HHS Public Access

Author manuscript

J Interpers Violence. Author manuscript; available in PMC 2022 February 01.

Published in final edited form as:

J Interpers Violence. 2022 February ; 37(3-4): 997–1022. doi:10.1177/0886260520922514.

Maternal Intimate Partner Violence Exposure and Autonomic Reactivity: Associations With Positive Parenting

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Abstract

Intimate partner violence (IPV) can negatively impact parenting, posing a threat both to the wellbeing of mothers and their young children. Parenting may also be influenced by emotion regulation (ER), which can support parents' ability to navigate relational challenges or buffer against the influence of adverse experiences on parenting. Changes in maternal respiratory sinus arrhythmia (RSA) during parent–child interactions have been conceptualized as a psychophysiological index of ER. Competing theoretical models posit that RSA response may mediate or moderate the relation between IPV and parenting or may be independently associated with parenting, however, there is little prior evidence concerning these hypothesized associations. This study examined these associations in a sample of 125 low-income maltreating and comparison mothers and their 3- to 5-year-old children. Dyads completed a moderately challenging laboratory task, and positive parenting and maternal RSA were measured during the task. Maternal verbal IPV exposure, but not physical IPV, was associated with less positive parenting, while greater maternal RSA activation over the task was associated with more positive parenting. Maternal RSA activation did not mediate or moderate the relationship between IPV exposure and parenting, and this association did not differ by whether or not the mother had perpetrated child maltreatment. Consequently, verbal IPV exposure and greater RSA activation independently predicted positive parenting. Results suggest that interventions for IPV-exposed mothers of young children may benefit from ensuring psychological safety and improving maternal ER to promote positive parenting for at-risk children.

Keywords

intimate partner violence; parenting; respiratory sinus arrhythmia; emotion regulation; young children

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Introduction

Intimate partner violence (IPV) is a significant public health problem affecting many children and families (Hamby et al., 2011; Smith et al., 2017), particularly low-income families (Cunradi et al., 2002) and those involved with the child welfare system (Marcenko et al., 2011). IPV is defined as physical, sexual, psychological, or emotional abuse that occurs in a close relationship with a current or former spouse or partner (Centers for Disease Control, 2017). Researchers hypothesize that IPV victimization causes significant stress and fear, which impedes mothers' abilities to care for their children (Huang et al., 2010; Levendosky & Graham-Bermann, 2000; Postmus et al., 2012) and negatively impacts the parent–child relationship and children's outcomes (Holt et al., 2008). This is particularly concerning for parents of young children, since they are at higher risk for exposure to IPV (Gjelsvik et al., 2003) and the demands of providing sensitive, responsive caregiving are greatest during early childhood (Shonkoff & Phillips, 2000).

Studies suggest that parental emotion regulation (ER) abilities, particularly in the context of parent–child interactions, may prevent the negative sequelae of IPV by helping parents regulate their emotions in challenging situations or when faced with adversity in the environment (Crandall et al., 2015; Gurtovenko & Katz, 2020). However, Crandall et al. (2015) raise competing hypotheses about whether parental ER plays a buffering role against family and environmental stressors like IPV, whether environmental stressors impede ER and lead to poor parenting, or whether environmental stressors and ER are independent predictors of parenting. Understanding the pattern of these associations between IPV, parental ER during parent–child interactions, and parenting may improve intervention efforts for IPV-exposed families of young children. Therefore, this study tested competing hypotheses concerning the interrelations between maternal IPV exposure, maternal respiratory sinus arrhythmia (RSA) as a physiological index of ER during dyadic interaction, and parenting among a low-income sample of maltreating and comparison mothers of young children.

IPV and Parenting

Physical, verbal, and psychological IPV affect a significant portion of children and families. Data from the National Intimate Partner and Sexual Violence Survey (NISVS) indicate that over one in three U.S. women experienced physical violence, sexual violence, or stalking in a relationship with an intimate partner, and nearly half of women experienced psychological aggression over the course of their lifetimes (Smith et al., 2017). It is particularly important to examine IPV and parenting among at-risk families, including low-income families and those involved with the child welfare system. Rates of IPV are higher among these populations (Cunradi et al., 2002; Marcenko et al., 2011) and at-risk families often experience high levels of isolation, poor social support, and personal and interpersonal stress that impact both the experience of IPV (Goodman et al., 2009) and the quality of parenting (Klebanov et al., 1994).

An often-cited proposition for why IPV exposure may negatively impact parenting is the "spillover" hypothesis, in which hostile behavior between parents is believed to increase parents' negative behavior toward their children, ultimately leading to poor social–emotional

outcomes among children (Krishnakumar & Buehler, 2000). Although a small group of studies have suggested that mothers exposed to IPV may overcompensate by being more warm and nurturing to their children (Greeson et al., 2014), the majority of studies support the spillover hypothesis, in that IPV exposure is associated with lower parental warmth and responsiveness (Casanueva et al., 2008; Gustafsson et al., 2015; Levendosky & Graham-Bermann, 2000), increased use of harsh parenting (Grasso et al., 2016; Krishnakumar & Buehler, 2000), and higher rates of corporal punishment (Huang et al., 2010; Postmus et al., 2012) across samples with diverse age and gender compositions.

The majority of studies on this topic utilize maternal reports of parenting (Grasso et al., 2016; Greeson et al., 2014; Postmus et al., 2012), which are less reliable than observational measures (Levendosky et al., 2003), and studies do not typically focus on differences between physical and psychological experiences of IPV. In addition, only five studies examined the associations between IPV and parenting in families of preschool age children (Casanueva et al., 2008; Grasso et al., 2016; Huang et al., 2010; Levendosky et al., 2003; Postmus et al., 2012), a particularly important developmental period that predicts children's later health and wellbeing (Shonkoff & Phillips, 2000). Of these, only four studies examined IPV and parenting using observational measures (Casanueva et al., 2008; Gustafsson et al., 2015; Huang et al., 2010; Levendosky et al., 2003) and only one study measured parenting during challenging parent–child interactions (Gustafsson et al., 2015), which may be those most likely to elicit parenting differences in the context of IPV. Three of the four observational studies focused on parents of preschool age children found that maternal IPV exposure was associated with less responsive and more harsh observed parenting (Casanueva et al., 2008; Gustafsson et al., 2015; Huang et al., 2010), but the majority did not differentiate between types of IPV, even though physical and psychological IPV may have differential effects (Gustafsson et al., 2015; Levendosky & Graham-Bermann, 2000). Gustafsson et al. (2015) found that maternal physical IPV exposure was associated with less sensitive parenting over time for children from ages of 2 to 5 years, but that verbal IPV was associated with less sensitive parenting only at the age of 2 years. Finally, only one of these studies examined IPV and observed parenting among mothers involved in the child welfare system (Casanueva et al., 2008). Further research is needed regarding the association between both verbal and physical IPV exposure and observed parenting among at-risk families of preschool age children, particularly during challenging parent–child interactions, as well as the underlying mechanisms.

RSA as a Physiological Measure of ER

RSA refers to variation in the increases and decreases of an individual's heart rate (HR) across the respiratory cycle, and is an index of parasympathetic nervous system (PNS) influence on HR (Berntson et al., 1997; Porges, 2011). According to neurovisceral integration (Thayer & Lane, 2000, 2009) and polyvagal theories (Porges, 2011), RSA is an index of vagal control, particularly in terms of the flexible responses to the environment and dynamic regulation of, or inhibition of, neural and hormonal responses to stress. As such, it is often conceptualized as marker of neural regulatory control of cardiac response to signals in the environment, and as a marker of ER in emotionally evocative contexts (Beauchaine, 2015).

RSA reactivity refers to RSA activation or withdrawal over the course of a task. In contrast to resting or baseline RSA, which is often thought to reflect regulatory capacity in general (Beauchaine, 2015), RSA reactivity is particularly well suited to addressing dynamic emotional experience and regulation in the parent–child context. Different patterns of RSA reactivity have been associated with aspects of emotional function and regulation (Balzarotti et al., 2017). For example, studies have shown that RSA withdrawal, or a decrease in RSA from resting state to challenge, is generally associated with the experience of psychological stress and negative emotions and, at times, with a flexible and adaptive coping response to stress (Balzarotti et al., 2017; Beauchaine, 2015). However many studies have found that RSA activation, or an increase in RSA relative to resting baseline, is associated with an individual's efforts to regulate his or her emotions in social situations (Balzarotti et al., 2017; Butler et al., 2006; Skowron et al., 2011). Despite these general themes, findings suggest that the interpretation of RSA depends not only on the type of ER function but also the socioemotional context itself (Balzarotti et al., 2017), which is particularly relevant for parenting as parents may experience interactions with their children as stressful or alternatively as affectively meaningful social experiences. Consequently, although there is sufficient support to consider RSA an index of ER in context and in real time (Balzarotti et al., 2017; Beauchaine, 2015), additional research is needed to understand the role of RSA reactivity in ER across different emotionally salient parenting contexts.

A base of evidence has emerged in the past few years suggesting that associations exist between parenting behavior and RSA reactivity during parent and child interactions (Connell et al., 2017; Shaffer et al., 2018; Skowron et al 2013). In the context of caregiving, parents who engage in more warm and less harsh parenting behavior show higher average RSA scores, compared with baseline, while interacting with their children (Lorber & O'Leary, 2005; Shaffer et al., 2018). Other studies have found greater RSA withdrawal associated with more sensitive and responsive parenting during stressful or challenging parent–child interactions (Leerkes et al., 2017; Moore et al., 2009). However, others have found that greater RSA suppression is associated with less optimal parenting, suggesting that other factors at the parent or task-level may influence which aspect of emotional experience and regulation is evoked. For example, RSA change over a task may be associated with the emotional context of the interaction, which may differ depending upon the child's reaction to the task. Another such factor is child maltreatment status, with previous work showing that the relation between RSA change and both hostile and positive parenting differs by maltreatment status (Skowron et al., 2013). In this study, nonmaltreating mothers demonstrated more variability in their RSA scores over a dyadic task, reflecting greater flexibility, whereas maltreating mothers demonstrated more consistent RSA scores over time (Skowron et al., 2013). In addition, decreases in RSA were associated with subsequent increases in positive parenting, but only for nonmaltreating mothers (Skowron et al., 2013). Therefore, although RSA reactivity is associated with parenting, it is important to consider moderators such as maltreatment status.

IPV, Maternal RSA, and Parenting

Developmental studies of the association between childhood trauma, particularly abuse, and ER in later life (Kim & Cicchetti, 2010; Powers et al., 2015) highlight the plausibility that

IPV may influence maternal ER. In addition, recent theoretical and empirical work on ER and parenting posits that family and neighborhood factors may directly impact parenting by impeding parental ER (Crandall et al., 2015; Oosterman et al., 2019). Alternatively, it has also been proposed that ER may reduce the impact of environmental stressors on parenting (Crandall et al., 2015), which is consistent with the broader theoretical proposition that the effect of stress and adversity on behavioral and health outcomes will differ by the level of reactivity to context individuals display (Ellis & Boyce, 2008; Obradovi c et al., 2011). However, despite its theoretical relevance, there is little research that specifically addresses the potential intersection between IPV, RSA reactivity as a physiological measure of ER, and parenting, of which there are multiple possibilities. First, maternal RSA reactivity may be influenced by IPV, and thus may mediate the association between IPV and parenting. Second, RSA reactivity could moderate the association between IPV and parenting, such that IPV may have a differential effect on parenting depending on how mothers regulate their emotions and respond to stress within parent–child interactions. For example, patterns of RSA reactivity indicative of utilization of active ER strategies during parenting may provide a buffer against the effect of adversity on parenting behaviors, therefore reducing the association between IPV and parenting. Alternatively, RSA and IPV could represent independent predictors of parenting, suggesting the importance of examining unique mechanisms by which RSA and IPV each contribute to parenting.

There is little research focusing on RSA as a potential mediator or moderator of the relation between adversity and parenting outcomes. Two studies have examined RSA reactivity as a possible mechanism in the link between maternal adverse childhood experiences and impaired parenting, but they found no evidence of indirect effects and did not test the competing hypothesis that RSA reactivity might function as a moderator (Buisman et al., 2019; Oosterman et al., 2019). A third study found no association between RSA reactivity and cumulative trauma exposure or posttraumatic stress (PTS) symptoms (Kiser et al., 2019). Nevertheless, there have been no studies examining the relation between IPV and RSA reactivity, and whether it might function as a mediator of the association between maternal IPV exposure and parenting, or whether IPV and RSA reactivity may independently predict positive parenting.

To our knowledge, only one study considered such potential intersections in terms of IPV, ER, and parenting, using RSA reactivity, in terms of moderation (Gurtovenko & Katz, 2020). This study focused on RSA as a moderator, within a sample of mothers who had all been exposed to IPV, and found that RSA reactivity moderated the relation between maternal PTS symptoms and negative parenting. In particular, mothers who exhibited less vagal suppression during interactions with their children were more likely to endorse nonsupportive parenting in the presence of PTS symptoms, suggesting that RSA withdrawal may mitigate associations between trauma symptoms and negative parenting. Although supportive of moderation, this study examined moderation with respect to PTS symptoms, in the context of IPV, rather than moderation of the effect of IPV itself. Consequently, it remains unclear what role RSA reactivity plays in the relation between variations in IPV exposure and parenting behaviors.

Summary and Study Purpose

Overall, this study aimed to address two central unresolved issues in the literature. First, it has not been determined whether verbal and physical IPV exposure are associated with maternal RSA reactivity, particularly in the context of challenging parent–child interactions. Second, there are competing hypotheses regarding the intersection between verbal and physical IPV, maternal RSA reactivity, and positive parenting, with little evidence as to whether maternal RSA reactivity mediates or moderates the association between IPV and parenting or whether RSA reactivity and IPV operate as independent factors in predicting parenting. Addressing these issues is critical for researchers and practitioners to understand the role of IPV and ER in parenting behavior, to support the most effective intervention strategies with low-income, at-risk families. Consequently, we examined these questions in a sample of low-income mothers of young children, including those with a documented case of child maltreatment, who reported on their level of IPV exposure and had RSA reactivity and observed parenting behaviors measured during a structured parent– child interaction task that was designed to elicit frustration.

Method

Participants

Low-income mother–child dyads were recruited as part of a study of parenting and parent–child interaction among maltreating and comparison families. Families were recruited from public welfare and community agencies in rural Pennsylvania and from birth announcements in local newspapers. Dyads were invited to participate if mothers were 18 years of age or older, fluent in English, and living with their preschool age children. The sample for the present study consisted of 125 mother–child dyads who had complete data for maternal RSA, IPV exposure, and parenting behavior. Characteristics of the participants are presented in Table 1. On average, mothers in the sample were 29.4 years of age and the majority identified as White. The sample was of low socioeconomic status, with 65.9% reporting household incomes at or below US$30,000 per year. Children ranged from 3 to 5 years old and 56% were female. A review of child welfare records using the Maltreatment Classification System (MCS; Barnett et al., 1993) revealed that 57 mothers had a documented instance of child maltreatment, resulting in 7% of the sample having a case of physical abuse, 31.2% having a case of physical neglect, and 6.4% having a case of emotional abuse.

Procedures

Mother–child dyads completed three sessions, including one laboratory visit to assess physiological processes and observe parent–child interaction and two home visits for psychological assessments. Families were paid US$150 to complete the protocol and were provided transportation, snacks, and small toys. All procedures used in this study were approved and monitored by the university’s Institutional Review Board.

Procedures

Laboratory assessment.—Lab visits lasted approximately 2.5 hr, and this analysis focuses on one of the dyadic tasks administered, the Duplo task, as it was designed to elicit frustration (Hoffman et al., 2006). First, mothers and children completed a 5-min resting baseline period in which dyads were seated on a comfortable couch with the lights dimmed while they watched a Baby Einstein video of animal characters with soothing music. Later, mothers and their children participated in a 3- to 5-min Duplo puzzle task, a challenging problem-solving task in which the dyad was seated at a small table together and the child was given a model three-dimensional Duplo figurine and 12 disassembled blocks to put together (Hoffman et al., 2006). The child was asked to build a figure identical to the model, while mothers were instructed to help as they normally would but without handling the blocks. Parenting behaviors were recorded throughout the task, and RSA was measured during both baseline and task periods.

Measures

Exposure to IPV.

Maternal self-report of exposure to verbal and physical IPV was assessed using the Conflict Tactics Scale (CTS-Couple Form R; 1985). The CTS-R has high internal reliability (Straus et al., 1990) and validity (Straus, 1995), and has been used in national studies of family violence (Straus & Gelles, 1986). Mothers reported on verbally aggressive behaviors including items asking whether their partner “threatened to hit or throw something” or “insulted or swore” at them. Mothers also reported on physical aggression, including whether their partner “pushed, grabbed, or shoved” them or “threatened [them] with a knife or gun.” For this study, subscales were transformed into frequency-weighted scores to capture chronicity of exposure, in which items were weighted according to the frequencies indicated in the response categories. Following established guidelines (Straus, 1995), the midpoints for each response category were summed (e.g., “1” = once, “2” = twice, “4” 3 – 5 times, “8” 6 – 10 times, etc.). The frequency-weighted subscales of verbal IPV (α = .76) and physical IPV (α = .85) demonstrated good internal consistency in this sample. Descriptive statistics are presented in Table 1.

RSA.

Electrocardiogram (ECG) data were acquired using three disposable, Ag/AgCI electrodes, placed on the mother’s distal right collar bone, lower left rib, and lower right rib. The ECG signal was recorded at 500 Hz using Mindware Technologies ambulatory electrocardiograph (MW1000A; Gahanna, OH), transmitted via a wireless signal to a computer. Afterwards, ECG data were scored using Mindware Technologies HRV 3.0.10 software and output in 30-s epochs within each task. Trained research assistants verbally and visually inspected the data, and manually edited the erroneously identified R peaks when possible. The resulting interbeat interval time series was subjected to a fast-Fourier transformation, and RSA was defined as the power in the respiratory frequency range .12–.40 Hz. RSA values were averaged across the resting period to create a single score for the baseline period, RSA_{Base}, and similarly averaged across the dyadic Duplo puzzle task, RSA_{Task}. Then, a measure of reactivity, RSAReact, was computed by subtracting RSA_{Base} from RSA during the task (i.e.,

RSAReact = $RSA_{Task} - RSA_{Base}$). Consequently, more positive reactivity values indicate RSA increase or activation during the task, whereas negative reactivity values indicated RSA decreases or withdrawal from baseline to task engagement. Descriptive statistics are shown in Table 1.

Parenting behaviors.

Observational data obtained from the dyadic Duplo task were coded using the Structural Analysis of Social Behavior (SASB; Benjamin, 2011; Benjamin & Cushing, 2000), a model of inter-personal behavior used to study parent–child interactional processes that has over 25 years of research supporting its validity (Pincus & Benjamin, 2004). Sixteen cluster codes representing parent and child behaviors are distributed across two circumplex surfaces. Coders assigned a code to each speaking turn by determining (a) focus, (b) degree of warmth/affiliation, and (c) degree of interdependence. Coders completed 60 hr of training and achieved sufficient reliability before coding parent–child interactions in the Duplo task. Interrater reliability was calculated on 15% of the full study sample, and weighted kappas for individual parenting codes ranged from .52 to 1.0 (M = .74) (Giuliano et al., 2015), reflecting moderate to excellent levels of interrater reliability (Landis & Koch, 1977). A total of eight SASB behavior codes were extracted, which reflected the proportion of speaking turns that the mother engaged in various parenting behaviors, including emancipate, affirm, love, protect, control, criticize, attack, and neglect. A summary measure of positive parenting was devised from the eight SASB cluster codes, the weighted affiliation score (Benjamin & Cushing, 2000), which has been used previously (Noll et al., 2015). A high affiliation score represents parenting behavior that exhibits greater warmth and nurturance. To calculate this score, each of the cluster scores was weighted to reflect their distance from the affiliation pole (i.e., how positive or negative they are). Descriptive statistics are included in Table 1.

Child temperamental negativity.—The Child Behavior Questionnaire (CBQ-Short Form; Rothbart et al., 2001) and the Observed Child Temperament Scale (OCTS; Stifter et al., 2008) were used to control for the impact of the child's temperamental negativity on maternal parenting behaviors during the Duplo task. The CBQ-Short Form is a 94-item parent report measure in which mothers rate their child's temperament over the past 6 months. It demonstrates adequate validity (Putnam & Rothbart, 2006). For this study, the negative affectivity factor was used, with higher scores reflecting greater temperamental negativity. The alphas for the five subscales comprising the negative affectivity factor, which were anger, discomfort, fear, sadness, and soothability, were .73, .75, .61, .54, and .63 in the present study, respectively. The OCTS is a valid observer rating of child temperament (Stifter et al., 2008) that is consensus coded by two coders. The frustration/anger proneness item (which ranges from 1 to 9) of the OCTS was used to capture an observer rating of child temperamental negativity.

Child and maternal characteristics.—Demographic information was collected for mothers and children, such as the mother's age, race/ethnicity, and education level and the child's sex and age (see Table 1). In regression analyses maternal education was coded

as a continuous measure of years of education. In addition, for regression analyses maternal ethnicity/race was coded as a dichotomous variable (White/non-White).

Data Analyses

All analyses were conducted using SPSS 25.0. First, we examined whether missing data were associated with our variables of interest by conducting independent sample t tests and χ^2 analyses. Participants included in the analysis did not differ from participants in the larger study on IPV exposure, RSA reactivity, child temperament, or maternal and child demographics (all $p > .10$). Second, bivariate correlations were calculated between maternal IPV exposure, maternal RSA_{React}, and maternal parenting behaviors to ascertain whether verbal IPV and/or physical IPV were significantly associated with maternal positive parenting, using the SASB weighted affiliation score during the Duplo task, and to understand the associations between IPV exposure and RSA_{React}, as well as RSA_{React} and positive parenting behavior.

Next, we tested competing hypotheses regarding associations between IPV, RSA reactivity, and parenting. We utilized multiple regression to assess whether maternal RSA and IPV exposure independently predicted positive parenting over the Duplo task, controlling for maternal age, ethnicity, and socioeconomic status, as well as the child's age, sex, and maltreatment status (results are presented in Table 3). Child age and sex were included as control variables since prior research shows that they are predictors of parenting and IPV (Gjelsvik et al., 2003; Leaper, 2002). To assess the robustness of the primary models, additional regression models were conducted to examine whether findings were independent of child temperament. To test the hypothesis that RSA reactivity is part of the mechanism relating IPV to parenting, we conducted mediation analyses using PROCESS version 3.3 (Hayes, 2017) to test for the significance of indirect effects of IPV exposure on positive parenting through RSA_{React}. Subsequently, to test the hypothesis that RSA reactivity may buffer against the impact of IPV on parenting, we tested models that included interactions between verbal and physical IPV exposure and RSA_{React}. For all moderation analyses, maternal RSA_{React} and IPV exposure were centered. Final exploratory moderation analyses were conducted to determine if the associations between positive parenting and both IPV and RSA_{React} differed by maltreatment status.

Results

Preliminary Analyses

Maternal exposure to verbal and physical IPV were significantly correlated ($r = .48$, $p < .01$). Maternal exposure to verbal IPV was significantly negatively correlated with positive maternal behavior over the Duplo task ($r = .26$, $p < .01$), but maternal exposure to physical IPV was not ($r = -.02$, $p = .81$), see Table 2. In addition, contrary to hypotheses, there were no significant correlations between either verbal or physical IPV exposure and maternal RSA_{React} (see Table 2), and thus there was no evidence that IPV was associated with this physiological index of ER. However, positive maternal behavior was associated with maternal RSA_{React} ($r = .17$, $p = .06$) at trend level, without accounting for covariates.

Independent Predictors of Positive Parenting

First, a regression model was estimated to examine the associations of verbal IPV exposure and RSA_{React} with positive parenting (see Table 3, Model 1), independent of potential confounds. Maternal verbal IPV exposure was negatively associated with positive maternal behavior ($\beta = .23$, $p < .01$), whereas maternal RSA_{React} was positively associated with positive maternal behavior ($\beta = .26$, $p < .01$). Therefore, higher levels of verbal IPV exposure were associated with less positive and warm parenting, while an increase in maternal RSA over the task, compared to baseline, was associated with more positive and warm parenting. To strengthen our confidence in the robustness of our findings, a follow-up analysis was conducted to determine if these results were independent of child temperament, which might contribute to differences in parenting or maternal RSA. When accounting for observer and maternal ratings of temperament, verbal IPV exposure continued to be negatively associated with positive parenting ($\beta = .22$, $p = .01$), and maternal RSA_{React} continued to be positively associated with positive parenting ($\beta = .27$, $p = .001$), and both the observer ($\beta = .07$, $p = .41$) and maternal ($\beta = .03$, $p = .71$) ratings of temperament were nonsignificant. Subsequently, a second regression model was conducted to examine the associations of physical IPV and RSA_{React} with positive parenting (see Table 3, Model 3). Maternal physical IPV exposure was not associated with positive parenting ($\beta = .09$, $p = .26$), whereas RSA_{React} was positively associated ($\beta = .26$, $p = .002$).

Mediation and Moderation Analyses

After establishing that maternal verbal IPV and RSA_{React} were independently associated with positive parenting, even when including a number of control variables, we examined hypotheses concerning mediation and moderation. With respect to mediation, two PROCESS models were run, one for verbal IPV and one for physical IPV, including all control variables. Results showed that the indirect effect of verbal IPV on positive parenting through RSA_{React} was nonsignificant (indirect effect = .003, 95% bias-corrected [BC] confidence interval [CI] [−.04, .06]). The indirect effect of physical IPV on positive parenting through RSAReact was also nonsignificant (indirect effect =.01, 95% BC confidence interval [CI] [−.04, .06]).

To test moderation, we added an interaction term between verbal IPV exposure and RSA_{React} to the basic regression model specified earlier (see Table 3, Model 2). This interaction was not significant ($\beta = .05$, $p = .55$), showing that the association between verbal IPV exposure and maternal positive parenting did not depend on RSA activation. In addition, there was no significant interaction between physical IPV exposure and RSA_{React} ($\beta = -.12$, $p = .25$) shown in Table 3, Model 4, indicating that there was no evidence that RSA_{React} moderated the association between physical IPV and positive parenting as well.

Finally, exploratory models were estimated to examine whether the associations between IPV, RSA activation, and positive parenting differed in mother–child dyads in which the mother had a documented case of child maltreatment. Therefore, interaction terms were included for child maltreatment status with verbal IPV, physical IPV, and RSA_{React}. Results showed that the interaction of verbal IPV and maltreatment ($\beta = .17$, $p = .15$) and the interaction of RSA_{React} and maltreatment ($\beta = .01$, p = .88) were not significant, while

maternal RSA_{React} (all $p < .05$) and verbal IPV exposure (all $p < .05$) continued to be significant predictors of positive parenting in these models. In addition, results showed that the interaction of physical IPV and maltreatment ($\beta = .08$, $p = .42$) was not significant. These results demonstrate that the associations among IPV exposure, RSA_{React}, and positive parenting are not dependent upon whether or not the mother had perpetrated maltreatment.

Discussion

This study was the first to test competing hypotheses regarding relationships between IPV exposure, RSA reactivity, and parenting over the course of a challenging task among low-income mothers of young children. The results demonstrated that both RSA reactivity and verbal IPV exposure were independently associated with positive parenting, and thus there is no evidence for the theory that RSA reactivity is part of the mechanism underlying the association between IPV and parenting, nor that RSA reactivity is an independent characteristic that might buffer or reduce the association between IPV on parenting.

First, maternal IPV exposure was associated with observed parenting, but there were differences in terms of verbal and physical IPV. Consistent with previous studies, mothers who were exposed to verbal IPV demonstrated less positive parenting in our sample, raising concerns about how this may impact their children's social–emotional outcomes (Holt et al., 2008). Few prior studies have examined IPV using observational measures of parenting (Casanueva et al., 2008; Gustafsson et al., 2015; Huang et al., 2010) and this finding provides stronger evidence that verbal IPV is related to differences in positive parenting. Nevertheless, the finding that verbal, rather physical, IPV was associated with parenting was not anticipated. These findings may reveal a key difference in how verbal and physical IPV impact mothers, or may reflect underreporting of physical IPV in this sample. There are several reasons mothers may not report physical IPV, including a lack of trust with the interviewer, concerns about privacy, or the possibility of re-referral to the child welfare system.

Second, in terms of competing hypotheses we found support for the independent effects model. Maternal RSA activation, and by extension ER, and verbal IPV exposure were both independently associated with positive parenting, and there was no evidence that maternal RSA mediated or moderated the association between IPV exposure and parenting. Although these associations are not evidence of causality, they raise the possibility that both verbal IPV and ER have separable effects on parenting, suggesting that they predict parenting by different mechanisms. In addition, these results suggest that RSA reactivity does not buffer against the effects of IPV, which may mean that it is more important to provide universal intervention for IPV-exposed mothers, rather than targeting IPV-exposed mothers with ER difficulties. Finally, although children's behavior may shape parents' responses (Levendosky & Graham-Bermann, 2000), the associations between verbal IPV, RSA reactivity, and positive parenting were independent of child temperament. In addition, we found that these associations did not differ by whether or not the mother had a documented case of maltreatment.

Third, the results showed that an increase in maternal RSA from baseline to task was positively associated with positive parenting. Previous research has shown that positive parenting is associated with both RSA activation and withdrawal (Leerkes et al., 2017; Lorber & O'Leary, 2005; Moore et al., 2009; Shaffer et al., 2018), but some researchers have argued that different types of tasks and contexts place different demands on physiological systems, and therefore adaptive RSA responses may look different in different contexts (Connell et al., 2017; Cui et al., 2019). For example, RSA withdrawal has been associated with adaptive functioning during stressful tasks (Balzarotti et al., 2017; Connell et al., 2017), but RSA activation has been associated with adaptive functioning and efforts to engage in self-regulation in positive social interactions and to recover from stress (Balzarotti et al., 2017; Butler et al., 2006). This points to the importance of considering whether the child responds with positive or negative emotion in the task, which could change what the task means to the parent. In this sample, increased RSA activation may indicate that this is not necessarily interpreted as a stressful task requiring an adaptive and flexible stress response, but instead that mothers' efforts to regulate their experience and expression of emotion were associated with a more positive dyadic experience.

Fourth, maternal physical and verbal IPV exposure were not significantly associated with maternal RSA reactivity. This was surprising, since previous research has shown that traumatic experiences can negatively impact ER abilities (Kim & Cicchetti, 2010; Powers et al., 2015). These results may reflect the lack of an association between IPV exposure and RSA, and ER as well, in caregiving contexts, or they may be due to limits of the IPV measure used in this study. The Conflict Tactics Scale-Form R measures physical and verbal IPV over the past 12 months and does not assess lifetime IPV exposure. It is possible that chronic exposure to IPV, or IPV exposure earlier in life, is more strongly associated with ER and RSA, and thus this study may underestimate the role of IPV for ER in parenting contexts.

Finally, our study raises questions regarding the importance of sociodemographic diversity, which is a critical area for future research. In this study we found that maternal education predicted positive parenting, with the largest effect size in the final model, demonstrating the importance of considering the broader context of socioeconomic diversity and family adversity in parent–child interactions among low-income families. Future studies should explore whether a broader range of sociodemographic diversity and psychosocial risk factors beyond IPV exposure are associated with differences in RSA reactivity among parents, particularly during parent–child interactions, since research shows that environmental and psychosocial risks like household chaos impact parental ER (Crandall et al., 2015). There is little research in this area that directly examines RSA reactivity as a measure of ER, but one study suggests that RSA reactivity may be linked to parenting among mothers who experienced childhood trauma (Oosterman et al., 2019), and another shows that perceived racial/ ethnic discrimination predicts lower HR variability (Hill et al., 2017). In our study, concurrent IPV exposure did not predict maternal RSA reactivity, but in accordance with life course models (Kuh et al., 2003), the accumulation of IPV exposures and adversities and stressors that compound over time may end up impacting RSA reactivity in caregiving contexts, which may then lead to poor parenting behaviors. Overall, future studies should examine associations between patterns, severity and type of life course IPV exposure,

parenting, and physiological measures like RSA in low-income, culturally and linguistically diverse, and historically marginalized populations, as well as high-income samples. Such research would assist intervention researchers in developing tailored interventions to promote ER abilities among different populations of parents.

There are a number of limitations of this study. First, assertions about causality cannot be made about the relationships between IPV exposure, RSA reactivity, and positive parenting. Second, the degree to which parent–child interactions in the lab, and physiological responses during those interactions, generalize to naturalistic environments is an open question. It is proposed that mothers may engage in more positive behaviors in the lab setting to appear more socially acceptable (Levendosky & Graham-Bermann, 2000), which may understate the magnitude of the relationships between IPV, RSA, and parenting. Third, we were not able to examine severity or frequency of IPV over the life course or explore other types of IPV like sexual violence and stalking. Finally, this study was limited to mother–child dyads, and future studies should examine these associations among father–child dyads in at-risk families.

The results of this study also indicate that a better understanding of the associations between maternal ER and parenting, and between IPV and parenting, is important for intervention research with low-income mothers. Recent theoretical work has emphasized the importance of assessing ER capabilities in parenting and dyadic interventions (Crandall et al., 2015; Maliken & Katz, 2013), as parental ER abilities may be crucial skills that enable parents to be attentive, responsive, and adaptable in response to environmental demands. Over the past decade, several evidence-based treatments (EBTs) for families experiencing IPV have emerged (Wathen & MacMillan, 2013), yet no empirical studies have examined maternal ER in EBTs for families exposed to IPV, particularly using a physiological measure of ER like RSA. The independent associations found in this study suggest that a comprehensive approach focused on supporting ER as well as other needs following IPV exposure may be most effective. Moreover, future research should examine whether maternal trauma exposure and ER might mediate effects of interventions or explain the lack of intervention success with specific populations.

In summary, in testing competing theoretical models we found that verbal IPV exposure and maternal RSA activation, as an index of ER, independently predicted positive parenting, with no evidence of mediation or moderation. These findings emphasize the potentially important roles played by both maternal IPV exposure and ER in shaping how mothers respond to their young children in challenging caregiving situations, and the promise of research on how strategies to address these domains can enhance the effectiveness of parenting interventions for at-risk families.

Acknowledgments

The authors thank the members of the Family Systems Lab for assistance with data collection, transcription, and coding.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This project was supported by National Institutes of Health Research grant R01 MH079328 to E.A. S. and funded by the National Institute of Mental Health and Administration for Children and Families/Children's Bureau of the Administration on Children, Youth, and Families as part of the Federal Child Neglect Research Consortium.

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Table 1.

Sample Characteristics.

Demographics	***M (SD)* or *n* (%)**
Maternal age	29.4 (5.5)
Maternal race/ethnicity	
White	115 (92.0)
Hispanic/Latino	4 (3.2)
African American	2 (1.6)
Mixed race	4 (3.2)
Maternal education	
Less than high school	12 (9.6)
High school diploma	75 (60.0)
Some college	11 (8.8)
College degree	20 (16.0)
Master's degree	6 (4.8)
Child age	3.7 (0.7)
Child sex	
Male	55 (44.0)
Female	70 (56.0)
Child maltreatment history	
No child maltreatment	68 (54.4)
Child maltreatment perpetrated by the mother	57 (45.6)
Intimate partner violence—Conflict Tactics Scale	*M (SD)*
Maternal exposure to verbal aggression	28.6 (28.7)
Maternal exposure to physical violence	2.7 (11.8)
Maternal respiratory sinus arrhythmia (RSA)	*M (SD)*
RSA baseline	5.8 (1.3)
RSA Duplo task (average)	6.0 (1.3)
RSA reactivity (RSA_{Task} — RSA_{Base})	0.18 (0.8)
Maternal parenting behavior—Structural Analysis of Social Behavior (SASB)	*M (SD)*
Weighted affiliation score	38.8 (15.0)

Table 2.

Bivariate Correlations Among Variables of Interest (n=125).

Variable	1	2	3	4
1. Maternal report of verbal IPV by partner (CTS-R)	–			
2. Maternal report of physical IPV by partner (CTS-R)	.48**	–		
3. RSA reactivity over task	.04	.02	–	
4. Positive maternal behavior over task (SASB)	−.26**	−.02	.17t	–

Note. CTS-R = Conflict Tactics Scale Couple Form-R; IPV = Intimate partner violence; RSA = respiratory sinus arrhythmia; SASB = Structural Analysis of Social Behaviour.

** $p < .01$.

t $p < .10$.

Table 3.

Predictors of Positive Maternal Behavior (n=125).

	Model 1		Model 2		Model 3		Model 4	
Variable	***β***	**Sig. (*p*)**	**B**	**Sig. (*p*)**	***β***	**Sig. (*p*)**	***β***	**Sig. (*P*)**
Maternal verbal IPV exposure (CTS-R)	−.23	.005	−.24	.005				
Maternal physical IPV exposure (CTS-R)					−.09	.261	−.02	.888
Maternal RSA_{React}	.26	.001	.27	.001	.26	.002	.24	.005
Child's sex	−.01	.868	−.01	.883	−.02	.794	−.02	.849
Child's age	.25	.003	.25	.002	.23	.007	.22	.009
Child maltreatment	−.04	.614	−.05	.595	−.08	.350	−.10	.265
Maternal age	.03	.741	.04	.673	.03	.729	.03	.790
Maternal ethnicity	.01	.896	.01	.938	.01	.892	.01	.906
Maternal education (years)	.31	.001	.30	.002	.35	.001	.36	.000
Verbal IPV Exposure × Maternal RSA_{React}			.05	.548				
Physical IPV Exposure × Maternal RSA_{React}							−.12	.254
R^2	.25		.24		.20		.20	

Note. Maternal verbal IPV exposure, maternal physical IPV exposure, and RSA_{React} were centered at their mean values. CTS-R = Conflict Tactics Scale Couple Form-R; IPV = intimate partner violence.