Early Community Violence Exposure And Adolescent Aggressive Behavior: Moderation By Sympathetic Nervous System Reactivity

EARLY COMMUNITY VIOLENCE EXPOSURE AND ADOLESCENT AGGRESSIVE BEHAVIOR: MODERATION BY SYMPATHETIC NERVOUS SYSTEM REACTIVITY

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ABSTRACT

Extant research has found that childhood community violence exposure (CVE) is associated with later maladaptive behaviors, including aggression. However, research has been mixed regarding the influence of CVE on the development of the different forms (i.e., physical and relational) and functions (i.e., proactive and reactive) of aggression. Additionally, it remains unclear whether individual differences in children's sympathetic nervous system reactivity (SNS-R) moderates associations between CVE and forms and functions of aggression. Thus, the goal of the current study was to add to the current literature by investigating how self-reported CVE, SNS-R to fear, and their interaction at age 7 predict forms and functions of aggression at age 12 in a diverse community sample of 197 children. Findings indicated that blunted SNS-R was related to increases in proactive physical aggression. Additionally, CVE was related to increases in proactive relational aggression. For girls only, a significant interaction emerged such that CVE predicted increases in proactive relational aggression among those exhibiting blunted SNS-R to fear. Implications for theory and intervention are discussed.

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Aggressive behaviors are associated with negative psychosocial outcomes, and early intervention is important to mitigate later maladjustment for aggressive youth (Card and Hodges 2008; Hodges et al., 2003). Community violence exposure (CVE) in early life is one well-known risk factor for aggressive behavior (Scarpa, 2003). However, less is known about how CVE relates to the development of different forms (i.e., physical and relational) and functions (i.e., proactive and reactive) of aggression. Further, not all children exposed to community violence engage in aggressive behavior, raising questions about how individual vulnerabilities (i.e., diatheses) might interact with community violence. One potential diathesis is dysregulated physiological reactivity (e.g., Golding & Fitzgerald, 2019; Scarpa, 2003; Scarpa & Ollendick, 2003); in fact, dysregulated sympathetic nervous system reactivity (SNS-R) has been found to be a physiological moderator of the associations between social adversity, including CVE, and aggressive outcomes in children (Fagan et al., 2017; Rabkin, 2014). Further, fear induction may be an important context in which to assess SNS-R, as CVE has been associated with increased feelings of fear (Patton et al., 2012; Rojas-Flores et al., 2013), and differences in reactivity to fear tasks have been linked to differing forms and functions of aggression (Gao et al., 2015; Thomson et al., 2021). Thus, the purpose of the current investigation was to assess associations between early CVE and forms/functions of aggression in adolescence, as well as the moderating effects of SNS-R to fear.

Violence Exposure and Aggressive Behaviors

Researchers have long been interested in the effects of adverse childhood experiences (ACEs) on developmental outcomes (Boullier & Blair, 2018; Hardt & Rutter, 2004; Struck et al., 2021). ACEs refer to an individual's experiences up to 18 years of age with common examples being abuse (i.e., physical, emotional, and sexual), neglect (i.e., physical and emotional), and an unsafe home environment (e.g., witnessing maltreatment towards a caregiver; Boullier & Blair, 2018). Although violence exposure has not traditionally been measured as an ACE, emerging research suggests that violence exposure should be considered as such (Hughes et al., 2017; Lee et al., 2017). Childhood violence exposure, which includes witnessing violent interpersonal events or experiencing the consequences of such encounters, can impede healthy brain development and has been associated with impaired emotion and self-regulation as well as worse language, academic, and physical health outcomes (Moffitt, 2013; Perkins & Graham-Bermann, 2012; Supol et al., 2021). Unsurprisingly, many children exposed to high rates of violence commonly develop behavioral disorders and increased antisocial behaviors, including aggression (Perkins & Graham-Bermann, 2012).

There are several theories that suggest that childhood violence exposure will increase risk for aggression. Social cognitive theories purport that violence exposure is associated with aggressive behavior because it alters cognitive views of aggression (e.g., viewing aggression as normal or acceptable) that in turn increase risk for engagement in aggression (McMahon et al., 2009). Additionally, some researchers have argued that hostile attribution bias (HAB), defined as the tendency to attribute hostile intentions to others' actions in ambiguous provocations, may serve as a mechanism by which violence exposure in childhood gives way to later aggressive behaviors (Martinelli et al., 2018).

That is, children exposed to high rates of violence may learn that others often act with hostile intent, which may in turn increase their chances of believing that others are hostile even in the absence of clear evidence, ultimately leading to hostile reactions to conflicts (e.g., aggression; Bradshaw et al., 2009; Calvete & Orue, 2011). Further, having experienced or witnessed high rates of violence in childhood may alter other aspects of social information processing (SIP), such as making aggression a salient response and increasing perceptions that aggression will result in positive outcomes (Bradshaw et al., 2009; Calvete & Orue, 2011). Indeed, researchers have found that violence exposure predicts aggression through both hostile attribution and response search/selection (Calvete & Orue, 2011). Thus, theoretical perspectives suggest violence exposure may increase risk for aggression.

To date, the majority of research on violence exposure has focused on family or domestic violence, with less of an emphasis on the effects of CVE, broadly defined as witnessing or experiencing violence in a community setting (e.g., the street, the neighborhood, and the school). The lack of attention to CVE in this area of research is surprising, as CVE has long been accepted as a public health concern, with particularly high rates in urban and rural areas (Buka et al., 2001; Luthar & Goldstein, 2004). In fact, a prospective study investigating the effects of CVE on 423 high-risk youth found that CVE predicted externalizing behaviors and conduct disorder (McCabe et al., 2005). Further, SIP has been found to be a stronger mediator between violence exposure in the community and aggressive behaviors, as compared to violence exposure in the home and aggressive behaviors (Calvete & Orue, 2011). This may suggest a greater role of SIP in CVE than domestic violence exposure, perhaps because CVE involves a greater variety

of social scenarios than violence in the home. As CVE is a notable form of violence exposure related to aggression in youth, it is critical to explore how childhood CVE is associated with aggression.

Forms and Functions of Aggression

To date, much of the research in this area has focused on the associations between CVE and aggression broadly, highlighting the need to explore whether CVE is uniquely associated with distinct forms and functions of aggression. In fact, an important limitation of work in this area is the relative focus on physical forms of aggression, with much less research investigating the role of CVE in relational aggression. Whereas physical aggression is defined as behaviors that cause physical harm to one's well-being (e.g., hitting, kicking), relational aggression is defined as behaviors that are harmful to relationships or which evoke feelings of exclusion (e.g., spreading rumors, giving someone the silent treatment; Henninger, 2004). Preliminary research suggests that CVE may be associated with relational aggression as well as physical aggression. For instance, in a study of adolescents, CVE was correlated with heightened fighting as well as relational/verbal bullying (Low & Espelage, 2014). In a recent study with college students, CVE was associated with both relational and physical aggression (Amoh & Allwood, 2020). Although the research on CVE and relational aggression is limited, this preliminary research underscores the need for more research on the association between CVE and both forms of aggression.

In addition, CVE may be associated with both reactive and proactive functions of aggression. Reactive aggression is associated with impulsivity and is based upon the frustration-aggression hypothesis, which argues that aggressive behaviors are the result of

frustration or anger as a response to a perceived threat (Berkowitz, 1989; Martinelli et al., 2018; Murray-Close & Ostrov, 2009). There is theoretical reason to expect that CVE will be associated with reactive aggression. In fact, CVE appears to be closely tied to cognitive and emotional risk factors for reactive aggression. For instance, some evidence suggests that retaliatory beliefs about aggression (e.g., believing it is appropriate to respond to provocation with aggression), but not general beliefs about aggression (e.g., overall beliefs about the acceptability of aggression), mediated associations between CVE and aggressive behavior (McMahon et al., 2009). Additionally, CVE is related to emotion dysregulation (e.g., Heleniak et al., 2018; Scarpa, 2003), which is associated with reactive functions of aggression (Card & Little, 2006). This suggests that CVE may lead youth to develop hostile views of others and difficulties in regulating emotional reactions, increasing their risk for reactive aggression.

CVE may also increase risk for proactive functions of aggression. Proactive aggression is theoretically based on social learning theory, which posits that aggressive behaviors are intentional acts used to obtain a perceived goal or reward (Bandura, 1973). Children who witness high rates of community violence (CV) may learn that violence is an appropriate and even adaptive act that can be effective in attaining desired outcomes. Thus, high levels of CVE may hinder children's ability to consider other more adaptive behaviors and lead to the reliance on proactive aggression as a method of problem solving. CVE may also relate to proactive aggression because it leads to biased social-cognitive processes, such as greater normative beliefs, positive expectations, and lack of guilt regarding aggression (Chaux et al., 2012). In fact, Farrell and colleagues (2022) found that the association between violence exposure and proactive aggression was

mediated by both lower self-efficacy for nonviolence and beliefs supporting proactive aggression among 2,705 early adolescents. In sum, the existing literature suggests that CVE may be positively associated with both reactive and proactive functions of aggression (Chaux et al., 2012; Scarpa et al., 2008).

Sympathetic Nervous System Reactivity

Importantly, not all children exposed to CV engage in aggressive behavior. For example, Guerra et al. (2003) found that the correlations between CVE and aggression were small to moderate among 4,458 elementary school children living in urban areas (Guerra et al., 2003). Thus, it is possible that some youth may be especially vulnerable to the effects of CVE, perhaps due to individual risk factors (i.e., diatheses) that interact with contextual risk factors. One potential diathesis is dysregulated physiological reactivity (e.g., Golding & Fitzgerald, 2019; Scarpa, 2003; Scarpa & Ollendick, 2003). Indeed, theorists have argued for the importance of investigating biosocial interactions in the development of aggression (Scarpa et al., 2008). One commonly studied component of physiological arousal is activity of the sympathetic nervous system (SNS), which coordinates the "fight or flight" response. When exposed to threats or stressors, SNS activation is often considered an adaptive response as it helps mobilize necessary resources for coping (e.g., cardiovascular responses such as increased heart rate and blood pressure; Murray-Close et al., 2017). One commonly used measure of SNS activity is preejection period (PEP), a measure of cardiac contractility, which assesses the influence of the sympathetic branch on cardiovascular functioning (Murray-Close, 2013). PEP is an inverse measure of SNS (i.e., longer PEP-R reflects lower SNS-R and shorter PEP-R reflects greater SNS-R). Accumulating research indicates that dysregulated SNS-

R is a risk factor for antisocial behaviors, including aggression (Murray-Close, 2013). In fact, dysregulated PEP reactivity (PEP-R) has been associated with aggressive behaviors in children and adolescents, although the direction of this association has been mixed, potentially due to lack of attention to distinct functions of aggression (e.g., Fanti et al., 2019; Sijtsema et al., 2015). It is possible, then, that dysregulated SNS-R may serve as a diathesis increasing risk for aggressive behavior in the context of CVE.

Theoretical models posit that distinct patterns of physiological functioning may increase risk for proactive and reactive functions of aggression (Murray-Close et al., 2017). Specifically, fearlessness theory and stimulation-seeking theory suggest that underarousal of the SNS serves as a risk factor for proactive aggression, which is typically thought of as "cold-blooded" and calculated (Blankenstein et al., 2022; Moore et al., 2018; Murray-Close et al., 2017). From a fearlessness theory perspective, underarousal of the SNS reflects the inability to experience appropriate levels of fear, leading to less responsiveness to punishment, ultimately interfering with adaptive social development (Murray-Close et al., 2017; Raine, 1997). Conversely, stimulation-seeking theory posits that underarousal of the SNS is experienced as an aversive physiological state, increasing the likelihood that youth will engage in behaviors aimed at increasing SNS activity, including aggression (Murray-Close et al., 2017; Raine, 1997). In fact, Schoorl et al. (2016) found that in a clinical sample of school aged boys, lower SNS arousal (assessed via low skin conductance reactivity to a stressor) was associated with greater proactive aggression. However, some research has been mixed regarding the association between SNS-R and functions of aggression (see Blankenstein et al., 2022), highlighting the need for more research in this area. Thus, although fearlessness theory

and stimulation seeking theory suggest underarousal of the SNS serves as a diathesis for proactive aggression, further research is needed to clarify the association.

In contrast with proactive aggression, reactive aggression is typically thought of as "hot blooded" (Card & Little, 2006) and several researchers have hypothesized that reactive aggression will be associated with overarousal of the SNS. For instance, heightened SNS-R may be indicative of amplified negative emotional responses to stressors (Murray-Close, 2013). The frustration-aggression theory purports that overarousal of the SNS following an aversive event reflects a negative emotional state (e.g., frustration), which leads to enactment of aggression (Berkowitz, 1989; Murray-Close et al., 2017). Consistent with this suggestion, Hubbard et al. (2002) found that among second-grade children, heightened SNS-R to a frustration task was associated with greater reactive aggression (Hubbard et al., 2002). Additionally, Murray-Close et al. (2017) found that heightened SNS-R to a stressor task predicted reactive relational aggression among college students (Murray-Close et al., 2017). Taken together, then, heightened SNS-R may serve as a risk factor for reactive aggression.

Further, these distinct physiological patterns may interact with CVE in predicting proactive and reactive functions of aggression. In fact, some research indicates that different patterns of SNS-R are associated with increased risk for proactive versus reactive functions of aggression among youth exposed to adverse contexts. For instance, research has found that harmful conditions (e.g., history of sexual abuse, negative parenting) were associated with greater proactive aggression among individuals demonstrating low SNS-R to stress, and that harmful conditions were associated with greater reactive aggression among individuals demonstrating heightened SNS-R to stress

(Murray-Close & Rellini, 2012; Wagner & Abaied, 2016). Therefore, it is possible that CVE will be associated with aggression that is reactive in function for children who exhibit heightened SNS-R, and with aggression that is proactive in function for children who exhibit blunted SNS-R.

Biosocial interactions between SNS-R and CVE in the prediction of aggression may also be important to consider in the development of both physical and relational forms of aggression. Although much of the research regarding associations between SNS-R and aggression have focused on physical forms of aggression, emerging research indicates that heightened SNS-R may be related to reactive relational aggression, whereas blunted SNS-R may be associated with proactive relational aggression (Murray-Close et al., 2017; Murray-Close & Rellini, 2012). However, there may be important differences in the psychophysiological risk factors for physical and relational aggression (Gower & Crick, 2011; Sijtsema et al., 2011). For instance, Sijtsema and colleagues (2011) found that for adolescent girls, blunted SNS-R was related to greater relational aggression, whereas heightened SNS-R was associated with greater physical aggression (Sijtsema et al., 2011). These findings raise the possibility that, in the context of CVE, distinct patterns of SNS-R may serve as diatheses for the development of physical versus relational forms of aggression. However, to our knowledge, no research to date has investigated the moderating role of SNS-R in associations between CVE and forms of aggression in adolescents, highlighting the need for research in this area.

In addition, it is important to consider the stimuli used to assess SNS-R in studies of aggressive behavior. In fact, prior research has found that physiological reactivity to stimuli that are negative or aversive (e.g., induce fear or frustration) produces more

reliable associations with antisocial behaviors than physiological reactivity to positive stimuli (Lorber, 2004). Further, CVE has been found to be associated with increased fear (Patton et al., 2012; Rojas-Flores et al., 2013), and theoretical models (e.g., fearlessness theory) underscore the importance of SNS-R to fear in the development of different functions of aggression (Blankenstein et al., 2022; Gao et al., 2015). In fact, Thomson et al. (2021) found that heightened SNS-R to a fear-inducing interactive horror video was associated with greater reactive aggression in young men and women. Although research investigating the associations between SNS-R to fear and forms of aggression in children is limited, Kalvin and colleagues (2016) found that among an urban sample of 169 kindergarteners, heightened heart rate reactivity to a fear inducing film clip was associated with greater teacher reported externalizing behaviors, although SNS-R, assessed via PEP, was not. However, PEP shortening (indicating greater SNS-R) to the fear clip was associated with lower peer rated prosocial behaviors (Kalvin et al., 2016). Thus, although understudied, SNS-R to fear may be an especially salient physiological response to investigate in research considering the effects of CVE on different forms and functions of aggression. In the present study, we assessed SNS-R in response to fear induction.

Gender

Finally, researchers have found that although gender differences in relational forms of aggression are too small to be meaningful, boys engage in higher levels of physical aggression than girls (Card et al., 2008). This raises the possibility that boys exposed to CV may be more likely than girls to be at risk for engaging in physically aggressive behavior. Although limited, existing research investigating gender differences

in the effects of CVE on aggression is mixed (e.g., Guerra et al., 2003; Lambert et al., 2005). For example, Guerra et al. (2003) found that among a large sample of urban children, violence exposure predicted later relational and physical aggression for both girls and boys. Conversely, Lambert et al. (2005) found that, among a large urban sample of adolescents, witnessing CV was positively associated with predominantly physical aggression for girls only. Thus, in the present study, we conducted exploratory analyses investigating whether the proposed associations differed by gender.

The Present Study

In sum, the aim of the current study was to investigate the unique and interactive roles of CVE and SNS-R to fear (assessed via PEP-R) at age 7 in the prediction of forms and functions of aggression at 12 years of age in an ethnically diverse sample. Understanding the development of aggression across this developmental period is important because aggression rates in children are typically more stable throughout early and middle childhood (i.e., 2 to 8 years) and become more variable during early adolescence (i.e., 9-13 years; see Piquero et al., 2012). Furthermore, environmental influences (e.g., poor home environments, CVE) can emerge as predictors which influence the trajectories of aggressive behaviors from childhood through early adolescence (Guerra et al., 2003; Harachi et al., 2006; Jester et al., 2005; Piquero et al., 2012). Additionally, research suggests that children become more susceptible to influences outside of the home during early to middle childhood (see Ostrov & Godleski, 2010). Therefore, CVE at age 7 may be more strongly related to aggression across middle childhood and early adolescence than in earlier developmental periods.

Study hypotheses were investigated in an ethnically diverse sample with a large percentage of Latinx youth. Latinx youth report significantly higher rates of CVE as compared to their White peers, according to a national survey of adolescents (Crouch et al., 2000). In fact, Mora et al. (2021) found that in their sample of 416 urban Latinx adolescents, 90% had reported witnessing at least one act of community violence within the past year. These experiences have important implications for the adjustment of Latinx youth; for example, CVE in Latinx youth has been found to be associated with increased PSTD symptoms, worse academic and physical health outcomes, and sleep impairments (Mora et al., 2021; Santacrose et al., 2021). Importantly, some research suggests that while CVE positively predicted antisocial behaviors, ethnic identity among African American and Latinx youth did not (Williams et al., 2014). Thus, it is important to investigate the impact of CVE on youth behavior in diverse samples that may be at heightened risk for experiencing CVE.

In sum, the current study hypothesized in an ethnically diverse sample that a) CVE would be associated with physical and relational forms of aggression; b) SNS-R to fear would moderate these effects, such that CVE would be most strongly related to proactive aggression among adolescents with lower SNS-R to fear and reactive functions of aggression among adolescents with high SNS-R to fear. Finally, gender differences in these effects were investigated in an exploratory fashion.

Method

Participants

Participants included 197 children (50% female) who were recruited as part of a larger longitudinal study that included a total of 250 participants. Participants were

included in the current subsample if they had relevant data available at the age 7 assessment (i.e., physiological data, aggression data, and/or CVE data). Regarding race and ethnicity, participants were 46.0% Latinx, 17.0% Black, 11.0% White, 10.5% White/Latinx, and 14.0% other mixed race. This subsample consisted of data collected at two time points: once when participants were on average 7 years old (Time 1, or T1), and then again when participants were on average 12 years old (Time 2, or T2).

Caregiver data was collected at recruitment of the original larger study when children were age 4 years (i.e., approximately 3 years prior to T1 in the present sample). Of the caregivers, 91.4% were biological mothers, .5% were biological fathers, 2.5% were adoptive mothers, and 3% were other caregiver kin. Caregivers were on average 32 years old at time of recruitment (M = 31.67, SD = 7.33), caregiver education levels were variable (13.5% had not completed high school, 39.0% had a high school diploma or GED, 4.5% completed a 4-year college degree, and 5.0% had graduate school training). The majority of participating caregivers were married (70.9%), with smaller percentages self-reporting as single (15.8%), divorced (4.6%), or widowed (1.5%) (14 caregivers, or 7.1%, did not provide marital status). Socioeconomic status (SES) was assessed via the Hollingshead Four-Factor Index of Social Status (Hollingshead, 1975). The measure is a composite score of caregiver education and occupation. Education scores ranged from 1 (less than 7th grade) to 7 (graduate or professional training). Occupation scores ranged from 1 (farm laborers and unskilled service workers) to 9 (executives and major professionals). To achieve the composite SES score, education scores were multiplied by 3 and occupation scores were multiplied by 5. When assessing 2 caregivers in the same

home, scores were averaged for a family SES. Scores ranged from 9 to 66, with higher scores indicating higher SES (M = 31.64, SD = 12.26).

Measures

Community Violence Exposure. Children's lifetime community violence exposure was assessed at age 7 using the mean score of the *Things I have Seen and Heard: Child Report* (Richters & Martinez, 1992). This scale was originally developed to assess CVE and has been widely used in subsequent CVE research (Richters & Saltzman, 1990; Trickett et al., 2003). Participants rated on a 5-point Likert scale the frequency of CVE (*0 = never, 1 = one time, 2 = two times, 3 = three times, and 4 = 4 or more times*). Consistent with prior research (see Thompson et al., 2007), the present study omitted four items as they measured feelings of safety (e.g., "I feel safe at school."), and omitted 1 of the original items due to human subject concerns (i.e., "Seen someone in home shot or stabbed"). Examples of items include "Seen a knife pulled on someone" and "Heard gun shots." This measure had good internal consistency in the present sample (15 items; α = .85).

Child's Forms and Functions of Aggression. Children's aggressive behavior was assessed at ages 7 and 12 years. Children's proactive physical and reactive physical aggression were assessed via a caregiver report of the Reactive-Proactive Aggression Questionnaire (RPQ) developed for elementary aged children (Dodge & Coie, 1987; Raine et al., 2006). This measure assessed proactive physical aggression (3 items; e.g. "Your child uses physical force (or threatens to use force) in order to dominate other kids.") and reactive physical aggression (3 items; e.g., "When your child has been teased or threatened, he/she gets angry easily and strikes back."). Children's proactive relational

and reactive relational aggression were assessed via caregiver reports of the Preschool Proactive and Reactive Aggression measure (PPRA; Ostrov & Crick, 2007). Although the PPRA was initially used for teacher reports, this measure has been successfully adapted for caregiver reports (Baker, 2022). This measure was chosen as it is developmentally appropriate for children at the initial assessment period (age 4) and uses language consistent with measures for older samples (3^{rd} – 6^{th} grade; Crick, 1996). This measure assessed proactive relational aggression (3 items; e.g., "Your child often tells others that s/he won't be their friend anymore to get what s/he wants") and reactive relational aggression (3 items; e.g., "When your child is angry at others, your child will often tell them that s/he won't be their friend anymore"). For both measures, items were rated on a 5-point Likert scale, reflecting how frequently the items were true for the target child (*1 = Never or Almost Never True, 5 = Always or Almost Always True).* Internal consistency of the mean scores was acceptable at T1 (proactive physical $\alpha = .78$, reactive physical $\alpha = .75$, proactive relational $\alpha = .78$, reactive relational $\alpha = .72$) and ranged from acceptable to good at T2 (proactive physical $\alpha = .75$, reactive physical $\alpha = .79$, proactive relational $\alpha = .80$, reactive relational $\alpha = .63$).

Child's physiological reactivity to fear. Children's sympathetic nervous system reactivity was assessed via pre-ejection period (PEP) at age 7 during a series of films evoking different emotions, following Bennett and Lewis (2011). Children first viewed a peaceful nature film clip for baseline followed by 3 short clips evoking emotions. The first two clips were developed to induce feelings of happiness and sadness, and were not used in the present study. The third clip depicted a scene from the movie *Stand by Me* in which a train barrels down on two children on a train track; this video was used to induct

feelings of fear. Between each emotion video, participants viewed peaceful nature video clips (1 min) to allow them to recover from the prior emotion induction. In order to assess PEP activity during the clips, four spot electrodes were placed on the neck and torso to collect impedance and respiratory measures, and electrocardiogram (ECG) measures were collected via three spot electrodes placed on the right clavicle, left lower rib, and right abdomen. Mindware's 3.0.10 analysis program (www.mindwaretech.com) was used to identify PEP scores. Specifically, PEP data were obtained using dZ/dt waveforms to quantify the time interval in milliseconds from the onset of the ECG Q-wave to the B point of the dZ/dt wave (Berntson et al., 2004).

The mean of the 6 30-sec epochs from the 3-min peaceful nature clip was used to assess baseline PEP. The mean of the 4 30-sec epochs from the fear clip was used to assess PEP during fear. Standardized residuals were used to identify PEP-R to fear; specifically, PEP-R to fear was regressed onto PEP during baseline, such that, relative to the rest of the sample, higher PEP-R scores indicated greater PEP elongation (i.e., SNS inhibition) than expected, and lower PEP-R indicated greater PEP shortening (i.e., SNS activation) than expected. This approach describes each participants' relative change in SNS-R as compared to the other participants (El-Sheikh et al., 2001; Manuck et al., 1990; Rudd & Yates, 2018).

Data were screened for outliers (i.e., > 3 SDs) relative to each participants data pattern per minute. Expert scorers edited any abnormalities in the B-points as needed. Participants data were deleted if greater than 25% of the epochs were missing due to equipment malfunction or outliers. Of our subsample of 197 participants, 60 participants

were missing PEP baseline measures, and 63 were missing data for PEP-R to the fear clip.

Procedure

As described in Coulombe, Rudd, and Yates (2019), children and caregiver(s) were recruited through flyers given to community-based childcare centers. Exclusion criteria included children who were non-English speakers, as the study lacked sufficient funds for translator services. At each time point, child-caregiver dyads came to the child-friendly university laboratory to complete an extensive assessment including self-report measures, surveys, and observational and physiological data. Caregivers completed measures of aggression at both time points. At age 7, children completed measures of CVE, and physiological measures to the fear inducing video were collected. Written informed consent was obtained from the caregiver at the start of each laboratory session, and verbal assent was obtained from the participating child. Caregivers were compensated $25 per hour and children received a small gift for participation. All procedures were approved by the University's Institutional Review Board.

Data Analytic Plan

Preliminary descriptive statistics were run via SPSS version 28. Correlational analyses between demographics (i.e., gender, race/ethnicity, and socioeconomic status [SES]) and the variables of interest (i.e., CVE, forms and functions of aggression, and PEP-R) were conducted. Demographic variables were included as covariates if they were significantly related to key study variables. Homoscedasticity was confirmed via a visual analysis of scatterplots of the variables of interest. Primary models were conducted using Mplus, version 8.7. Analyses were run with maximum likelihood estimation to account

for missing data; in addition, maximum likelihood estimation with robust standard errors (MLR) was used to accommodate data non-normality (i.e., skewness statistic >2* skewness standard error [SE]). Outliers for PEP-R (i.e., > 3 SDs from the mean) were winsorized to within 3 SDs of the mean.

In the primary model, CVE, PEP-R, and the interaction between CVE and PEP-R served as predictors of all four correlated aggression outcomes (i.e., proactive physical, reactive physical, proactive relational, reactive relational) at age 12. Forms/functions of aggression at age 7 were included as covariates. Continuous predictors and covariates (i.e., forms and functions of aggression, and PEP-R) were all mean-centered prior to analyses. Simple slopes were calculated at +1/-1 SD from the mean for the moderator (i.e., PEP-R) for significant interactions between CVE and PEP-R.

Exploratory analyses were also conducted to investigate whether associations between CVE, PEP-R, and their interaction in predicting forms/functions of aggression differed by gender. Specifically, multigroup models were conducted by gender. An omnibus Wald chi-square test of parameter equalities (see Muthén & Muthén, 1998-2017) was used to investigate whether the associations between CVE, PEP-R, and their interaction in the prediction of each form/function of aggression differed by gender.

G Power version 3.1 was used to determine the power of the interaction effect with R^2 increase. With $N = 197$ and an alpha level of .05, the present study is sufficiently powered at .80 to detect a small effect size of .04 (Cohen, 2013). Power for multigroup comparisons were conducted using the change in RMSEA of competing models (MacCallum et al., 2006) with freely available software (http://quantpsy.org/). Specifically, we investigated the power to detect gender differences in associations

between CVE, PEP-R, and their interaction in the prediction of aggression. We specified the unconstrained model with $df = 22$, $N = 197$, and an RMSEA reflecting good model fit (RMSEA ≤ .06). We specified as the alternative hypothesis a model in which associations between CVE, PEP-R, and their interaction in the prediction of aggression is constrained across groups ($df = 25$) and RMSEA reflects poor model fit (REMSEA ≥ .10). Power was equal to .71 to detect significant differences across these models.

Results

Descriptives, Correlations, and Missing Data

Descriptive statistics regarding key study variables, including the number of participants included for each variable, as well as correlations among key study variables, are presented in Table 1. Correlations indicated that girls scored higher in reactive relational aggression at T1 than boys. Latinx participants scored lower than non-Latinx participants for reactive physical aggression at T1 and T2 as well as lower in proactive relational aggression at T2. Age was positively associated with T2 proactive relational aggression. SES was associated with PEP shortening (i.e., lower PEP-R; indicative of greater SNS activation) to fear, but was unrelated to other study variables. CVE was positively related to proactive physical aggression at T1, reactive physical aggression at both time points, and proactive relational and reactive relational aggression at T2. Correlations between forms and functions of aggression at T1 with aggression subtypes at T2 ranged from small/moderate to large (rs = .21-.66, all ps < .001), with the exception that proactive physical aggression at T1 was unrelated to proactive relational and reactive relational aggression at T2. Thus, given the cross-subtype associations between time points, all T1 aggression subtypes served as predictors of all T2 aggression subtypes in

primary analyses to elucidate the longitudinal effects of the key variables (i.e., CVE, PEP-R, and their interaction) on aggression.

Regarding missing data, Little's MCAR test, which included all four aggression variables at both time points, CVE, PEP-R, ethnicity, SES, and gender, was not significant, suggesting data may be Missing Completely at Random [MCAR; $\chi 2$ (138) = 139.11 p = 0.458]. However, as the present study design did not include planned missing data, data were most likely Missing at Random (MAR, Little et al., 2014). Thus, consistent with best practice, maximum likelihood estimation was utilized to accommodate missing data (Little et al., 2014). In primary analyses, robust standard errors (MLR) were used to accommodate deviations from normality such as variable skew (see Table 1).

Primary Analyses

In the primary model, CVE, PEP-R, and the interaction between CVE and PEP-R served as predictors of all four correlated aggression outcomes (i.e., proactive physical, reactive physical, proactive relational, reactive relational) at T2. Forms/functions of aggression at T1 were included as covariates.

The first primary model included CVE, PEP-R, and their interaction predicting all subtypes of aggression at T2, with gender, ethnicity, and SES, as well as T1 subtypes of aggression serving as covariates (CFI = .958, RMSEA = .063, SRMR = .042). Results of the model are presented in Table 2. In general, subtypes of aggression at T1 were related to higher aggression at T2. Specifically, reactive physical aggression and proactive relational aggression were stable across time points. Furthermore, T1 reactive physical aggression significantly, positively predicted T2 proactive physical aggression and T2

reactive relational aggression. However, T1 proactive physical aggression and T1 reactive relational aggression did not significantly predict any T2 aggression subtypes.

Additionally, PEP lengthening (i.e., higher PEP-R, indicative of SNS inhibition) positively predicted T2 proactive physical aggression. CVE was positively associated with T2 proactive relational aggression. Gender was significantly associated with T2 proactive physical aggression, such that girls had higher proactive physical aggression at T2 than boys. Furthermore, SES was marginally, negatively associated with T2 reactive relational aggression. Ethnicity was not significantly associated with any T2 aggression subtypes.

For exploratory analyses, a multigroup model with gender as the grouping variable was run to investigate whether associations between CVE, PEP, and their interaction in the prediction of forms/functions of aggression at T2 differed by gender. An omnibus Wald test of parameter equalities in Mplus was used to investigate whether the association between the predictors of interest (CVE, PEP-R, and CVE*PEP-R) and aggression at T2 differed by gender. A separate Wald test was run for each outcome at T2 (i.e., proactive physical aggression, reactive physical aggression, proactive relational aggression, reactive relational aggression).

The omnibus Wald tests of gender moderation of associations between CVE, PEP-R, and their interaction predicting proactive relational aggression was significant, Wald $\chi 2(3) = 14.71$, $p = .002$. In contrast, omnibus Wald tests indicated that CVE, PEP-R, and their interaction in the prediction of reactive relational aggression, Wald $\chi 2(3) = .90$, $p = .825$, proactive physical aggression, Wald $\chi 2(3) = .33$, $p = .953$, and reactive physical aggression, Wald $\chi 2(3) = .21$, $p = .976$, did not differ by gender. Thus, for the

final model, the pathways from CVE, PEP-R, and CVE*PEP-R were left unconstrained across gender in the prediction of proactive relational aggression but were constrained across gender for all other subtypes of aggression (i.e., proactive physical, reactive physical, and reactive relational).

Results of the exploratory model are presented in Table 3. Covariates in the exploratory model revealed that Latinx boys had significantly lower levels of T2 reactive physical aggression and T2 proactive relational aggression as compared to non-Latinx boys. For girls, SES was negatively associated with T2 reactive relational aggression. Regarding stability, both reactive physical aggression and proactive relational aggression were stable across time points for boys and girls. In addition, T1 reactive physical aggression positively predicted T2 reactive relational aggression for both genders. In the context of the multigroup model, several significant results regarding longitudinal associations between subtypes of aggression emerged for one gender but not the other. However, Wald tests of parameter equalities investigating if these associations were moderated by gender were not significant; thus, although these pathways were left unconstrained across gender in the multigroup model, as they were not the primary interest of the present study, findings should not be interpreted as significant gender differences in longitudinal associations between forms and functions of aggression.

With respect to the primary paths of interest, for girls only, CVE was significantly associated with increases in proactive relational aggression. Additionally, for girls only, greater PEP-R (i.e., PEP lengthening, indicative of SNS inhibition) was associated with greater proactive relational aggression. Furthermore, for girls only, the interaction between CVE and PEP-R was significantly associated with increases in proactive

relational aggression. Follow-up simple slope analyses revealed that for girls, at high levels of PEP-R (i.e., PEP lengthening, 1 SD above the mean, indicative of SNS inhibition), CVE predicted significant increases in proactive relational aggression at T2 (b = .70, p < .001). However, at low levels of PEP-R (i.e., PEP shortening, 1 SD below the mean, indicative of SNS activation), CVE was not associated with proactive relational aggression (b = .06, p = .480; see Figure 1).

Discussion

The present study examined the longitudinal associations between cumulative CVE in childhood and forms and functions of aggression in early adolescence. In addition, patterns of effects due to children's SNS-R to fear as well as gender were explored. Overall, findings indicated that greater PEP-R (i.e., PEP lengthening, indicative of SNS inhibition) predicted greater proactive physical aggression in the overall sample. In addition, CVE served as a risk factor in the development of proactive relational aggression among girls. Furthermore, blunted SNS-R to fear was a risk factor for the development of proactive relational aggression for girls only. Additionally, there was a significant interaction between CVE and SNS-R in the prediction of proactive relational aggression among girls, such that CVE was only related to increases in proactive relational aggression among girls who displayed blunted SNS-R to fear. Findings illustrate how CVE, SNS-R, and gender interact to predict proactive relational aggression over time.

As expected, in the context of bivariate correlations, CVE was positively related to concurrent aggression (i.e., proactive and reactive physical aggression at T1), and with aggression over time (i.e., reactive physical, proactive relational, and reactive relational

subtypes of aggression at T2). Interestingly, CVE was not correlated with T2 proactive physical aggression. In general, subtypes of aggression at T1 were related to subtypes of aggression at T2, with the exception that T1 proactive physical aggression was not associated with T2 reactive relational or proactive relational aggression. These findings suggest that aggression was stable over time in the current sample, as children who scored higher in one subtype of aggression at T1 were likely to score higher in that subtype of aggression at T2, which is consistent with prior developmental research (e.g., Girard et al., 2019). Additionally, in line with prior research on cross-subtype associations (e.g., Girard et al., 2019), children in the current sample who scored high in one subtype of aggression at T1 were likely to score high in other subtypes of aggression at T2. These findings are consistent with social learning theories of aggression, which suggest that children who engage in one subtype of aggression learn through modeling and reinforcement to continue to aggress generally, while simultaneously reducing the utilization of alternative behaviors (e.g., seeking support from a trusted adult) over time (Bandura 1973; Girard et al., 2019).

In general, there were few gender differences in the bivariate correlations, with the exception that girls scored higher on T2 reactive relational aggression; these findings are generally consistent with evidence that girls engage in similar rates of relational aggression as boys (Card et al., 2008). Surprisingly, no gender differences were found for physical forms of aggression. This lack of significant gender differences may be due to reporter effects. In fact, a meta-analysis by Card et al. (2008) found that gender differences in physical aggression were smallest when using self- and parent-reports. Therefore, the use of caregiver-reported aggression in the current study may have played

a part in the similar rates of physical aggression across gender. Alternatively, it is possible that the lack of gender differences in physical aggression was in part due to the sample being predominantly Latinx. For instance, Fries et al. (2013) found that girls engaged in higher rates of physical aggression than boys in a community sample of 975 Latin American adolescents. The authors posit these findings may be due to shifting gender norms in developed Latin countries (e.g., Chile) and/or living in urban areas (Fries et al., 2013). Thus, a diverse sample and/or use of parent-reported aggression may have contributed to the lack of gender differences in rates of physical aggression in the current sample.

In the context of the primary model including all subtypes of aggression, CVE was only uniquely associated with increases in proactive relational aggression over time. The longitudinal association between CVE and proactive relational aggression is in line with prior research, and may reflect social learning processes wherein children learn that aggression is an adaptive behavior that can be used to obtain desired outcomes (Chaux et al., 2012). Furthermore, CVE may increase normative beliefs surrounding aggression, as well as decrease self-efficacy in utilizing nonaggressive strategies (Farrell et al., 2022). That is, youth higher in CVE may learn that violence or aggression is an effective behavior, thus decreasing self-efficacy for non-aggressive behaviors and increasing the use of proactive aggression in order to meet their goals or needs.

However, contrary to hypotheses, CVE was not uniquely associated with increases in proactive *physical* aggression in the current study. Although unexpected, these findings add nuance to the current literature which is mixed regarding the associations between CVE and proactive physical aggression (e.g., Myers et al., 2018;

Scarpa et al., 2008). For example, Scarpa et al. (2008) found that CVE was not directly associated with increases in proactive physical aggression among a community sample of 13-year-old children. Furthermore, Myers et al. (2018) found CVE predicted only reactive functions of physical aggression when accounting for time 1 aggression among adolescent juvenile boys. Conversely, Chaux et al. (2012) found that CVE did in fact predict proactive general aggression among a Colombian sample of school-aged children.

Findings from the current sample suggest that CVE may serve as a unique risk factor for proactive *relational*, but not proactive physical, aggression. It is possible that late childhood and early adolescence are developmental periods in which youth are particularly sensitive to the effects of violence exposure on the development of relational aggression. In fact, these developmental periods are characterized by increased importance of peer relations and social competence (see Harold & Hay, 2005) as well as decreased rates of physical aggression and increased rates of relational aggression (see Card et al., 2008). Furthermore, relationally aggressive adolescents have been found to be more socially accepted and less rejected than physically aggressive adolescents (Salmivalli et al., 2000). Indeed, Delveaux and Daniels (2000) found that, during early adolescence, utilization of relational aggression was associated with goals such as maintaining peer relations whereas physical aggression was associated with goals of control and revenge. Therefore, although CVE may increase risk for proactive aggression generally, adolescence may be a developmental period in which CVE predicts greater relational as opposed to physical forms of aggression because adolescents are aware of the social costs of physical aggression.

In addition, CVE was not significantly associated with increases in reactive functions of aggression (i.e., reactive physical or reactive relational aggression). These unexpected findings contrast with prior work indicating an association between CVE and greater reactive aggression (e.g., Calvete & Orue, 2011; Myers et al., 2018). Prior research has also indicated indirect effects of CVE on reactive functions of aggression via processes such as HAB, impulse control, and emotion dysregulation (e.g., Chaux et al., 2012; Cooley et al., 2019; Myers et al., 2018). It is possible that the lack of findings regarding reactive aggression in the current study may be related to the distinct types of CVE experienced. For instance, Chaux et al. (2012) reported that whereas CVE was associated with both reactive and proactive aggression, exposure to youth gangs was only associated with proactive aggression. It is possible, then, that the types of CVE most prevalent in the current sample (i.e., witnessing violence in the neighborhood outside of the home) may be especially predictive of processes that facilitate proactive aggression.

Additionally, it is notable that CVE often captures observational (e.g., seen a knife pulled on someone) rather than direct victimization (e.g., experienced someone pulling out a knife on oneself). Indeed, being the direct target of violence and aggression has been found to predict greater reactive, as opposed to proactive, functions of aggression in youth (e.g., Camodeca et al., 2002). Moreover, direct victimization in youth is related to greater emotional dysregulation, which is largely associated with reactive functions of aggression (e.g., Schwartz et al., 2000). Thus, processes facilitating reactive aggression, such as HAB, may be more strongly connected to being the target of victimization, and less closely tied to exposure to violence more broadly. Conversely, as CVE often involves observing aggression and violence, it may facilitate processes that

increase normative beliefs regarding the acceptability and outcomes of aggression, leading to increased imitation of aggressive or violent behaviors as a means to achieve desired goals. In fact, the development of proactive functions of aggression is grounded in social learning theory wherein youth learn behaviors through the observation of others (Bandura, 1975). Therefore, it is possible that these observational experiences may be most closely tied to proactive functions of aggression. Future research should investigate this possibility and examine the influence of different types of CVE on underlying processes facilitating different functions of aggression.

Regarding physiology, consistent with our hypotheses, PEP lengthening (indicative of SNS inhibition) in response to fear induction was related to later proactive physical aggression. These results support prior research indicating blunted SNS-R as a salient risk factor for proactive aggression (e.g., Blankenstein et al., 2022; Moore et al., 2018; Murray-Close et al., 2017; Raine, 1997). These results are in line with prior research demonstrating an association between blunted SNS-R and greater proactive aggression in a clinical sample of boys (Schoorl et al., 2016). The association between blunted SNS-R to fear and aggression is consistent with fearlessness theory, which suggests that low sympathetic arousal is indicative of temperamental fearlessness and thus impaired responsiveness to punishment and distress cues of others (Frick & Morris, 2004; Murray-Close et al., 2017). According to this theory, fearless children and adolescents may be more likely to choose aggressive behaviors to obtain desired outcomes, as they are less affected by potential consequences. In fact, Fanti et al. (2016) found that children who displayed a blunted physiological reaction to fearful stimuli scored high in both conduct problems and callous unemotional traits, both of which are

associated with proactive functions of aggression (e.g., Lozier et al., 2014). Furthermore, fearlessness may increase risk for proactive aggression as children who do not experience typical levels of fear may be less adept at recognizing fear in others (Thomson, 2022). Thus, low sympathetic reactivity to fear in the current sample may be indicative of fearlessness, consequently predicting later proactive aggression.

Stimulation seeking theory similarly posits that low SNS activity serves as a risk factor for aggression. Specifically, according to stimulation seeking theory, sympathetic underarousal is experienced as an aversive physiological state; underaroused youth thus engage in behaviors aimed at increasing sympathetic arousal, such as aggression (Murray-Close et al., 2017; Raine, 1997). Therefore, the blunted SNS-R to fear found in the current study may be indicative of an aversive physiological state, leading to greater rates of proactive aggression. Importantly, findings regarding physiological reactivity depend on the stimuli used. For example, in their meta-analytic work, Beauchaine et al. (2019) found that physiological reactivity to negative emotion induction, but not positive emotion induction, was related to externalizing behaviors. Furthermore, a review by Fanti et al. (2019) illustrates how heart rate reactivity to social stressor tasks was negatively correlated with conduct problems, whereas heart rate reactivity to empathy inducing tasks was positively correlated with conduct problems. As the current study used a fear inducing video to assess SNS-R, the association between blunted SNS-R and proactive aggression may be more closely tied to fearlessness, rather than stimulation seeking, in this study. Future research regarding physiological correlates of forms and functions of aggression should include physiological reactivity to rewarding stimuli to target physiological processes that may be more closely tied to stimulation seeking tendencies.

Although analyses assessing gender moderation were exploratory in nature, a number of gender differences emerged in the present study. In fact, when gender moderation was investigated, findings indicated that there was a significant association between CVE, SNS-R, and their interaction in the prediction of proactive relational aggression among girls but not boys. That is, there were significant main effects of CVE and blunted SNS-R, as well as their interaction, in the prediction of later proactive relational aggression for girls only. Follow-up analyses of the interaction effect indicated that CVE was related to later proactive relational aggression among girls exhibiting blunted SNS-R to fear. These gender differences are inconsistent with some prior work indicating similar correlates of CVE for boys and girls. For instance, one large study found that CVE was associated with later physical and relational aggression for both boys and girls (Guerra et al., 2003). Similarly, Hamner et al. (2015) found that among a sample of adolescent immigrants, CVE predicted both functions of physical aggression for both boys and girls.

Indeed, the literature has been mixed regarding gender differences in associations between physiology and functions of aggression. For instance, Thomson et al. (2021) found that physiological reactivity to fear consistent with fearlessness (i.e., blunted SNS and blunted parasympathetic nervous system [PNS] activity) was associated with proactive physical aggression in men but not women. Conversely, Moore et al., found that blunted sympathetic reactivity during virtual peer scenarios significantly predicted proactive aggression in both boys and girls among a sample of 5th graders. Moreover, Murray-Close and Rellini (2012) demonstrated that among women with a history of sexual abuse, blunted physiological reactivity to relational stressors significantly

predicted proactive relational aggression. Therefore, the present study contributes to the existing literature by shedding light on the role of blunted SNS-R to fear as a significant risk factor in the development of proactive relational aggression among adolescent girls.

Further, the interaction between blunted SNS-R to fear and CVE in the prediction of proactive relational aggression in girls is consistent with prior work indicating interactions between adversity and blunted SNS reactivity in the prediction of proactive aggression. For instance, among young adults who have experienced greater adversity in the form of sexual abuse (e.g., Murray-Close & Rellini, 2012) and negative parenting (e.g., Wagner & Abaied, 2016), blunted SNS-R to negative emotion inducing stimuli was associated with greater proactive relational aggression. The current study extends these findings by highlighting the moderating role of SNS-R in the association between an additional type of adversity – that is, CVE - and proactive relational aggression among girls.

Unexpectedly, blunted SNS-R did not moderate the relationship between CVE and proactive relational aggression in boys. Further, among boys, there were no main effects of CVE or SNS-R in the prediction of proactive relational aggression. One consideration for why the interaction between CVE and blunted SNS-R predicted proactive relational aggression in girls only is because relational aggression is the modal form of aggression for girls (Card et al., 2008). Risk factors thus might be most closely tied to relational aggression outcomes for girls. Another possibility is that other physiological processes may be relevant to understanding the association between CVE and aggression in boys. Supporting this notion, Fagan et al. (2017) found that lower resting heart rate mediated the association between social adversity and antisocial

behaviors in males but not in females. Furthermore, PEP-R was not a significant mediator between social adversity and antisocial behaviors in males (Fagan et al., 2017). The authors suggest that, since heart rate reflects both the sympathetic and parasympathetic branches of the autonomic nervous system (ANS), the sympathetic branch alone may not predict antisocial behaviors in males experiencing social adversity. Therefore, it is imperative for future research to explore how CVE and the reactivity of both branches of the ANS (i.e., SNS-R and PNS Reactivity (PNS-R)) interact to predict externalizing behaviors in both boys and girls.

Interestingly, the findings did not support the hypothesis that CVE would be most strongly related to reactive functions of aggression among adolescents with high SNS-R to fear. It is possible that associations with reactive aggression may be evident in studies that focus on SNS-R to anger, rather than fear. In fact, reactive functions of aggression are grounded in the frustration-aggression hypothesis, which argues that increases in SNS arousal following negative events predict enactment of reactive aggression (Berkowitz, 1989; Martinelli et al., 2018). Thus, use of negative stimuli to induce feelings of anger or frustration may better capture the underlying processes of reactive functions of aggression. In fact, Hubbard et al. (2002) found that greater SNS-R to a frustration inducing task was significantly related to children's reactive, but not proactive, aggression. Future research may seek to disentangle the mechanisms underlying reactive functions of aggression in the context of CVE by using frustration or anger inducing stimuli or tasks.

The finding that Latinx youth in the current sample scored significantly lower on reactive physical aggression at both time points as well as on T2 proactive relational

aggression is interesting and warrants examination. On the one hand, these findings are consistent with the finding that Hispanic boys were less likely to be relational aggressors as compared to their White peers (Wang et. al., 2012). Additionally, prior research has highlighted the protective role of parenting styles and family dynamics that are more typical in Latin households (such as family cohesion), against the development of aggression among Latinx youth exposed to CV (Xu et al., 2020). However, the role of parenting and family dynamics was not investigated in the present study; thus, their influence on rates of aggression remains speculative and further research is warranted. It is also possible that the ethnicity differences in subtypes of aggression observed in the present study may reflect the methodology used in assessing aggression (i.e., caregiver reports). For instance, Baker et al. (2008) found that African American children scored higher in both functions of aggression than White and Asian American youth when self- and teacher-reports were used, but aggression levels were equivalent when caregiver-reports of aggression were used. Thus, although research is limited, it is possible there are differences in caregiver reports of aggression in Latinx youth as compared to other ethnic groups. Furthermore, prior research has found that Latinx youth are more likely to be perceived as aggressive and disruptive than White youth by school staff, with aggression rates in Latinx youth likely being overreported (Matute-Bianchi, 1991). Therefore, the pattern of findings in the current study may differ depending on the informant used to assess aggression, and future research is needed to investigate whether these results replicate with use of self-reported, peer-reported, and teacher-reported aggression. Finally, lower SES was associated with blunted SNS-R to fear, which may represent greater allostatic load, as individuals living in lower SES tend to experience greater

chronic stressors, which has been linked to later blunted sympathetic reactivity (Loeb et al., 2022).

Strengths, Limitations, and Future Directions

Strengths of the current study include the multimethod, longitudinal design demonstrating novel associations between CVE, blunted SNS-R to fear, and proactive relational aggression in girls. The inclusion of forms and functions of aggression extends prior research investigating the effects of CVE and physiological reactivity on externalizing behaviors (e.g., Cooley et al., 2019; Scarpa et al., 2008). Further, given that the majority of the current research has focused on physical forms of aggression (e.g., Guerra et al., 2003; Hamner et al., 2015; Thomson et al., 2021), this study extends prior work by investigating relational forms of aggression. Finally, the focus on middle childhood to early adolescence extends prior research on adults (e.g., Thomson et al., 2021) and is particularly relevant to the development of relational aggression (Card et al., 2008).

Despite these strengths, it is important to evaluate findings in the context of study limitations. First, although the use of SNS-R to fear was a strength of the current study, it may not have captured the relationship between heightened SNS-R, CVE, and reactive functions of aggression. Future research should incorporate anger/frustration emotion inductions to better capture the relationship between SNS-R and CVE in predicting reactive aggression. Additionally, the stimulus used in the current study may best capture fearlessness (i.e., fear inducing video clip). As stimulation seeking theories posit that low arousal is experienced as an aversive state (Murray-Close et al., 2017; Raine, 1997),

future research should investigate physiological reactivity to rewarding stimuli to better elucidate the processes underlying stimulation seeking and aggressive behaviors.

Furthermore, future research should investigate the PNS in tandem with the SNS to achieve a full picture of ANS coordination and reactivity (e.g., Murray-Close et al., 2017). Indeed, prior research has indicated that the two branches of the ANS work together to influence the body's net arousal, which has associations with externalizing behaviors (e.g., El-Sheikh & Erath, 2011; Murray-Close et al., 2023). In fact, prior research suggests that reciprocal activation of the ANS (i.e., low SNS and high PNS or high SNS and low PNS) is a more adaptive response to a stressor, whereas nonreciprocal patterns of the ANS such as coinhibition (i.e., low SNS and low PNS) and coactivation (i.e., high SNS and high PNS) have more ambiguous effects (e.g., Murray-Close et al., 2017). Therefore, incorporating both branches of the ANS may be important in understanding the development of aggression in the context of CVE.

Furthermore, although significant overlap between the functions of aggression is consistent with prior research (e.g., Card & Little, 2006), this overlap may have reduced the power to detect the unique effects of CVE and physiology in the prediction of proactive and reactive aggression. To improve future research investigating differences in functions of aggression, there are a couple key considerations. First, employing statistical approaches such as factor analysis (see Little et al., 2003) may help distinguish the functions of aggression. Second, incorporating established measures such as the teacher-reported Instrument for Reactive and Proactive Aggression (IRPA), which was developed to minimize overlap in functions of aggression and has been found to have both good convergent and divergent validity (see Polman et al. 2009), may offer a clearer picture of

functions of aggression. Thus, future research should incorporate both statistical approaches, such as factor analyses, and measures developed to better distinguish between functions of aggression, in order to better understand distinct correlates of functions of aggression.

Additionally, research has found a bidirectional link between violence exposure and aggressive behaviors, especially among children with low effortful control (i.e., temperamental self-regulation abilities; Esposito et al., 2020), underscoring the need for longitudinal research investigating the direct and indirect paths of violence exposure to aggressive behaviors. In fact, Mrug and Windle (2009) found that delinquency in early adolescence served as a risk factor for both witnessing and being victimized by CV. Additionally, research from Farrell et al. (2020) suggests the bidirectional relationship between witnessing CV and physical aggression serves as a feedback loop, such that increasing CVE leads to increased physical aggression, which in turn leads to greater CVE. Examining bidirectional effects can provide a more comprehensive understanding of factors contributing to aggression. Furthermore, bidirectional effects may shine light on feedback loops in which CVE and aggression perpetuate each other (e.g., Farrell et al., 2020). A better understanding of these feedback loops may inform intervention and prevention efforts aimed at breaking this cycle. Although the longitudinal design of the current study is a strength, future research may extend these findings by investigating potential mediators (e.g., effortful control) or considering longitudinal bidirectional effects.

In addition to investigating bidirectional effects, future research may benefit from investigating how CVE, physiology, and their interaction influence subtypes of

aggression at different developmental periods. Although this study used a developmental period critical for understanding peer relations and the development of relational aggression, future research should incorporate different developmental periods to see how the associations between CVE, physiology, and aggression change over time. For example, one study found that CVE decreased on average during elementary school, whereas aggressive cognitions and behaviors increased during this time (Guerra et al., 2003). In addition, different developmental periods are characterized by differing levels of aggression (e.g., physical aggression decreases in late childhood/early adolescence whereas relational aggression increases; Card et al., 2008). Indeed, these shifts in aggression subtypes during development may stem from biological alterations associated with puberty. In fact, prior research suggests that puberty can influence the functioning of physiological stress systems, including the nervous system, which has important implications for different aggression subtypes (Murray-Close, 2013; Viau, 2002). Consequently, investigating these associations across different developmental stages can provide insights into critical periods of vulnerability or resilience regarding childhood CVE. Future research should aim to explore how CVE, physiological changes, and their interaction might contribute to varying trajectories in aggression subtypes across developmental periods, with particular attention to pubertal transitions.

Furthermore, the lack of findings in the present study regarding CVE predicting physical and reactive subtypes of aggression may be in line with a study conducted by Mora et al. (2022), which suggests that research may misattribute or overestimate the effects of CVE on youth outcomes, when other neighborhood effects should be considered (e.g., gender-based harassment). Given this suggestion, future research should

consider accounting for the effects of other forms of victimization when investigating the impact of CVE on subtypes of aggression. As prior research has demonstrated a large overlap between CVE and other types of violence exposure (e.g., domestic, see Herrenkohl et al., 2008), it is vital for future research to determine the extent to which CVE contributes to the development of aggression, above and beyond other types of violence exposure. Another possibility for the lack of significant findings regarding associations between CVE and reactive and physical subtypes of aggression may be due to the lack of power in the current sample. Thus, future research should aim to replicate the current study with larger sample sizes. Moreover, although the sample of the current study was diverse in including predominantly Latinx youth, future research should extend these findings to other diverse populations (e.g., Black youth, Asian American youth, youth in rural areas) in order to increase the generalizability of study findings.

Additionally, the current study utilized self and caregiver reported measures, and future research should expand on the informants used. Indeed, prior research has found that both caregiver- and child-reported measures of aggression result in smaller gender differences as compared to teacher reports (Card et al., 2008). Furthermore, there are higher rates of CV in lower income areas (Buka et al., 2001; Luthar & Goldstein, 2004), which also has higher rates of shift work and irregular work schedules (e.g., Baum et al., 2021). Caregivers in areas high in CV may be more likely to work irregular hours, potentially leading to less interactions with their children and fewer opportunities to observe child behavior. Therefore, teachers may be an important informant to include in future research, as they can provide valuable insights into children's behaviors and experiences, especially in areas where irregular work schedules are common among

caregivers. Furthermore, given the increased importance and time spent in peer groups from middle childhood to adolescence, methods such as peer nominations may provide a more comprehensive and accurate assessment of aggression rates (e.g., Card et al., 2008). By incorporating multiple informants, future research can gain a more holistic understanding of the influences of CVE and physiology on children's subtypes of aggression, while also mitigating potential reporter bias.

Finally, the present study utilized a modified version of the Things I have Seen and Heard: Child Report measure (Richters & Saltzman, 1990; Trickett et al., 2003) as a means to capture CVE. It is possible this questionnaire did not capture the full scope of CVE this sample experienced. Although this questionnaire has been widely used in research investigating CVE (Richters & Saltzman, 1990; Trickett et al., 2003), future research may wish to compare patterns of findings with qualitative reports of CVE to further capture the complexity and nuance of its effects. That is, distinct types of CVE may have unique effects on the development of externalizing behaviors, and qualitative research may help capture a full picture of CVE. In fact, prior research has indicated that varying types of CV (e.g., witnessing versus victimization, youth gangs, violence between strangers versus familiar people) have unique associations with subtypes of aggression (Calvete & Orue, 2011; Chaux et al., 2012). Furthermore, future studies should incorporate the voices of the youth they are researching to better understand the personal impacts of violence exposure. For example, Bailey and Coore-Desai (2012) incorporated quantitative and qualitative data regarding the effects of CVE on Jamaican children and found that qualitative reports of CVE provided significant insights regarding how these experiences interact with the culture and barriers within the community. Thus,

inclusion of both qualitative and quantitative approaches may elevate the voices of those being researched and provide a more nuanced understanding of the effects of CVE.

Conclusions

The current findings add to a growing body of research longitudinally examining the interaction of CVE and physiological reactivity in the development of adolescent forms and functions of aggression. In fact, the present study aimed to fill in the gaps of research regarding CVE and SNS-R in the development of *relational* forms of aggression in addition to physical forms. Furthermore, findings highlight gender differences in these processes, such that CVE predicted greater proactive relational aggression for girls, but not boys, who demonstrated blunted SNS-R to fear. This research has important theoretical implications while also informing intervention and prevention efforts. Theoretically, these findings are in line with diathesis-stress models, which highlight how vulnerabilities (e.g., blunted SNS-R to fear) may interact with specific contexts (e.g., CVE) in the development of externalizing behaviors.

Regarding applied implications, findings demonstrate the importance of considering the unique interactions between physiology and adverse events. That is, incorporating physiological assessments may inform clinicians about who is most at risk when facing adversity. Finally, these findings highlight the importance of implementing policies which aim to reduce structural inequalities and thus reduce harmful contexts such as CVE. In sum, it is clear that CVE and physiological reactivity serve as risk factors for youth in the development of aggressive behaviors, and efforts to mitigate the presence and effects of CVE are greatly needed.

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APPENDIX

Table 1

Descriptive Statistics and Correlations of Study Variables

	N	Mean(SD)	Min-Max	Skew	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Child Age (Months)	197	7.17(.23)	6.57-8.06	1.56	--												
2. Child Gender	197	.50(.50)	---	.01	**.20***	--											
3. Child Ethnicity	197	.47(.50)	---	.13	.03	-.08	--										
4. SES	182	31.64(12.26)	13-66	.65	.11	.02	-.11	--									
5. CVE	192	.76(.74)	.00-3.71	1.50	.08	-.05	.00	-.13	--								
6. PEP-R to Fear	134	.02(.80)	-3.00-3.00	-.36	.01	-.03	-.01	**-.18***	.00	--							
7. Proactive Phys T1	197	.20(.41)	.00-2.33	2.47	-.01	.08	-.00	.11	**.17***	-.01	--						
8. Reactive Phys T1	195	1.31(.92)	-.00-4.00	.56	.02	-.01	**-.15***	.01	**.18***	-.11	**.40***	--					
9. Proactive Rel T1	197	.71(.77)	.00-3.33	.89	.10	.10	-.12	.10	.08	-.10	**.41***	**.39***	--				
10. Reactive Rel T1	196	1.11(.82)	.00-3.33	.41	.09	**.15***	-.09	.05	.11	.00	**.41***	**.47***	**.70***	--			
11. Proactive Phys T2	183	.18(.42)	.00-2.67	3.01	-.11	-.14	-.05	-.04	.12	.08	**.26***	**.34***	**.25***	**.21***	--		
12. Reactive Phys T2	184	1.16(.96)	.00-4.00	.66	-.08	-.07	**-.20***	-.06	**.19***	-.01	**.23***	**.51***	**.30***	**.30***	**.50***	--	
13. Proactive Rel T2	181	.38(.62)	.00-4.00	2.45	**.15***	.06	**-.15***	-.04	**.20***	-.02	.10	**.28***	**.38***	**.25***	**.48***	**.39***	--
14. Reactive Rel T2	183	.82(.74)	.00-3.00	.76	-.01	.05	-.12	-.09	**.17***	-.10	.13	**.39***	**.34***	**.33***	**.43***	**.49***	**.66***

Note: Gender is coded: 0 = boys, 1 = girls; Child Ethnicity is coded: 0 = Non-Latinx, 1 = Latinx; SES = Socioeconomic Status; CVE = Community Violence Exposure; PEP-R to Fear = Preejection Period Reactivity to Fear at Time 1; Phys = Physical Aggression; Rel = Relational Aggression; values represent winsorized data. *$p < .05$; **$p < .01$.

Table 2.

CVE, PEP-R, and their interaction predicting subtypes of aggression

Proactive Physical				
	b	SE	*t*	*p*
CVE	.03	.04	.71	.481
PEP-R	**.10***	**.04**	**2.33**	**.020**
CVE x PEP-R	-.02	.05	-.31	.754
Covariates				
T1 ProPhys	.12	.12	.98	.328
T1 RePhys	**.12****	**.05**	**2.67**	**.008**
T1 ProRel	.10	.07	1.42	.155
T1 ReRel	-.03	.05	-.67	.500
Race/Ethnicity	.02	.06	.38	.704
Gender	**-.13***	**.06**	**-2.27**	**.023**
SES	-.00	.00	-.68	.499
Reactive Physical				
	b	SE	*t*	*p*
CVE	.12	.09	1.36	.175
PEP-R	**.**13	.10	1.26	.209
CVE x PEP-R	-.15	.16	-.91	.362
Covariates				
T1 ProPhys	.03	.22	.15	.884
T1 RePhys	**.45****	**.09**	**4.96**	**.000**
T1 ProRel	.22	.16	1.40	.163
T1 ReRel	-.07	.13	-.52	.603
Race/Ethnicity	-.18	.13	-1.37	.171
Gender	-.15	.13	-1.17	.244
SES	-.01	.01	-1.31	.189
Proactive Relational	*b*	SE	*t*	*p*
CVE	**.14***	**.06**	**2.34**	**.020**
PEP-R	.05	.06	.76	.449

CVE x PEP-R	.14	.10	1.42	.157
Covariates				
T1 ProPhys	-.15	.14	-1.06	.288
T1 RePhys	.10	.05	1.92	.055
T1 ProRel	**.28****	**.08**	**3.59**	**.000**
T1 ReRel	-.03	.07	-.47	.640
Race/Ethnicity	-.07	.08	-.83	.407
Gender	.04	.08	.53	.597
SES	-.00	.00	-.70	.484
Reactive Relational				
	b	SE	*t*	*p*
CVE	.07	.06	1.21	.226
PEP-R	-.04	.08	-.56	.577
CVE x PEP-R	-.13	.11	-1.18	.238
Covariates				
T1 ProPhys	-.15	.15	-1.00	.318
T1 RePhys	**.20****	**.05**	**3.65**	**.000**
T1 ProRel	.16	.10	1.55	.121
T1 ReRel	.09	.09	1.08	.279
Race/Ethnicity	.01	.10	.05	.957
Gender	.01	.10	.12	.906
SES	-.01	.00	-1.69	.090

Note: Gender is coded: 0 = boys, 1 = girls; Child Ethnicity is coded: 0 = Non-Latinx, 1 = Latinx; SES = Socioeconomic Status; CVE = Community Violence Exposure; PEP-R to Fear = Preejection Period Reactivity to Fear at Time 1; Shortened PEP (i.e., low PEP-R) reflects heightened SNS activation, whereas elongated PEP (i.e., high PEP-R) reflects SNS inhibition. Values represent winsorized data.
*$p < .05$; **$p < .01$.

Table 3.

CVE, PEP-R, and their interaction predicting subtypes of aggression: Exploratory model moderated by gender

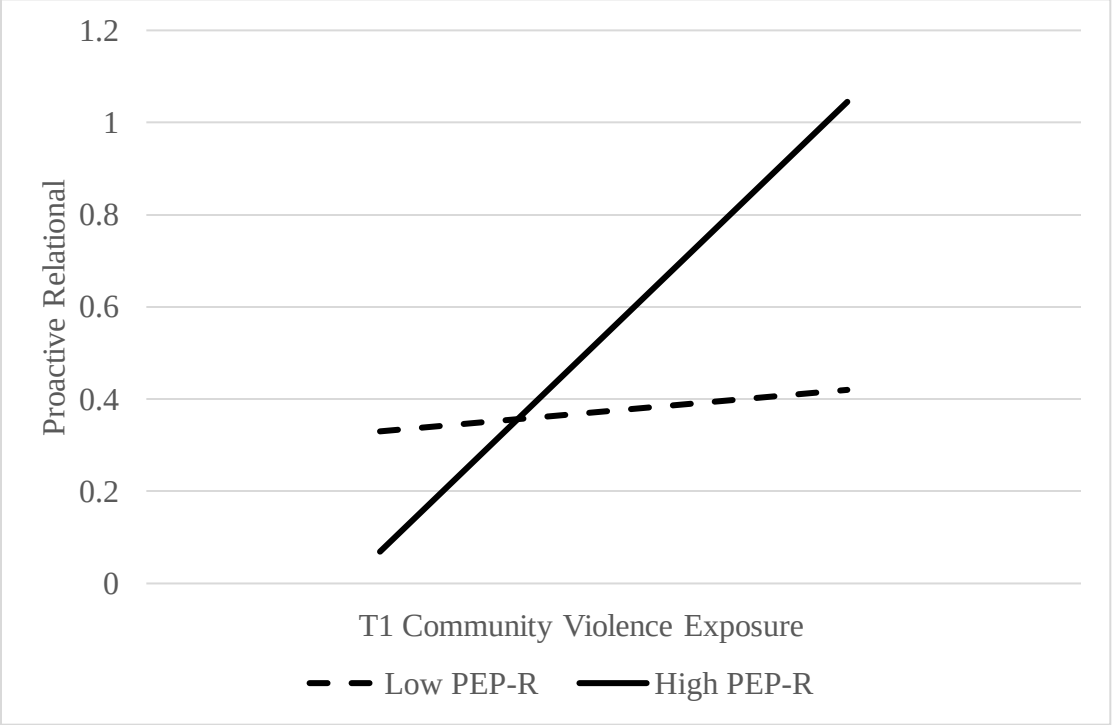
Proactive Physical				
	b	SE	*t*	*p*

CVE	.02	.04	.38	.701
PEP-R	.09	.06	1.54	.124
CVE x PEP-R	-.05	.07	-.76	.445
Covariates				
T1 ProPhys	.**42***/-.05	**.21**/.09	**1.98**/-.52	**.048**/.607
T1 RePhys	.12/**.13****	.07/**.05**	1.84/**2.63**	.066/**.009**
T1 ProRel	.15/.11	.10/.06	1.54/1.82	.124/.070
T1 ReRel	-.02/-.09	.07/.05	-.23/-1.68	.821/.093
Race/ethnicity	-.07/.07	.08/.09	-.96/.71	.335/.478
SES	-.01/.00	.00/.00	-1.38/.83	.166/.410
Reactive Physical				
	b	SE	*t*	*p*
CVE	.12	.09	1.28	.199
PEP-R	.12	.10	1.29	.196
CVE x PEP-R	-.19	.14	-1.35	.177
Covariates				
T1 ProPhys	.32/-.03	.25/.25	1.30/-.14	.194/.892
T1 RePhys	**.47**/.48****	**.10**/**.16**	**4.79**/**3.00**	**.000**/**.003**
T1 ProRel	**.38***/.05	**.17**/.22	**2.25**/.24	**.025**/.811
T1 ReRel	-.06/-.07	.17/.16	-.37/-.43	.708/.670
Race/ethnicity	**-.35***/-.11	**.15**/.18	**-2.27**/-.61	**.023**/.544
SES	-.01/-.01	.01/.01	-1.25/-.80	.210/.425
Proactive Relational				
	b	SE	*t*	*p*
CVE	.03/**.46****	.05/**.11**	.61/4.21	.544/**.000**
PEP-R	.04/**.17***	.08/**.07**	.51/**2.38**	.612/**.017**
CVE x PEP-R	.01/**.40****	.11/**.11**	.07/**3.59**	.943/**.000**
Covariates				
T1 ProPhys	.34/**-.62****	.18/**.21**	1.86/**-2.99**	.062/**.003**
T1 RePhys	.03/**.26****	.07/**.10**	.42/**2.61**	.677/**.009**
T1 ProRel	**.27**/.52****	**.09**/**.19**	**2.99**/**2.74**	**.003**/**.006**
T1 ReRel	-.07/-.13	.07/.13	-1.01/-.97	.312/.332
Race/ethnicity	**-.27****/.14	**.08**/.15	**-3.37**/.90	**.001**/.367
SES	-.00/.01	.00/.01	-.99/1.05	.324/.294
Reactive Relational				
	b	SE	*T*	*p*
CVE	.05	.06	.88	.381
PEP-R	-.04	.07	-.54	.589
CVE x PEP-R	-.11	.10	-1.11	.269
Covariates				
T1 ProPhys	.26/**-.38***	.24/**.18**	1.08/**-2.10**	.282/**.036**
T1 RePhys	**.20***/.18*	**.08**/**.08**	**2.42**/**2.19**	**.015**/**.029**
T1 ProRel	.23/.21	.12/.16	1.86/1.29	.063/.196
T1 ReRel	-.03/.17	.11/.12	-.29/1.37	.770/.170
Race/ethnicity	-.19/.04	.15/.15	-1.32/.29	.186/.772
SES	-.00/**-.01***	.01/**.01**	-.60/**-1.96**	.552/**.050**

Note: Estimates for boys are on the left of the / and those for girls are on the right. For key associations (i.e., i.e., CVE, PEP-R, and CVE*PEP-R predicting T2 aggression), omnibus comparisons by gender were conducted in a multigroup model. For these key associations, parameters were freely estimated when significantly different across gender; parameters that did not differ across gender were constrained. Child Ethnicity is coded: 0 = Non-Latinx, 1 = Latinx; SES = Socioeconomic Status; CVE = Community Violence Exposure; PEP-R to Fear = Preejection Period Reactivity to Fear at Time 1; Shortened PEP (i.e., low PEP-R) reflects heightened SNS activation, whereas elongated PEP (i.e., high PEP-R) reflects SNS inhibition. Values represent winsorized data.
*p < .05; **p < .01.

Figure 1.

Interaction plot of CVE x PEP-R predicting proactive relational aggression for girls



Note. Boys' PEP-R moderates the effect of cumulative community violence exposure (CVE) at T1 on proactive relational aggression at T2. The solid line represents a significant slope, and the dashed line represents a nonsignificant slope. High PEP-R (i.e., PEP lengthening; SNS inhibition) represents 1 SD above the sample's mean and low PEP-R (i.e., PEP shortening; SNS activation) represents 1 SD above the sample's mean.