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Parenting and Cortisol in Infancy Interactively Predict Conduct Problems and Callous-Unemotional Behaviors in Childhood

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Abstract

The current study examines observed maternal sensitivity, harsh-intrusion, and mental-state talk in infancy as predictors of conduct problems (CP) and callous-unemotional (CU) behaviors in middle childhood, as well as the extent to which infants' resting cortisol and cortisol reactivity moderate these associations. Using data from the Family Life Project (n = 1,292), results indicate that maternal sensitivity at 6 months predicts fewer CP at first grade, but only for infants who demonstrate high levels of cortisol reactivity. Maternal harsh-intrusion predicts fewer empathic-prosocial behaviors, a component of CU behaviors, but only for infants who demonstrate high resting cortisol. Findings are discussed in the context of diathesis-stress and differential susceptibility models.

There is an appreciation in developmental and clinical research that infants' psychobiological functioning and early experiences with caregivers directly and interactively influence in the emergence of externalizing behavior problems (Waller, Gardner, & Hyde, 2013), and this appreciation informs contemporary research on the development of conduct problems (CP) and callous-unemotional (CU) behaviors (Frick, Ray, Thornton, & Kahn, 2014). Conduct problems, a broad term encapsulating both oppositional defiant and conduct disordered qualities, are characterized by aggressive, deceitful, and norm-violating behaviors, and are often associated with deficits in emotional and behavioral regulation (Frick, Cornell, Barry, Bodin, & Dane, 2003). CU behaviors describe an affective and interpersonal style characterized by a lack of guilt and empathy, limited prosociality, insensitivity to punishment, and a callous use of others -- and typically signify risk for later antisocial behavior and psychopathy (Frick et al., 2014). Whereas early CP is a risk factor

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for ongoing behavioral problems, the presence of CU behaviors in early childhood represents an additional, and perhaps more profound, risk for lifelong antisocial and delinquent behaviors (Frick et al., 2014).

Advances in our ability to measure these forms of externalizing psychopathology in early life have prompted an increase in research investigating the early environmental and biobehavioral predictors of later CP and CU behaviors (Wagner, Mills-Koonce, Willoughby, Zvara, & Cox, 2015;). This work has identified the importance of multiple qualities of early parenting (Hyde, Waller, & Burt, 2014), as well as distinct psychobiological correlates of early CP and CU behaviors (Mills-Koonce et al., 2015; Wagner, et al., 2015). Despite the significant advancements on this topic, little research has examined the extent to which parenting in infancy and early psychobiological functioning interactively contribute to the emergence of CP and CU behaviors, a notion consistent with developmental theory (Boyce & Ellis, 2005). Research suggests that both CP and CU behaviors are etiologically heterogeneous (Frick et. al, 2014), and studies that incorporate both behavioral and psychobiological functioning would be well positioned to provide insight into the unique developmental pathways of these behaviors.

To address this gap in the literature, the current study focuses on the role of multiple aspects of caregiving and hypothalamic-pituitary-adrenal (HPA) axis functioning, an important psychobiological indicator of stress functioning, in infancy in the development of CP and CU behaviors. Although previous theoretical and empirical research provides support for the assertion that infants with elevated psychobiological functioning may be more affected by their caregiving environment (Belsky, J., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H., 2007; Boyce & Ellis, 2005; Obradović, Bush, Stamperdahl, Adler, & Boyce, 2010), this notion is yet to be tested systematically with regard to the development of CP and CU behaviors. The goal of this manuscript is to examine the extent to which infants' HPA axis functioning moderates the influences of early caregiving experiences on the development of CP and CU behaviors and, if so, uncover the nature of these interactions The current study tests multiple paths to disordered behavior with a goal of contributing to a body of literature which suggests that psychopathology emerges from the probabilistic associations between early patterns of psychobiological functioning and early experience (Boyce & Ellis, 2005).

Parenting in Infancy

A growing number of empirical studies have identified multiple aspects of the caregiving environment as playing an important role in the development of CP and CU behaviors (i.e. (Bedford et al., 2017; Mills-Koonce, Willoughby, Garrett-Peters, Wagner, & Vernon-Feagans, 2017; Wagner, et al., 2015; Waller, Gardner, & Hyde, 2013; Willoughby, Mills-Koonce, Propper, & Waschbusch, 2013). For example, harsh parenting and corporal punishment (Pardini et al., 2007) predict both CP and CU behaviors, even after controlling for earlier behavior problems (Wagner, et al., 2015). Findings also show that higher levels of positive reinforcement, sensitivity, and warmth predict lower levels of CU behaviors (Frick, Cornell, Bodin, et al., 2003).

Importantly, longitudinal research suggests that the *early* parent-child relationship likely exerts enduring influence on children's externalizing behavior problems (Fearon, Bakermans-Kranenburg, van Ijzendoorn, Lapsley, & Roisman, 2010), including both CP and CU behaviors. For example, Willoughby and colleagues (2013) found that harsh parenting in infancy but not toddlerhood predicted CU behaviors whereas harsh parenting in infancy and toddlerhood predicted later oppositional defiant behaviors (Willoughby et al., 2013), and a study by Bedford and colleagues showed that maternal sensitivity measured at 29 weeks has been shown to predict later CU behaviors at 2.5 years (Bedford, Pickles, Sharp, Wright, & Hill, 2014). Providing compelling evidence for the importance of caregiving in infancy on the development of CU behaviors, Hyde and colleagues (2016) found that adoptive mother positive reinforcement at 18 months buffered the effects of heritable risk for CU behaviors posed by biological mother antisocial behavior (Hyde et al., 2016).

The ways in which parents influence developmental pathways are many (e.g., Cox, Mills-Koonce, Propper, & Gariepy, 2010), and there is accumulating evidence that parents' mental-state talk, which refers to caregivers' verbalizations that recognize the internal states of the child or others, is associated with sensitive caregiving behaviors (Laranjo, Bernier, & Meins, 2008; Meins et al., 2012) and likely plays an important role in protecting against subsequent behavioral difficulties (Meins, Centifanti, Fernyhough, & Fishburn, 2013). Mothers' use of mental-state talk, including the in the use of words such as “think”, “want”, and “feel” (Taumoepeau & Ruffman, 2006), demonstrates an attunement to their infants' internal states and may play a role in the development of psychopathology including both CP and CU behaviors (Meins et al., 2013). For example, mothers' mental state talk in infancy has been shown to predict lower scores on concurrent measures of aggression at age 2 years (Garner, Dunsmore, & Southam-Gerrow, 2008) and was negatively associated with externalizing problems at 44 months (Meins et al., 2013). To date, only one study has examined direct associations between mothers' mental-state talk in infancy and children's CU behaviors, and it showed that mental-state talk predicts later CU behaviors via their influence on children's emotional understanding (Centifanti, Meins, & Fernyhough, 2015). Importantly, no research has examined both positive and negative aspects of early caregiving as well as mental state talk use simultaneously in the same study, an important next step to building a comprehensive understanding of the associations between the early caregiving environment and later CP and CU behaviors.

Hypothalamic-Pituitary-Adrenal Axis Functioning

Cortisol, a glucocorticoid hormone that reliably indexes activity in the Hypothalamic-Pituitary-Adrenal (HPA) axis (Gunnar & Quevedo, 2007), has been featured in developmental psychopathology research given the role of the stress system in both facilitating adaptive stress responses and operating to maintain and reestablish homeostasis (Doom & Gunnar, 2013). When confronted by a stressor, the HPA axis operates through a cascade of hormones eventually triggering the release of cortisol, a primary stress hormone (Alink, Cicchetti, Kim, & Rogosch, 2012). Following stressful experiences, excess cortisol binds to glucocorticoid receptors which facilitates the stress system's return to homeostasis. Cortisol is also produced in daily non-stress situations and follows a diurnal rhythm which plays a key role in the central nervous system where it is involved in learning, memory, and emotion, as well as in the metabolic and immune systems (Gunnar & Vazquez, 2001).

Ideal cortisol functioning in response to a moderate challenge is often described as an inverted U shape, with moderate levels of cortisol reactivity in response to a stimulus associated with attention, effortful control, and adaptive engagement with the environment (Blair et al., 2008). Very high or very low levels of resting cortisol and exaggerated levels of cortisol reactivity are associated with regulatory deficits (Blair, Granger, & Razza, 2005) and with elevated levels of externalizing psychopathology (Mills-Koonce et al., 2015). Although remaining relatively plastic throughout development, there is evidence that patterns of cortisol functioning become consolidated in early life (Gunnar & Quevedo, 2007), and have both direct and interactive influences on the emergence of children's behavior problems. The inclusion of an indicator of HPA functioning, both at rest and in response to fear and frustration stimuli, in research on the emergence of CP and CU behaviors is useful because much of the neural circuitry involved with empathy- and callous-related responses has strong reciprocal connections with peripheral physiology, including cortisol (Shirtcliff et al., 2011). The maintenance of baseline physiology characterizes potential constraints on the magnitude of possible stress response (Cacioppo, Uchino, & Berntson, 1994), whereas cortisol reactivity characterizes physiological stress response in context of experiences of fear and frustration. As such, the inclusion of both resting cortisol and cortisol reactivity is an important next step and provides useful insight into early developmental processes.

Although existing research suggests that the associations between HPA axis functioning and externalizing problems may vary across different age ranges (see Alink et al., 2008), the majority of findings with samples of very young children provide evidence that behavior problems are typically associated with reactive or heightened HPA axis patterns of functioning (Frick & Viding, 2009), including a meta-analysis of over 5,000 participants which found a positive association between basal cortisol and externalizing behavior problems in preschoolers (Alink et al., 2008). Regarding CU behaviors, there is recent work with infants by Mills-Koonce and colleagues (2015) who, using the current sample, found that children high on CP and CU behaviors in the 1st grade had higher levels of baseline cortisol and demonstrated more behavioral fear reactivity at 15 months of age compared to children with low levels of CP and CU behaviors (Mills-Koonce et al., 2015). This study suggests that, similar to the patterns of early behavioral and HPA axis functioning associated with CP, infants with later CU behaviors may display elevated cortisol activity and behavioral reactivity very early in life.

Interactive Influences of Early Caregiving and HPA-Axis Functioning

While there have been many empirical studies that have examined the influences of early experiences with caregivers on eventual CP and CU behaviors (e.g., Waller et al., 2013), and a growing number of studies looking at links between HPA-axis functioning and these outcomes (e.g., Mills-Koonce et al., 2015), this is the first study to examine the extent to which the influences of early caregiving on later CP and CU behaviors depend on infants' resting cortisol and cortisol reactivity. Dominant theoretical models that guide our thinking about the relations between early risk factors and behavioral adaptation include diathesis-stress (Monroe & Simons, 1991) and differential susceptibility (Belsky et al., 2007; Pluess & Belsky, 2011). The diathesis-stress model suggests that environmental risk (e.g., low-quality parenting) is more likely to negatively impact the development of individuals who possess vulnerability factors but less likely to impact nonvulnerable individuals, whereas differential susceptibility argues that vulnerability factors are better understood as *plasticity* factors which may increase risk for negative outcomes in the context of environmental risk, but also increase the likelihood of positive outcomes in the context of supportive environments (see Ellis & Boyce, 2011 and Roisman et al., 2012). Related to but distinct from the diathesis-stress (Monroe & Simons, 1991) model, vantage sensitivity models suggest that some individuals are more positively responsive to the environmental advantages to which they are exposed (Pluess & Belsky, 2012). These theoretical models have supported significant advances in our understanding of the processes through which behavioral (Belsky et al., 2007), biological (Obradović et al., 2010), and genetic (Kochanska, Kim, Barry, & Philibert, 2011) characteristics moderate links between early experiences and the emergence of psychopathology.

Specific to the current research, existing literature has identified high levels of resting cortisol and cortisol reactivity as vulnerability factors, or markers for greater plasticity or sensitivity to early experiences. For example, Obradovic and colleagues (2010) found that children who exhibited high levels of baseline cortisol demonstrated the most and least prosocial behaviors depending on the quality of their rearing environment (Obradović et al., 2010), and an intervention for children with disruptive behavior disorder proved effective only for those displaying high cortisol reactivity (van de Wiel, van Goozen, Matthys, Snoek, & van Engeland, 2004). Given the evidence that both CP and CU behaviors are associated with elevated baseline cortisol and cortisol reactivity in infancy (Mills-Koonce et al., 2015; Wagner, et al., 2015), it is possible these patterns of biobehavioral functioning will exacerbate either the negative influences of harsh and insensitive caregiving experiences or the positive influences of sensitive caregiving experiences on later CP and CU behaviors.

Current Study

The current study is the first to test the extent to which the influences of parenting in infancy on later CP and CU behaviors depends on patterns of early HPA-axis functioning. Specifically, we simultaneously examined 3 dimensions of parenting behaviors (maternal sensitivity, harsh-intrusion, and mental-state talk) and 2 dimensions of HPA axis functioning (baseline cortisol and cortisol reactivity) as predictors of children's CP and two dimensions of CU outcomes in first grade, callous and empathic-prosocial behaviors. Additionally, we tested the extent to which the associations between early parenting behaviors and later CP and CU outcomes were moderated by baseline cortisol and cortisol reactivity. First, we hypothesized that sensitivity and mental state talk would negatively predict CP and CU outcomes, and that harsh-intrusion would positively predict CP and CU outcomes. Second, we hypothesized that infants with heightened resting cortisol and cortisol reactivity across fear and frustration tasks who were exposed to unsupportive caregiving environments during infancy and early childhood (i.e., harsh-intrusive and insensitive parenting behaviors, low emotional socialization) would exhibit the highest levels of CP and CU behaviors in the first grade. While our second hypothesis aligned with a diathesis-stress model, it was possible that infants with heightened resting cortisol and cortisol reactivity would also exhibit very low levels of CP and CU behaviors in the context of supportive caregiving as described by differential susceptibility models. As such, a goal of this study was to untangle potential moderation effects in the prediction of CP and CU behaviors.

Methods

Sample

The Family Life Project (FLP) is a large longitudinal study of children and families living in non-urban, lower income communities in the United States. Families and their newborns that lived in two major geographical areas of high child rural poverty (including three counties in eastern North Carolina and three counties in central Pennsylvania) were recruited in 2003 and 2004 using a stratified random sampling procedure yielding a representative sample of 1,292 families recruited over a one-year period at the time mothers gave birth to a child. There were 58 participants who were missing data on all variables of interest (i.e., CP, CU behaviors, parenting, cortisol, behavioral reactivity, and emotion socialization practices) and these participants were not included in the analyses. Participants who were missing on all variables of interest did not vary systematically from those who were not missing data as a function of state, $X^2(1) = 0.01$, $p = 0.93$, race, $X^2(1) = 0.98$, $p = 0.32$, poverty, $X^2(1) = 1.64$, $p = 0.19$, or sex $X^2(1) = 0.16$, $p = 0.69$. The final sample used in the current study consisted of 1,234 families that had at least partial data on the variables of interest at one of the assessment points.

Procedure

Data were collected during home visits completed when the child was approximately 6 and 15 months old, and when the child was in the 1st grade (*mean age* = 86.7 *months*, *sd* = 3.3 months). Visits consisted of interviews, questionnaires, child assessments, and observations of mother-child interactions. All interviews and questionnaires were computerized. At the 6 and 15 month visits, mothers and their children were videotaped while engaging in a free play activity using a standard set of toys. The mother was instructed to play with their child as they normally would for 15 minutes. At the 15 month visit primary caregivers (almost exclusively biological mothers) completed demographic questionnaires and children participated in two procedures designed to elicit physiological reactivity (Goldsmith & Rothbart, 1990). The first procedure as a mask presentation task during which children were presented with four unusual masks, one at a time. The experimenter wore the masks for 10 seconds while calling the child's name and moving slowly from side to side in front of the child. Infants' behavioral reactivity was recorded and later coded. The second task was a toy removal tasks during which the child was encouraged to play with an attractive toy for 60 seconds. The child's mother then removed the toy and engaged in conversation with the experimenter for 2 minutes. The mother then returned the toy to the child but continued to converse with the experimenter for 1 minute.

Measures

Salivary cortisol—Analysis variables include a baseline cortisol sample that was collected prior to the administration of the fear and frustration tasks. A second sample was

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collected 20-minutes following peak arousal as determined by the data collectors following clear guidelines established in the experimental protocol (i.e., 20 seconds of hard crying), and cortisol reactivity levels were calculated by subtracting the pre-task levels from the 20-min post-peak arousal levels. Unstimulated whole saliva was collected by using either cotton or hydrocellulose absorbent material and expressing the sample into 2-ml cryogenic storage vials using a needleless syringe (cotton) or by centrifugation (hydrocellulose). All samples were assayed for salivary cortisol with a highly sensitive enzyme immunoassay (Salimetrics, State College, PA) that has been U.S. Food and Drug Administration 510(k) cleared for use as an in vitro diagnostic measure of adrenal function. The test used 25 ml of saliva, had a range of sensitivity from 0.0007 to 1.8 g/dl, and had average intra- and interassay coefficients of variation of <10% and 15%, respectively. All samples were assayed in duplicate. The criterion for repeat testing was variation between duplicates of > 20%, and the average of the duplicates was used in all analyses. The cortisol distributions were subject to log transformation to correct for positive skew. Values >3 SD above the mean were removed as outliers ($n = 14$ for cortisol reactivity and $n = 19$ for baseline cortisol).

Maternal Sensitivity and Harsh-Intrusiveness—Mother-child interactions during the 10-min video recorded tasks at 6 and 15 months were later coded to assess levels of mothers' sensitivity (level of responsiveness and support offered to the child contingent on the child's needs), intrusion (intrusive, insensitive behaviors), detachment (degree to which the mother is disengaged), stimulation of development (degree to which parent fosters the child's development), positive regard (positive feelings and warmth directed toward the child), negative regard (negative regard and hostility), and animation (see Vernon-Feagans & Cox, 2013 for more detail). Trained and reliable coders rated globally each of the constructs using a scale ranging from 1 (*not at all characteristic*) to 5 (*highly characteristic*). Coders gave a single rating for each code based on the overall quality of the entire interaction using Likert-type scales. The coding teams for the 6- and 15-month time points varied slightly, but each coding team consisted of four to five coders and included two master coders who were consistent across both 6- and 15- months. Each coder was trained to be reliable with the master coders. Each coder completed approximately 30% of the assigned video tapes with the master coders, and differences in scores were conferenced to create a final score for double-coded videos. Reliability was calculated using the intraclass correlation (ICC) for the independent ratings made for the overlapping coding assignments. Reliability across subscales and composites at 6- and 15-months was high. Each pair of coders maintained ICCs above .80 and each individual coder maintained ICCs for each variable at or above .80 with the master coder. Consistent with previous factor analytic work with the observational measures of parenting used in this study (Willoughby et al., 2013), mean scores from 6- and 15- months were used to represent maternal sensitivity [comprised of sensitivity, detachment reverse-scored, positive regard, animation, stimulation of development] and a harsh-intrusion [comprised of intrusion, negative regard] in infancy. Maternal sensitivity at 6- and 15-months were significantly correlated, $r = .65$, $p < .001$, and harsh-intrusion at 6- and 15-months were significantly correlated, $r = .40$, $p < .001$.

Maternal Mental State Talk—Maternal discourse data were obtained from a picture-book task that was administered at a 6-month home visit. The mother was asked to sit in a comfortable chair or couch with her infant and was given the book Baby Faces (DK Publishing, 1998). This wordless picture book contained a picture of a baby face on each page, with each baby showing a different emotion. The videotaped interactions between the mothers and their 6-month-old infants were transcribed using the Systematic Analysis of Language Transcripts (SALT) software (Miller & Chapman, 1985). Research assistants were trained in coding the transcripts for mothers' mental state comments and using a coding manual that was adapted from previously used coding systems developed by Cervantes and Callanan (Cervantes & Callanan, 1998) and Meins and colleagues (Meins et al., 2012). Mental state talk refers to the mothers' tendency to frame the interaction in a mentalistic context and infer and comment on her infant's mental state, typically by using words such as think, feel, and want. Mental state talk was calculated as a ratio of number of mental state utterances to the number of minutes of the interaction. The range of intraclass correlations for trained coders was .84 to .96, and the reliability and validity associated with the use of the current coding procedure has been established in the literature (e.g., Garrett-Peters, Mills-Koonce, Zerwas, Cox, & Vernon-Feagans, 2011).

Conduct Problems and Callous-Unemotional Behaviors—The Disruptive Behavior Disorder Rating Scale (DBDRS; Pelham, Gnagy, Greenslade, & Milich, 1992) is a DSM-IV guided scale that includes subscales for assessing oppositional defiance, hyperactivity-impulsivity, conduct disorder, and inattention. Oppositional items assess various qualities including defiance, argumentativeness, and anger. Conduct disorder items focus on more disruptive behaviors such as aggression towards people and animals, destruction of property, theft, and serious violations of rules. Conduct problems were assessed using the DBDRS which was completed by maternal primary caregivers when the children were in first grade. The psychometrics of the DBDRS have been evaluated and the validity of the DBDRS has been established (Erford, 1997). The Inventory of Callous Unemotional (ICU; Frick, 2004) traits was used to assess callous-unemotional behaviors at first grade. The ICU was completed by maternal primary caregivers who responded to 24 items on a 4-point likert scale ranging from 0 (not at all true) to 3 (definitely true). The items that comprise the ICU were developed from other highly established clinical assessments (e.g. APSD, PCL-YV) and include questions about the extent to which the child uses emotions, expresses feelings, cares about getting in trouble, seems cold and uncaring, and hurts others' feelings.

Previous Family Life Project reports provide confirmatory factor analyses that identify unique measures of children's parent-rated conduct problems (17 items from the DBDRS) and two components of CU behaviors, empathetic-prosocial (13 items) and callous (13 items) behaviors in first grade (Willoughby, Mills-Koonce, Gottfredson, & Wagner, 2014). As established previously, the items loaded strongly on their designated factors and the resulting factors exhibited good criterion validity (e.g., conduct, empathetic prosocial, and callous behaviors were associated with parent, teacher, and peer relationship difficulties in expected ways (see Willoughby, Mills-Koonce, Waschbusch, & Gottfredson, 2014). Informed by this work, the current study uses continuous measures of conduct problems (CP; $\alpha = 0.92$), empathic-prosocial (EP; $\alpha = 0.87$) and callous (CU; $\alpha = 0.75$) behaviors as the primary outcomes of interest.

Additional covariates—Child's sex was collected at the time of recruitment and child's age in months was based on age at the first-grade visit. Maternal Education was assessed using self-report at each home visit. Analyses include whether the mother reported completing high school at any time point. An index of maternal mental health was assessed at the 6 month visit using the Global Severity Index (GSI) from the Brief Symptom Inventory (BSI-18; (Derogatis, 1993), a highly sensitive self-report screening index for psychological distress and mental health. The GSI is comprised of ratings on maternal depression, somatization, and anxiety. Parent-report and observational measures of infant temperament were also included as covariates to control for individual differences in general irritability or distress. Measures of temperament were drawn from the infant Behavior Questionnaire (IBQ; Rothbart, 1981), a parent report measure of temperament completed by primary caregivers at the 6-month home visit, and the Infant Behavior Record (IBR; Bayley, 1969), an observational measure completed by research assistants and used to evaluate infant behavior across the 6-month home visit was. Measures of infants' distress to limitations (α = .81) and distress or fear to novelty (α = .90) were taken from the IBQ and a measure of observed irritability (α = .70) was taken from the IBR. Time of day of cortisol collection were electronically recorded and included in the analyses to account for the well-known diurnal pattern of cortisol in which levels of salivary cortisol are lower at later assessment times during the day. Infant body temperature was also collected at the time of cortisol collection and was included as a covariate to account for associations between possible fever and circulating cortisol.

Analysis plan

The research questions proposed in this study were addressed in the following ways. First, we examined the extent to which maternal sensitivity and harsh-intrusion in infancy, mental state talk at 6 months, and cortisol activity and reactivity at 15 months directly predicted CP, EP, and CU behaviors in first grade, controlling for model covariates. Second, six interaction terms (3 parenting variables and 2 moderators) were simultaneously entered as exogenous predictors of CP, EP, and CU behaviors. Model outcomes were allowed to covary in both models. Predictors and outcomes were mean centered to reduce the multicollinearity between predictors and interaction terms and to aid interpretation of simple slopes.

The nature of significant interactions was elucidated following the recommendations provided by Roisman and colleagues (2012). First, in order estimate a snapshot of the association between the predictor and outcome at two specific reference points, significant interactions were probed at one standard deviation above and below the mean for the moderator variables (resting cortisol and cortisol reactivity) and the caregiving variables (sensitivity, harsh-intrusion, and mental state talk) providing. Second, regions of significance (RoS) analyses, which identify the exact range of values of the moderator for which the independent and dependent variables are significantly associated, were used to determine at which levels of resting cortisol and cortisol reactivity does caregiving predict CP and CU behaviors, but also for which levels of caregiving these associations were significant. A differential susceptibility effect was inferred when the association between the moderator and child outcome was significant at both ends of the distribution of the caregiving variable. A diathesis-stress model was inferred when the interaction was significant only on one end of the distribution (Roisman et al., 2012). Third, as suggested by Roisman and colleagues (2012), we also calculated the Proportion of the Interaction (PoI), an index which expresses the proportion of the total interaction that is represented on the right side of the crossover point for the interaction. PoI values close to 0.50 suggest differential susceptibility since the effect is equally represented on both the high and low end of the distribution of the predictor, whereas values closer to 0 provide evidence for diathesis-stress. Finally, given the complex sampling design of the Family Life Project, analyses utilized individual probability weights associated with oversampling of low-income and African American families and stratification on income, state, and race. The robust maximum likelihood (MLR) estimator was used to accommodate the use of sampling weights and stratification. Missing data was handled using the full information maximum likelihood methods (Enders & Bandalos, 2001). All path analyses were estimated using Mplus 7.1 (Muthén, L. K., & Muthén, B. O., 1998–2011).

Results

Demographics

Table 1 presents the bivariate correlations, means, and standard deviations for the model covariates and variables of interest. Measures of maternal sensitivity were negatively correlated with harsh-intrusion, $r = -.26$, $p < .01$, and positively correlated with mental state talk, $r = .40$, $p < .01$. Mental state talk was negatively correlated with harsh-intrusion, $r = -.10$, $p < .05$. Maternal sensitivity was negatively correlated with CP, $r = -.14$, $p < .01$, positively correlated with EP behaviors, $r = .19$, $p < .01$, and negatively correlated with CU behaviors, $r = -.19$, $p < .01$. Maternal harsh-intrusion was positively correlated with CP, $r = .08$, $p < .01$, negatively correlated with EP behaviors, $r = -.08$, $p < .05$, and positively correlated with CU behaviors, $r = .15$, $p < .01$. Mental state talk was not significantly correlated with CP, $r = -.05$, $p = .15$, but was positively correlated with EP behaviors, $r = .08$, $p < 0.01$ and negatively correlated with CU behaviors, $r = -.14$, $p < .01$. Baseline cortisol was negatively correlated with maternal sensitivity, $r = -.11$, $p < .05$, and not correlated with maternal harsh-intrusion or mental state talk. Cortisol reactivity was not correlated with any of the parenting measures. Baseline cortisol was negatively correlated with EP behaviors, $r = -.12$, $p < .05$, but was not significantly correlated with CP or CU behaviors. Cortisol reactivity was not correlated with CP, EP, or CU behaviors.

Prediction Models

Table 2 presents the parameter estimates and confidence intervals for the main effect and interaction models. Significant main effect associations indicated that reduced maternal sensitivity in infancy predicted higher levels of conduct problems in first grade, b = −.071, $\beta = -0.146$, $p < .01$, and the association between baseline cortisol and conduct problems approached significance, b = .031, $\beta = .068$, $p = .085$. Tests of moderating relations revealed significant interactions between maternal sensitivity and cortisol reactivity in the prediction of conduct problems, b = −.075, $\beta = -.102$, $p < .05$. Simple slopes analyses (Figure 1) revealed that the negative relations between maternal sensitivity and later CP was significant for individuals demonstrating high cortisol reactivity (+1 SD simple slope = −.123 [CI: −.19

to −.06], $p < .001$) but not low cortisol reactivity (−1 SD simple slope = −.024 [CI: −.08 to .03], $p = .38$).

RoS analyses indicated that the negative association between maternal sensitivity and CP was significant *inside* the lower and upper bounds of cortisol reactivity at −0.30 and 2.59, respectively. This suggests that the negative association between maternal sensitivity in infancy and children's later CP was significant for individuals demonstrating average to high levels of cortisol reactivity (i.e., −0.5 standard deviations below the mean and above) at 15 months. RoS analyses with respect to maternal sensitivity revealed lower and upper bounds of −3.04 and 0.83, respectively, suggesting that maternal sensitivity at or above 1.5 standard deviations above the mean negatively predicted CP for children with average to high levels of cortisol reactivity . The shaded area illustrated in Figure 1 represents the point at which maternal sensitivity predicts lower levels of CP for children demonstrating average to high levels of cortisol reactivity. The PoI was below 0.50 (0.41), providing further evidence that the described association was significant only at one end of the distribution of maternal sensitivity.

Maternal sensitivity in infancy predicted higher levels of EP behaviors at first grade, b = .117, $\beta = .156$, $p < .001$, and higher levels of baseline cortisol were associated with lower levels of EP behaviors, b = −.076, $\beta = -.109$, $p = .01$. Tests of moderating relations revealed significant interactions between harsh-intrusion in infancy and baseline cortisol in the prediction of EP behaviors b = −.098, $\beta = -.080$, $p < .05$. Simple slopes analyses (Figure 2) revealed that the negative relation between maternal harsh-intrusion was significant for individuals demonstrating high baseline cortisol (+1 SD simple slope = −.099 [CI: −.19 to −.01], $p < .05$), but not significant for individuals low on baseline cortisol (−1 SD simple slope = .050 [CI: −.05 to .15], $p = .35$).

RoS analyses indicated that the negative association between maternal harsh-intrusion and empathic-prosocial behaviors was significant *outside* the lower and upper bounds of baseline cortisol at −74.30 and 0.53, respectively. This suggests that the negative association between harsh-intrusion in infancy and children's later EP behaviors was significant for individuals demonstrating high levels of baseline cortisol (i.e., at or above 0.7 standard deviation above the mean) at 15 months. RoS analyses with respect to maternal harsh-intrusion revealed lower and upper bounds of −161.09 and −0.29, respectively, suggesting that maternal harsh-intrusion at just below the mean and above negatively predicts empathic-prosocial behaviors for children with high levels of baseline cortisol. The shaded area illustrated in Figure 2 represents the point at which maternal harsh-intrusion predicts lower levels of EP for children demonstrating high levels of baseline cortisol. The PoI was well above 0.50 (0.98), providing further evidence that the described association was significant only at one end of the distribution of maternal harsh-intrusion.

Maternal sensitivity in infancy was associated with lower levels of CU behaviors, b = −055, $\beta = -0.119$, $p < .01$, maternal harsh-intrusion in infancy was associated with higher levels of CU behaviors, b = .066, $\beta = 0.117$, $p < .01$, and mental state in infancy was associated with lower levels of CU behaviors in first grade, b = −.008, $\beta = -0.065$, $p < .05$. Measures of maternal caregiving in infancy did not interact with baseline cortisol or cortisol reactivity to predict CU behaviors in first grade. Interaction terms significantly contributed to the prediction of model outcomes, and accounted for an additional 3.5%, 2.6%, and 2.2% of the variance in CP, CU, and EP behaviors, respectively. The conditional residuals of first grade CP, EP, and CU behaviors were allowed to covary, cov(e_{CP} e_{EP}) = −0.07, $p < .001$, cov(e_{CP} e_{CU}) = 0.05, $p < .001$, cov(e_{CU} e_{EP}) = −0.04, $p < .001$. All standardized parameter estimates including estimates between the model covariates and variables of interest are shown in Table 2.

Discussion

The current findings add to the surprisingly sparse research on the extent to which individual differences in neuroendocrine functioning render infants more susceptible to the influences of early caregiving experiences on the development of CP and CU behaviors over time. Consistent with literature establishing links between early caregiving and psychobiological correlates of CP and CU behaviors (Mills-Koonce et al., 2015; Wagner, et al., 2015), results indicate that maternal sensitivity in infancy predicts lower levels of CP and CU behaviors, and higher levels of EP. Maternal harsh-intrusion in infancy predicted higher levels of CU behaviors, and mental-state talk in infancy predicted lower levels of CU behaviors in first grade. Importantly, this is the first study to identify both resting cortisol and cortisol reactivity as moderators of the influences of early parenting on CP, but also CU behaviors.

The negative associations between maternal sensitivity and children's CP are consistent with research suggesting that positive and supportive parenting behaviors are protective against externalizing behavior problems (Wagner, Mills-Koonce, Willoughby, Zvara, & Cox, 2015). However, contrary to previous research studies suggesting that harsh and controlling parenting styles may contribute to patterns of aggressive or coercive behaviors and interactions (e.g., Patterson, Debaryshe, & Ramsey, 1983), we did not find significant links between maternal harsh-intrusion at 6 months and children's CP at first grade. Perhaps this is due to the developmental importance of sensitive caregiving in the first year of life as foundational experience for ongoing developmental cascades related to attachment and self-regulation as critical precursors to adaptive social behaviors (Cox et al., 2010). In an intervention framework, Pasalich and colleagues (2015) found that harsh discipline predicted decreased conduct disorder symptoms, but only in the presence of low CU behaviors. Taken together with the current findings, it may be the case that at this age and in this analytic framework, which examines the influences of early harsh-intrusion on CP and CU outcomes simultaneously, negative parenting styles in infancy have a stronger influence on the emergence of CU-related constructs such as a lack of conscience, punishment sensitivity, and blunted fear responsivity than they do the emergence of aggression or defiance.

Results indicate that infants' cortisol reactivity across fear and frustration tasks at 15 months moderate the association between maternal sensitivity and CP in first grade. Analytic procedures aimed at untangling the nature of significant interactions suggest that maternal sensitivity negatively predicts CP for children demonstrating average or high cortisol reactivity, but that this association is only significant in the context of high sensitivity. Findings do not support a differential susceptibility interpretation because significant associations between parenting and CP were not observed at both high and low levels of maternal sensitivity. However, findings are consistent with a vantage sensitivity model, which suggests that some individuals are more positively responsive to the environmental advantages to which they are exposed (Pluess & Belsky, 2012). Consistent with the notion of *vantage sensitivity* (Pluess & Belsky, 2012), these data suggest that children who demonstrate elevated cortisol reactivity are more likely to benefit from experiences with highly sensitive mothers. In infancy, the sensitive and supportive parent serves as an external regulator by facilitating the development of children's self-regulatory capacities through structured and responsive care (Perry et al., 2013), and these bonds may be particularly beneficial for reactive children in the context of stress (Cassidy, 2008). Our findings suggest that children who are highly reactive, particularly in stressful situations of fear or frustration, may be more likely to benefit from responsive and supportive parenting, which supports the effective consolidation of self-regulatory capacities in infancy thus contributing to lower levels of CP in childhood.

Another idea central to developmental science which is relevant to the current findings is that early parenting behavior is a primary determinant of children's neuroendocrine response to stress and challenge. Rodent models have shown that high-quality maternal behavior, defined primarily by higher frequency of licking and grooming, is associated with a process by which pups acquire a greater number of glucocorticoid receptors in brain regions associated with the negative feedback system through which the HPA axis is regulated, essentially resulting in a better regulated HPA stress response (Meaney & Szyf, 2005). Furthermore, male rat pups exposed to corticosterone, a primary rodent glucocorticoid, in infancy demonstrate lower corticosterone concentrations in response to stressors in adulthood, and are characterized by greater executive cognitive and behavioral self-regulation compared to rodents not exposed in infancy (Parker, Buckmaster, Justus, Schatzberg, & Lyons, 2005). Taken together with evidence in human samples showing that maternal engagement is associated with increased cortisol reactivity in *infancy* and with an overall lower level of cortisol in *toddlerhood* (Blair et al., 2008), our findings may be capturing a snapshot of an ongoing developmental process whereby early maternal sensitivity contributes to better regulated HPA axis functioning in response to stress, resulting in lower levels of CP in childhood. It is important to note, however, that there is also substantial research linking early adversity with prolonged HPA axis activation, and that chronically high levels of cortisol can be maladaptive over time (e.g., Doom & Gunnar, 2013; Gunnar & Quevedo, 2007). The true nature of these associations may require a focused examination of relative levels of cortisol reactivity, as well as the study of the dynamic change of cortisol levels across reactivity and recovery. At the very least, these findings should motivate future longitudinal work examining the implications of ongoing sensitive caregiving, infants' neuroendocrine functioning, and the emergence of psychopathology.

The significant positive association between maternal sensitivity at 6 months and children's EP behaviors at first grade join a body of literature which demonstrates links between early positive and supportive parenting behaviors and the development of empathy (Kiang, Moreno, & Robinson, 2004) and prosociality (Newton, Laible, Carlo, Steele, & McGinley, 2014). Mothers' warmth, engagement, and sensitive responding are thought to model prosociality for children and scaffold children's social-cognitive awareness of others' needs and empathic behaviors (Krevans & Gibbs, 1996).

Analyses also indicate that harsh-intrusion predicts lower levels of empathic-prosocial behaviors, but only for children who demonstrate high levels of resting cortisol. Sensitive and responsive interaction patterns between a mother and her infant serve as a foundation for the development of empathy and conscience (Kochanska et al., 2010), and mothers who display harsh-intrusive parenting styles may inhibit the progression of these developmental processes, particularly for infants who demonstrate high basal HPA-axis functioning. Further, anxiety and discomforting arousal that follow wrong-doing and punishment are theorized to play an integral role in the internalization of empathic understanding (Kochanska, 1997). Very high resting cortisol may limit the extent to which an infant can engage with the environment adaptively during times of stress which might inhibit the development of empathic-prosocial behaviors in the context of a harsh-intrusive caregiving environment. Although the current study only measured resting cortisol a single time point, these findings provide support for future research projects which measure cortisol longitudinally in service of explicitly testing the proposed developmental processes.

Consistent with previous literature on the topic, the current study provides evidence that both maternal sensitivity and harsh-intrusion directly influence the development of CU behaviors. The associations between low levels maternal sensitivity and high levels of harsh-intrusion at 6 months and children's CU behaviors at first grade are consistent with research showing that mothers' warmth, engagement, and sensitive responding model prosociality for children, scaffold children's social-cognitive awareness of others' needs and empathic behaviors (Krevans & Gibbs, 1996), and predict conscience development in children showing fearlessness and punishment-insensitivity (Kochanska, 1997), all of which are relevant to the emergence of CU behaviors (Frick, Ray, Thornton, & Kahn, 2013).

Additionally, mental state talk at 6 months was found to negatively predict CU behaviors at first grade. This finding aligns with recent work showing that mothers' mental state comments at 8 months predict later CU behaviors through their influence on children's emotion understanding (Centifanti et al., 2015). The process of responding appropriately to infant's cues, which requires the mother to recognize that her infant has individual intentions, thoughts, and desires, is reflected in the mother's use of mental state talk, and lays the ground work for more complex forms of emotion socialization (Meins et al., 2002). Mental state talk is one of the earliest predictors of children's emotion understanding abilities (Meins et al., 2013) and the current findings suggest that it is an important predictor of later CU behaviors, above and beyond maternal sensitivity and harsh-intrusion. It is note-worthy that the influence of mental-state talk on children's CU behaviors remained significant despite the inclusion of observational measures of sensitivity and harsh-intrusion, and these findings suggest that the role of emotion socialization processes in the development of CU behaviors should garner more attention moving forward.

Limitations and Conclusions

The results of this study should be considered in the context of the following limitations. First, the use of a community sample in this study contributes to the generalizability of findings, but also restricts the extent to which the findings can be directly compared to and integrated with studies using clinical samples of older children. Although this study offers initial insight into the possibility of multiple pathways to CP and CU, the use of an older, clinically enlisted, sample might yield stronger predictive associations. Relatedly, the reported results should be interpreted with the understanding that the reported effects are of small magnitude. Links between early caregiving and later CP and CU behaviors are complex, and it is undoubtedly the case that the observed parenting measures and indices of HPA axis functioning included in this study are only part of a much larger story. While the use of the current sample and analytic approach aid generalizability, it may lack the level of behavioral severity that would be observed in clinical samples thus contributing to small effects.

Second, the current manuscript is limited in the extent to which we can test whether the observed interactions persist across childhood. Relatedly, cortisol was measured at a single time point rather than across a larger developmental window which limits our ability to draw conclusions regarding infants' ongoing experiences of elevated cortisol and the role these influences may play over time. Third, this study assesses a diversity of parenting behaviors which informed the creation of maternal sensitivity and harsh-intrusion composites. While this measurement approach has been validated in the literature, we recognize the importance of the continued refinement of the measurement and characterization of complex parenting behaviors in developmental research. Fourth, although multiple aspects of caregiving have been shown to predict CU behaviors even in adoption samples (e.g., Hyde et al., 2016), there remains strong evidence that CU behaviors are at least partially heritable (Waller et al., 2016). A recent study using an adoption sample found that biological mother fearlessness predicted child CU behaviors via child fearlessness, but that positive parenting buffered this risk pathway (Waller et al., 2016). It is clear the developmental pathways to CU behaviors are complex, and future studies should examine the interactive influences of children's psychobiological functioning and early experiences with caregivers using genetically informed designs.

The current study is the first to simultaneously examine direct associations between multiple measures of caregiving in infancy and later CP and CU behaviors, as well as the extent to which infants' resting cortisol and cortisol reactivity moderate these associations. This work joins a long history of research highlighting the importance of the caregiver-infant relationship. This early relationship, which clearly functions in the context of infants' HPA-axis functioning, plays an important role in the emergence of externalizing behavior problems, and, although the importance of this relationship persists throughout development as parents adjust their strategies to fit the child's age and characteristics, the parent-infant relationship, and its interaction with infants' psychobiological functioning, plays a vital role in providing a foundation and setting a course for subsequent development (Cassidy, 2008). Further, this study treats CP, EP, and CU behaviors as distinct aspects of children's externalizing behavior problems and, to the extent to which this is the case, our findings contribute to our understanding of differential pathways to these outcomes. We report variation in the relative influences of sensitivity, harsh-intrusion, and emotion socialization practices in infancy for the emergence of CP, EP, and CU behaviors, and we provide preliminary evidence that these influences are contingent on infants' neuroendocrine stress functioning. Developmental science is charged with producing translatable knowledge to inform the development and evaluation of methods for preventing and ameliorating psychopathological outcomes as well as supporting children's healthy emotional and behavioral development (Cicchetti, 2014) With this in mind, this study suggests that the clarity with which we comprehend pathways to disorder, an imperative for eventual intervention, partially depends on our ability to include diverse and longitudinal measurement.

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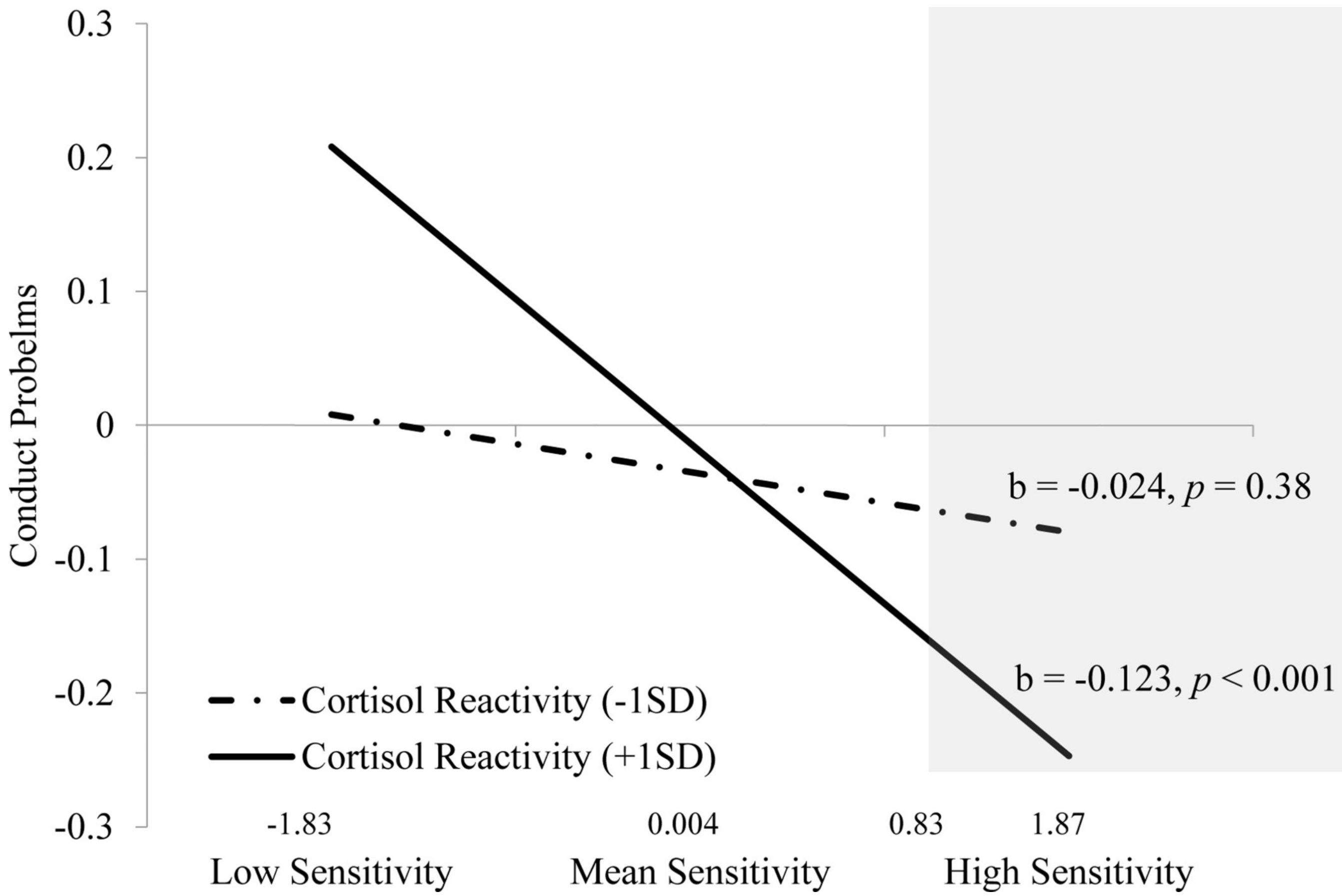

Figure 1. Sensitivity X Cortisol Reactivity

Regions of significance and simple slope estimates for the interaction between maternal sensitivity and children's cortisol reactivity in the prediction of conduct problems. The shaded area represents the point at which maternal sensitivity predicts lower levels of CP for children demonstrating average to high levels of cortisol reactivity.

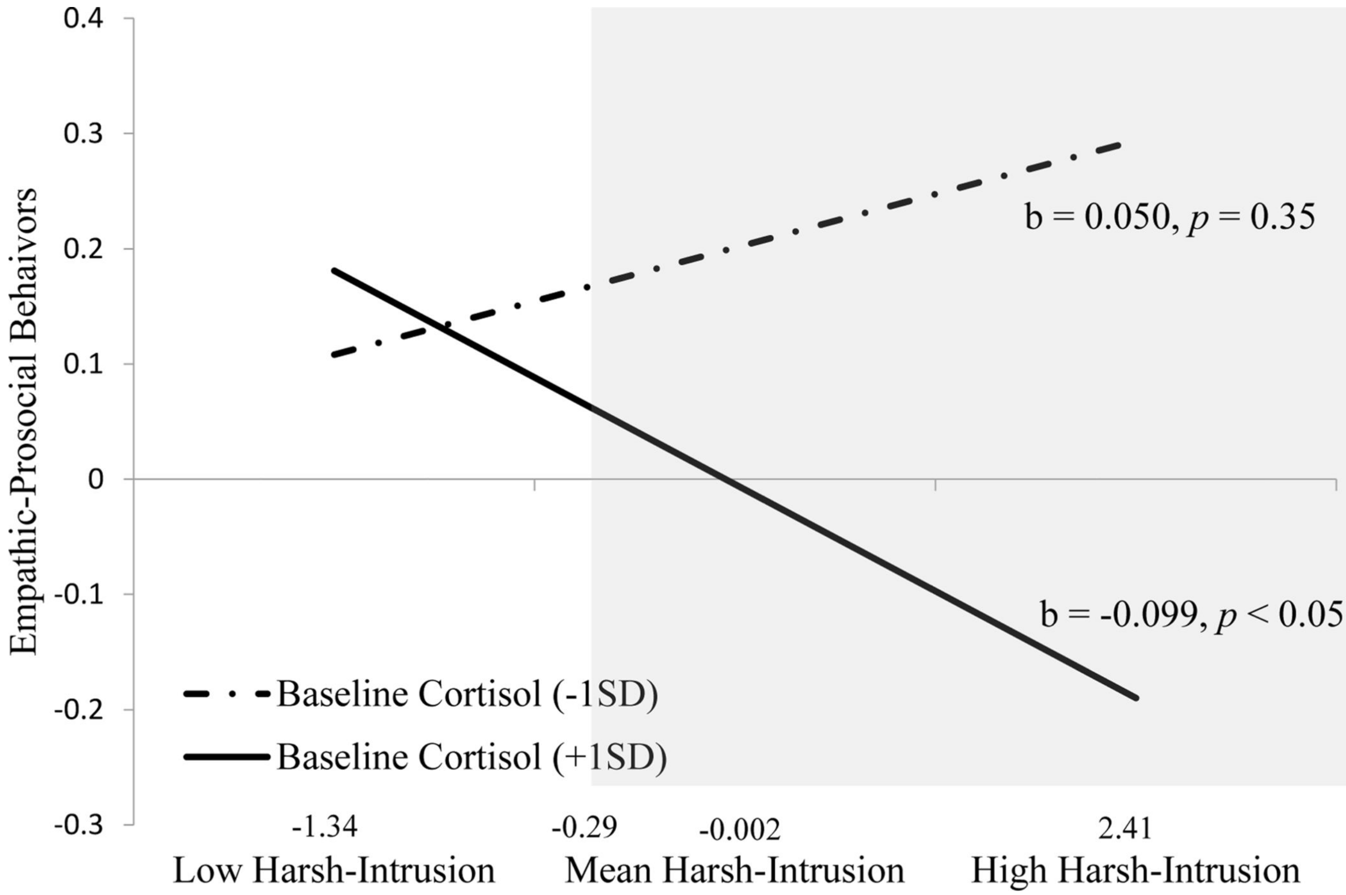

Figure 2. Harsh-Intrusion X Baseline Cortisol

Regions of significance and simple slope estimates for the interaction between maternal harsh-intrusion and children's baseline cortisol in the prediction of empathic-prosocial behaviors. The shaded area represents the point at which maternal harsh-intrusion predicts lower levels of empathic-prosocial behaviors for children demonstrating high levels of baseline cortisol.

Table 1

Means, Standard Deviations, and Zero-order Bivariate Correlation among Model Covariates.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Race (AA = 1)	-																		
2. Gender (Male = 1)	−.01	-																	
3. State (PA = 1)	.61*	−.07*	-																
4. Ed. (HS+ = 1)	−.07*	−.01	−.10*	-															
5. Age (1st)	−.16*	−.01	−.04	.03	-														
6. Dis. to Lim. (6m)	.24*	−.03	.21*	−.07$^{\wedge}$	.02	-													
7. Dis. to Nov. (6m)	.33*	−.11*	.26*	−.18*	.01	.37*	-												
8. Irritability (6m)	−.12*	−.03	−.17*	.05	.04	.09*	.12*	-											
9. Mat. GSI (6m)	.02	−.03	−.03	−.05	−.01	.19*	.14*	.02	-										
10. Time of Day	−.03	.03	.02	.02	.09*	.06	−.03	.08*	−.08*	-									
11. Body Temp.	−.12*	−.04	−.24*	.04	.07$^{\wedge}$	−.01	−.04	.06$^{\wedge}$	.07	−.09*	-								
12. Sensitivity	−.36*	−.01	−.26*	.23*	.05	−.17*	−.27*	.01	−.04	.06$^{\wedge}$	.06	-							
13. Harsh-Intrusion	.36*	.03	.25*	−.15*	−.01	.12*	.21*	−.07*	.10*	−.02	−.06	−.26*	-						
14. Mental State (6m)	−.16*	−.03	−.21*	.11*	−.08	−.10*	−.15*	.06$^{\wedge}$	−.01	−.01	.07$^{\wedge}$	.40*	−.10*	-					
15. Baseline Cort. (15m)	.12*	.02	.02	−.07$^{\wedge}$	−.07	.04	.06	−.02	−.06	−.19*	−.07	−.11*	.04	.01	-				
16. Cort. Reac. (15m)	−.09*	−.05	−.07$^{\wedge}$	−.04	.08$^{\wedge}$	−.03	.08$^{\wedge}$	.03	.02	−.03	.06$^{\wedge}$	.02	−.03	−.02	−.32*	-			
17. CP (1st)	−.07	.04	−.05	−.08	−.03	.12*	.05	.01	.18*	−.05	.08	−.14*	.08*	−.05	.07$^{\wedge}$	−.03	-		
18. EP Behaviors (1st)	−.13*	−.14*	−.10*	.06$^{\wedge}$	.01	−.10*	−.14*	.05	−.02	.07	.02	.19*	−.08*	.08*	−.12*	.03	−.37*	-	
19. CU Behaviors (1st)	.08*	−.01	.04	−.08*	−.07$^{\wedge}$	.12*	.07$^{\wedge}$	−.03	.12*	−.03	−.01	−.19*	.15*	−.14*	.07$^{\wedge}$	−.04	.50*	−.22*	-
Number	1226	1229	1229	1229	1229	956	1176	1139	1191	1149	1114	1186	1186	1138	988	888	1078	1080	1080
Means	1.80	.43	.51	.60	.89	86.70	3.46	2.81	3.06	50.50	98.10	2.89	2.33	2.89	−2.01	.17	.27	1.92	.50
Standard Deviation	1.40	.49	.50	.49	.31	3.30	.80	.99	1.02	10.60	.98	.79	.62	2.55	.74	.66	.36	.55	.35

Note:

$^{\wedge}p < .05$,

* $p < .01$;

income-to-needs is reported as a mean from 6 to 90 months; PA = Pennsylvania; AA = African American; HS = High School; CP = Conduct Problems; EP = Empathic-Prosocial; CU = Callous.

Table 2

Unstandardized Parameter Estimates and Confidence Intervals for Main Effect and Moderation Analyses

	CP		EP Behaviors		CU Behaviors	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Child Gender (Male = 1)	**.043^ (0.00 to 0.09)**	.05 (0.01 to 0.13)	**−.159* (−0.23 to −0.09)**	**−.164* (−0.23 to −0.10)**	−.012 (−0.05 to 0.03)	−.01 (−0.08 to 0.046)
Child Age in First Grade	−.004 (−0.01 to 0.01)	−.005 (−0.13 to 0.02)	.002 (−0.01 to 0.01)	.002 (−0.01 to 0.01)	−.006 (−0.01 to 0.01)	−.006 ` (−0.13 to 0.01)
Distress to Limitations (6m)	**.043^ (0.01 to 0.08)**	**.043^ (0.02 to 0.17)**	**−.047^ (−0.09 to −0.01)**	**−.045^ (−0.09 to 0.00)**	.026 (−0.03 to 0.06)	.024 (−0.01 to 0.13)
Distress to Novelty (6m)	−.017 (−0.05 to 0.01)	−.018 (−0.12 to 0.03)	−.025 (−0.07 to 0.02)	−.024 (−0.07 to 0.01)	−.005 (−0.03 to 0.02)	−.003 (−0.08 to 0.06)
Irritability (6m)	−.006 (−0.03 to 0.02)	−.006 (−0.09 to 0.06)	.017 (−0.02 to 0.05)	.018 (−0.02 to 0.05)	−.007 (−0.03 to 0.02)	−.008 (−0.10 to 0.05)
Maternal Mental Health Severity	**.006* (0.01 to 0.01)**	**.006* (0.08 to 0.23)**	.002 (−0.01 to 0.01)	.001 (−0.01 to 0.01)	**.003^ (0.01 to 0.02)**	**.003^ (0.02 to 0.17)**
Education (HS+ = 1)	−.003 (−0.12 to 0.10)	.015 (−0.073 to 0.10)	−.017 (−0.14 to 0.12)	−.028 (−0.16 to 0.1)	−.012 (−0.12 to 0.08)	.001 (−0.08 to 0.08)
Time-of-day (15m)	−.001 (−0.01 to 0.01)	−.001 (−0.09 to 0.04)	.001 (−0.01 to 0.05)	.002 (−0.01 to 0.05)	.001 (−0.01 to 0.02)	.001 (−0.05 to 0.07)
Body Temp. (15m)	.001 (−0.02 to 0.02)	.001 (−0.05 to 0.054)	.01 (−0.03 to 0.05)	.009 (−0.02 to 0.04)	.004 (−0.02 to 0.03)	.005 (−0.04 to 0.07)
Sensitivity (6/15m)	**−.071* (−0.11 to −0.03)**	**−.073* (−0.22 to −0.07)**	**.117* (0.07 to 0.17)**	**.119* (0.07 to 0.17)**	**−.055* (−0.08 to −0.03)**	**−.053* (−0.18 to −0.05)**
Harsh-intrusion (6/15m)	.028 (−0.02 to 0.07)	.031 (−0.02 to 0.12)	−.018 (−0.08 to 0.05)	−.025 (−0.09 to 0.04)	**.066* (0.02 to 0.12)**	**.067* (0.05 to 0.19)**
Mental State Talk (6m)	.001 (−0.007 to 0.007)	.002 (−0.04 to 0.07)	−.005 (−0.02 to 0.01)	−.006 (−0.02 to 0.01)	**−.008^ (−0.015 to −0.01**	**−.009^ (−0.13 to −0.01)**
Baseline Cortisol (15m)	.031 ` (−0.01 to 0.07)	.041 ` (0.00 to 0.18)	**−.076* (−0.13 to −0.02)**	**−.083* (−0.14 to −0.03)**	.024 (−0.01 to 0.06)	.029 (−0.02 to 0.16)
Cortisol Reactivity (15m)	.011 (−0.03 to 0.05)	.014 (−0.06 to 0.11)	−.019 (−0.08 to 0.04)	−.016 (−0.08 to 0.05)	.002 (−0.03 to 0.04)	.003 (−0.07 to 0.09)
Sensitivity X Baseline Cortisol	-	−.027 (−0.15 to 0.06)	-	−.025 (−0.09 to 0.04)	-	.011 (−0.07 to 0.11)
Sensitivity X Cortisol Reactivity	-	**−.075^ (−0.19 to −0.01)**	-	.053 (−0.04 to 0.15)	-	−.035 (−0.13 to 0.03)
Harsh-Intrusion X Baseline Cortisol	-	.048 (−0.02 to 0.16)	-	**−.098^ (−0.19 to 0.00)**	-	.033 (−0.04 to 0.12)
Harsh-Intrusion X Cortisol Reactivity	-	−.045 (−0.13 to 0.03)	-	.058 (−0.05 to 0.16)	-	−.028 (−0.11 to 0.04)
Mental State X Baseline Cortisol	-	.01 (−0.01 to 0.13)	-	−.02 ` (−0.04 to 0.01)	-	−.008 (−0.12 to 0.02)
Mental State X	-	.007 (−0.02 to 0.09)	-	−.008 (−0.03 to 0.02)	-	−.004 (−0.09 to 0.04)

	CP		EP Behaviors		CU Behaviors	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Cortisol Reactivity						

Notes:

\` $p < .10$,

^ $p < .05$,

* $p < .01$;

p-values under .05 are bolded to aid interpretation.