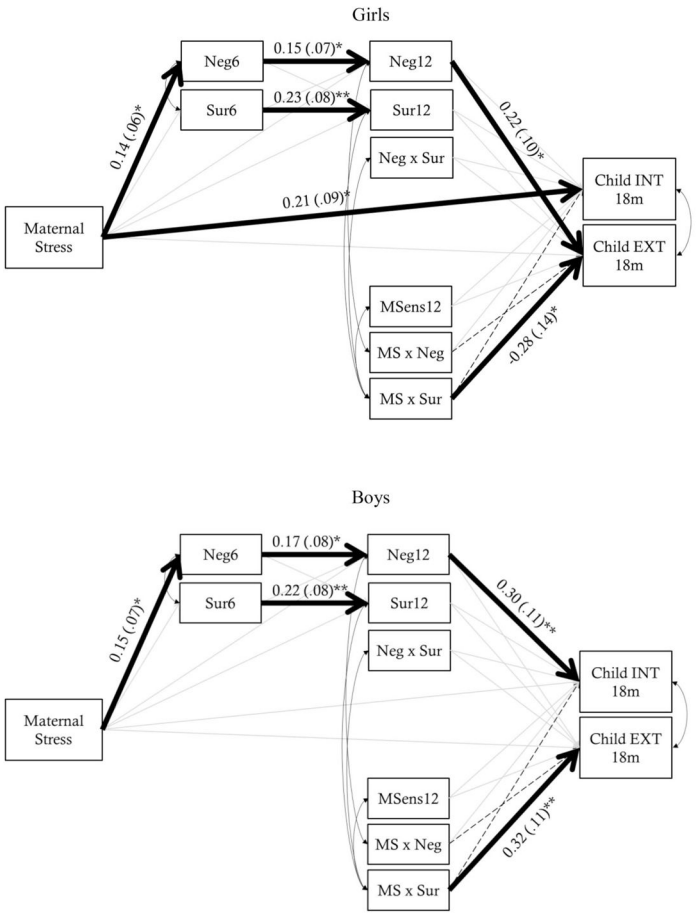

Figure 1.

Pre- and postnatal pathways to internalizing and externalizing behaviors by child sex. Only statistically significant standardized coefficients and their standard errors (in parentheses) are reported to aid readability. Dashed lines indicate marginally significant ($p < .10$) paths. $^{*}p < .05$. $^{**}p < .01$.

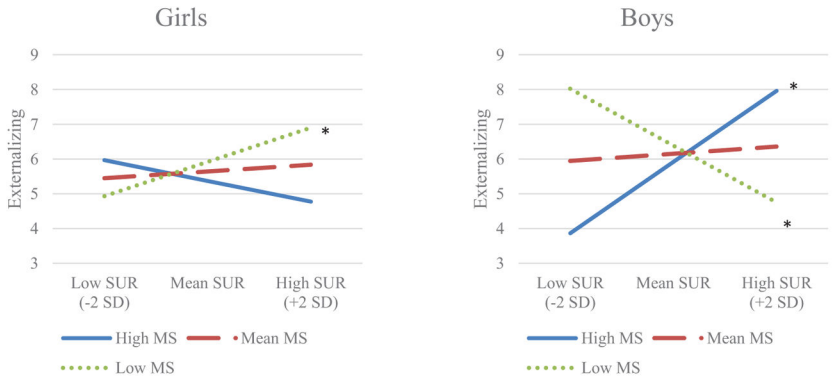

Figure 2.

Surgency by maternal sensitivity interaction and externalizing behaviors by child sex. Maternal sensitivity (MS) is plotted at one standard deviation above and below the mean. $^{*}p \leq .05$. See the online article for the color version of this figure.

Table 1

Descriptive Information

Variables	Mean (*SD*); range			
	Boys (*n* = 147)	Girls (*n* = 173)	*t*(*df*)	χ^2
Mother characteristics				
Age at prenatal visit (years)	27.37 (6.67); 18–42	28.23 (6.28); 18–42	*t*(317) = −1.18	
Country born (% U.S.)	16.3%	11.0%		1.95
Years living in U.S.	13.86 (7.00); 0–32	12.92 (6.69); 0–33	*t*(318) = 1.23	
Preferred language (% Spanish)	84.4%	80.3%		0.87
Anglo american orientation	2.60 (0.99)	2.54 (0.98)	*t*(319) = 0.71	
Mexican american orientation	4.21 (0.67)	4.28 (0.57)	*t*(319) = −1.17	
Marital status (% married or living together)	74.1%	79.8%		1.43
Level of education (% high school diploma)	40.8%	40.5%		7.44
Income (median)	$10,001–$15,000	$10,001–$15,000		14.04
# People supported by income	4.39 (2.00); 1–11	4.29 (2.00); 1–14	*t*(318) = 0.45	
Infant characteristics				
Gestational age	39.22 (1.64); 26–42	39.39 (1.20); 36–42	*t*(318) = −1.03	
Birth weight (grams)	3365.37 (547.31); 612–4935	3391.32 (437.33); 2379–4590	*t*(308) = −.46	
5-min APGAR	8.94 (0.40); 5–10	8.89 (0.57); 4–10	*t*(311) = 0.39	
Substantive variables				
Maternal stress (prenatal)	2.81 (2.26); 0–10	2.65 (2.16); 0–11	*t*(318) = 0.45	
Maternal stress (birth through 9 months)	1.90 (1.84); 0–7	1.81 (1.92); 0–9	*t*(295) = 0.43	
Negativity (6 weeks)	2.47 (0.72); 0.84–4.58	2.46 (0.69); .60–4.76	*t*(308) = 0.07	
Surgency (6 weeks)	2.23 (1.05);	2.28 (1.00);	*t*(308) = −0.42	
Negativity (12 months)	3.22 (0.75);	3.39 (0.87);	*t*(187) = −0.21	
Surgency (12 months)	5.34 (0.60); 0.21–5.86	5.55 (0.57); 0.29–6.38	*t*(187) = −1.72†	
Maternal Sensitivity (12 months)	4.02 (0.36); 2.09–3.80	3.93 (0.39); 2.21–3.89	*t*(179) = −1.03	
Internalizing behaviors (18 months)	3.20 (2.12); 0–10	3.18 (1.94); 0–9	*t*(235) = −0.19	
Externalizing behaviors (18 months)	3.95 (2.54); 0–12	3.16 (2.18); 0–10	*t*(200.84) = 2.29*	

Note. Means and *SD* on substantive variables with missing data were calculated using FIML. *t*-tests and chi-square tests employed listwise deletion.

† $p < .10$.

* $p < .05$.

Table 2

Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Mother characteristics																						
1. Age (prenatal)	—		0.01						0.07		0.01	0.13	0.13	−0.12	0.01	−0.03	−0.09	0.04	0.03	0.02	−0.02	0.05
2. Country born[a]		—					−0.01		−0.10	0.01	0.06	0.01	0.06	−0.03		−0.18	−0.14	0.21	−0.17	−0.09	−0.03	0.03
3. Years in U.S.	−0.02		—				0.11	0.12			−0.02	−0.04	−0.05	0.07	−0.11	−0.01	−0.07	−0.21	−0.02	−0.02	0.08	−0.04
4. Preferred language[b]				—			−0.08			0.10	0.04	0.08			0.08	−0.09	−0.14	0.21	−0.05	−0.10	−0.11	0.07
5. Anglo orientation					—		0.07			−0.10	−0.01	−0.12	−0.12	0.10	−0.08	0.06		−0.18	0.14	0.02	0.00	−0.05
6. Mexican orientation	0.19					—	−0.10	−0.10	−0.12	0.09	0.01	0.05	0.06		0.07	−0.08	−0.08				−0.15	0.02
7. Marital status[c]	−0.13					−0.09	—	−0.05	−0.14	−0.01	−0.04	−0.08	−0.05		0.26	0.01	−0.01	−0.11	0.05	0.10	−0.10	0.03
8. Level of education			0.02			−0.11	0.04	—			−0.05	−0.06		0.03	0.06	0.06	0.05	0.10	0.08	0.07	0.14	−0.01
9. Annual income	0.05	0.02	−0.08	0.02	0.06	0.05			—	0.03	−0.03	−0.04	−0.06			0.09	−0.01	0.11	−0.02	0.06		0.09
10. # People supported		0.09	0.13			0.03	−0.08		0.01	—	0.00	0.06	0.04	−0.06	−0.05	−0.04	−0.05	0.02	−0.14	−0.05	0.03	−0.11
Infant characteristics																						
11. Gestational age		−0.02	−0.02	0.06	0.01	0.04	−0.05	0.02	−0.04	−0.04	—		−0.11	−0.09	−0.08	−0.05	−0.08	−0.09	−0.12	−0.10		
12. Birth weight			−0.02	0.11		0.07	−0.09		−0.05	0.08		—	−0.08	−0.07	−0.03	0.08	0.04	−0.12	−0.08	−0.10	0.05	−0.12
13. 5-min APGAR	−0.10	0.03	−0.03	0.03	0.05	−0.05	−0.04	0.14	0.07	−0.01	−0.01	−0.02	—	−0.06	−0.07	−0.08	0.04	−0.12	−0.09	−0.12	0.04	0.02
Substantive variables																						
14. Prenatal stress				−0.35					−0.14	0.04	0.03	0.01	0.03	—		0.10	0.03	0.01	−0.02	0.01	−0.00	0.11
15. Postnatal stress	−0.02	−0.03	−0.01	−0.05	0.06	−0.03	0.08	0.02	0.05	0.00	−0.10	0.04	0.02		—	0.06	−0.05		0.06	0.04	−0.03	0.05
16. Negativity (6 w)	−0.15	−0.16	−0.05	−0.15	0.13	−0.10	0.03	0.07	0.05		−0.01	−0.10	0.09			—		0.13	0.04	−0.06	0.06	0.11
17. Surgency (6 w)	−0.10	−0.14	−0.06	−0.07		−0.10			0.03		−0.02	−0.12	0.00	0.13			—	−0.10		−0.04	0.13	0.13
18. Negativity (12 m)	−0.04	0.06	−0.24	−0.08	−0.12	−0.17	0.04	−0.02	−0.08	−0.12	−0.04	0.04	0.09	0.17			0.15	—	0.02	−0.01	0.12	0.15
19. Surgency (12 m)		0.16	−0.15	−0.01	−0.14	−0.00	0.08	−0.12	−0.01	0.09	0.03	−0.01	0.03	−0.02	−0.10	−0.02	0.09	0.00	—		0.04	0.04
20. M. sensitivity	−0.00	0.19	−0.13	0.09	0.01	0.19	−0.16	0.03	0.11	−0.18	−0.03	−0.01	0.05	−0.09	0.18	0.10	0.10	−0.03	0.12	—	−0.01	−0.12
21. Externalizing	−0.11	−0.01	−0.15	−0.03	−0.04	0.07	0.12	−0.07	−0.09	−0.12	0.05	0.04	0.06	0.12	−0.03	0.06	−0.00	−0.01	−0.13	−0.22	—	
22. Internalizing	0.04	−0.03	−0.16	−0.05	−0.18	0.01	0.03	−0.16		−0.02	0.01	0.12	0.01	−0.07	−0.06	0.06	0.10		−0.10	−0.11		—

Note. Correlations for girls are depicted above the diagonal, and correlations for boys are depicted below the diagonal. Correlations computed using FIML.

[a]0 = U.S.; 1 = Other.

[b] 0 = English; 1 = Spanish.

[c] 0 = Married/living together. 1 = Other.

[d] 0 = boy; 1 = girl. Bolded values indicate that correlations are statistically significant at $p \leq .05$.

See the online article for the color version of this table.