

# Moderating effects of childhood maltreatment on associations between social information processing and adult aggression

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**Background.** Associations between early life maltreatment, social information processing (SIP) and aggression in childhood and adolescence have been widely documented. Few studies have examined the importance of childhood maltreatment independent of SIP in the etiology of adult aggression. Furthermore, moderating effects of childhood maltreatment on the SIP–aggression links have not been explored.

**Method.** Hierarchical, multi-level models were fitted to data from  $n=2752$  twins aged 20–55 years from the PennTwins Cohort. Adult aggression was assessed with the Life History of Aggression questionnaire. Childhood maltreatment was measured using the Childhood Trauma Questionnaire. Two aspects of SIP were examined: hostile attribution biases (HAB); negative emotional responses (NER).

**Results.** Childhood maltreatment was positively correlated with adult aggression, independently of HAB and NER. In addition, childhood maltreatment moderated the relationships between both aspects of SIP and adult aggression. Specifically, the relationship between NER and aggression was stronger among individuals with higher levels of childhood maltreatment and NER was not associated with aggression for adults who experienced low levels of childhood maltreatment. Moderating effects of childhood maltreatment on the NER–aggression link were supported for total childhood maltreatment, emotional neglect and emotional abuse. In contrast, HAB was more strongly associated with adult aggression at lower levels of emotional abuse and physical neglect.

**Conclusions.** The current study provides insight into the mechanisms by which early life experiences influence adult aggression. Our findings suggest that childhood maltreatment may not only lead to increased levels of aggression in adulthood but may also modify the associations between SIP and adult aggression.

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**Key words:** Adult aggression, childhood maltreatment, hostile attribution biases, moderation, negative emotional responses.

## Introduction

Childhood maltreatment, namely, early life experiences of being neglected or abused by family members, is a serious social concern. Altogether, >1.25 million children (i.e. one in every 58 children) in the United States experienced maltreatment during 2005–2006 (Sedlak *et al.* 2010). Maltreatment not only impedes normal child development but also has detrimental effects on the development of later psychological disorders and behavioral problems. In particular, the long-term consequences of childhood maltreatment on adult aggression, defined as behavior directed toward another that is intended to cause

harm (Berkowitz, 1993; Anderson & Bushman, 2002), have been widely documented (e.g. Widom, 1989; Nicholas & Bieber, 1996; Loos & Alexander, 1997; Frazzetto *et al.* 2007; Taft *et al.* 2008; Berzenski & Yates, 2010).

In his review, Briere (2002) concluded that childhood maltreatment affects multiple aspects of social-emotional development in adolescence and adulthood, including negative cognitive schema regarding self and others, conditioned associations between abuse stimuli and emotional distress, cognitions/memories of maltreatment events triggered by unpleasant environmental stimuli and insufficiently developed affect regulation. All of these traumagenic mechanisms are closely associated with cognitive processes involved in social information processing (SIP). Therefore, current models of the effects of childhood maltreatment have identified SIP as an important factor underlying individual differences in aggression.

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The SIP model (Dodge, 1986; Crick & Dodge, 1994) delineates six steps of SIP: (1) encoding (i.e. attention to situational and internal cues); (2) interpretation and mental representation of these cues (e.g. attributions of intent); (3) clarification of goals (i.e. rationalization of the goals and desired outcome of a provocative situation); (4) response access or construction (i.e. generation of possible responses); (5) response evaluation and decision (i.e. determination of the quality of each alternative response and evaluation of the likelihood that each alternative will produce the desired outcomes); (6) behavioral enactment (Crick & Dodge, 1994). Biased processing during any of the six steps of the SIP model may lead to aggressive behavior (Dodge, 1986; Crick & Dodge, 1994; Orobio de Castro *et al.* 2002). To date, studies have provided ample evidence for the utility of SIP in the explanation of aggressive behavior in children and adolescents (e.g. Dodge & Crick, 1990; Quiggle *et al.* 1992; Pettit *et al.* 2001) and adults (e.g. Matthews & Norris, 2002; Basquill *et al.* 2004; Miller & Lynam, 2006; Bailey & Ostrov, 2008; Chen *et al.* in press), with many studies focusing on an individual's attributions of another's intent in social situations. Research consistently demonstrates a positive relationship between hostile attribution biases (HAB) and aggressive behavior (e.g. Dodge, 1980; Dodge & Somberg, 1987; Feldman & Dodge, 1987; Crick 1995; Hubbard *et al.* 2001; Crick *et al.* 2002; Bailey & Ostrov, 2008; Chen *et al.* in press).

SIP is also an integral part of the pathway from childhood maltreatment to later aggressive behavior. In 1990, Dodge and colleagues proposed a SIP model to explain 'the cycle of violence'. They hypothesized that abused children are more likely to develop biased and deficient patterns of SIP, which may, in turn, result in increased levels of aggressive behavior. In support of this view, childhood maltreatment has been associated with inadequate decoding of social cues, increased levels of HAB and favorable evaluation of aggressive responses. These deficits in SIP mediate the effects of early life maltreatment on later aggressive behavior across the lifespan (e.g. Dodge *et al.* 1990, 1995; Weiss *et al.* 1992; Taft *et al.* 2008; Calvete & Orue, 2011). However, evidence generally supports a partial mediation model (Dodge *et al.* 1990, 1995; Weiss *et al.* 1992; Calvete & Orue, 2011), whereby childhood maltreatment predicts later aggressive behavior above and beyond the effects of SIP.

This prior research highlights the importance of controlling for the effects of SIP when examining relationships between childhood maltreatment and later aggressive behavior. The majority of research in this area has focused on childhood and adolescence (but see Taft *et al.* 2008). In addition, most prior research has neglected affective processes, although emotions

have been proposed to be an integral part of the revised SIP model (Dodge, 1991; Crick & Dodge, 1994; Lemerise & Arsenio, 2000). In particular, consistent with Berkowitz's (1990) cognitive-neoassociationistic model of aggression, postulating that negative affect activates cognitive processes associated with aggressive behavior, the revised SIP model highlights the potential effects of negative emotions. In the context of ambiguous social situations, negative emotions can facilitate hostile attribution, distract from relationship-enhancing goals and can make it difficult for people to focus on generating alternative responses or evaluating these alternatives thoroughly (Lemerise & Arsenio, 2000). Empirically, negative emotions, such as anger and sadness, have been positively associated with aggressive behavior (e.g. Dodge & Coie, 1987; Dodge *et al.* 1997; Karatzias *et al.* 2002) and inversely related to cognitive ability to solve problems (e.g. Bodenhausen *et al.* 1994; Pakaslahti, 2000). Therefore, negative emotional responses (NER) should be incorporated and examined in SIP research exploring the cognitive mechanisms underlying aggressive behavior (Coccaro *et al.* 2009).

Finally, no studies to date have considered the potential moderating effects of childhood maltreatment on relationships between SIP and aggressive behavior, although theoretical work and emerging evidence from neurobiological studies suggest that the experience of childhood maltreatment might amplify relationships between deficits in SIP and increases in aggression. According to the self-trauma model developed by Briere (1992, 1996, 2002), a sustained sense of external security is essential for children to develop internal coping strategies for uncomfortable affect states and stressful experiences. Severely abused or neglected children are commonly exposed to enduring emotional pain, which prevents the establishment of a sense of security. Therefore, maltreated children are less likely to develop regulation skills to cope with negative cognitions or emotions (Briere, 2002). Adults who experienced childhood maltreatment may overact to distressing or threatening social cues and may respond to unpleasant cognitions or negative emotional arousal activated by these cues with aggression (Briere, 2002). Consistent with these hypotheses, findings from a growing number of neurobiological studies show effects of early life maltreatment on the development of brain structures that mediate self-regulation, including abnormalities in brain regions governing cognitive and emotional processing, such as the hippocampus, amygdala and prefrontal cortex (Teicher, 2000; Teicher *et al.* 2002; Bremner, 2003; Majer *et al.* 2010). Irregular activities in these brain structures are associated with impairments in emotion regulation and with poor impulse control

(see Lee & Hoaken, 2007 for a review). These neurobiological studies offer a mechanistic explanation for why hostile attributions and/or negative emotions may be more likely to result in aggressive behavior among people who experienced maltreatment in childhood. If individuals with history of maltreatment are less able to regulate their behavioral responses to unpleasant cognitive or emotional evocations, they would be more likely to externalize negative cognitions or emotions triggered during the social interaction. Thus, relationships between HAB and NER with aggression may be stronger in formally abused or neglected adults than among adults who did not experience childhood maltreatment. This hypothesis, however, has not been tested in prior studies.

Using a large, population-based sample of adults, the present study addresses limitations in prior research by examining associations between childhood maltreatment and aggressive behavior controlling for both cognitive (i.e. HAB) and emotional (i.e. NER) processes of SIP and by exploring the moderating effects of childhood maltreatment on the SIP-aggression links. As prior research has documented both cumulative and unique impacts of multiple types of childhood maltreatment on later psychosocial problems (e.g. Briere & Runtz, 1990; Dubowitz *et al.* 2004; Higgins, 2004), the current study considers both overall maltreatment severity as well as individual types of childhood maltreatment (i.e. physical abuse, emotional abuse, physical neglect and emotional neglect).

## Method

### Sample and procedures

Participants were from the PennTwins Cohort, a population-based sample of twins born in Pennsylvania between 1959 and 1978 (Coccaro & Jacobson, 2006). In 1996, a list of 77 012 individuals who were likely to be part of a twin pair based on computerized birth records was cross-referenced with active driving license records, resulting in an address list of 30 801 individuals. Of these 30 801 individuals, 9341 returned consent-to-contact forms. Differences on various demographic characteristics (e.g. age, race/ethnicity, household income) between individuals who consented to participate and those who were unresponsive or could not be located were negligible and non-systematic (Coccaro & Jacobson, 2006).

These 9341 twins were mailed a brief questionnaire containing basic demographic questions. Altogether, 7282 twins returned this questionnaire (response rate ~76%). Differences between twins whose co-twins did and did not return the demographic questionnaire indicate that twin pairs were slightly more likely

to be younger, female, Caucasian and unmarried (Coccaro & Jacobson, 2006). The Behavioral Health Questionnaire (BHQ), including the childhood maltreatment, SIP and aggression measures examined in the current study, was then sent to all twin pairs in which both twins had returned the demographic questionnaire ( $n=4204$ ). The response rate to the BHQ was 70–75%. BHQ data are currently available for 3070 participants. The multi-level regression models used in the current study require that missing data be processed with listwise deletion, resulting in a final study sample of  $n=2752$  participants aged 20–55 years (58.5% females). Analyses compared characteristics of the participants in the final sample with non-participants who provided BHQ data but were not included in the analyses. No significant differences ( $p>0.05$ ) were found in key demographic characteristics [i.e. age, gender and social economic status (SES)] or levels of aggression.

### Measures

#### Covariates

**Age.** Age was computed using participants' date of birth and the date the BHQ questionnaire was received (mean = 33.18, S.D. = 6.01).

**Gender.** Gender was coded as 0 = female and 1 = male.

**SES.** Participants' SES was measured by their current family income, based on a 6-point scale, where 1 = <\$15000 and 6 = >\$100000. On average, participants in the present study had a family income of \$50000–\$75000 (mean = 4.03, S.D. = 1.30).

**Social desirability.** Social desirability bias was assessed with the Minimization-Denial subscale of the 28-item Childhood Trauma Questionnaire-Short Form (CTQ; Bernstein *et al.* 1994), a self-report questionnaire for retrospective report of childhood maltreatment. The Minimization-Denial subscale consists of three items designed to identify individuals with a tendency to give socially desirable responses or produce false negative reports (e.g. 'When I was growing up, I had the perfect childhood'; Bernstein & Fink, 1998). Responses were given in a 5-point Likert scale (i.e. 1 = never true to 5 = very often true). A social desirability score was computed using the sum of the responses to the three items ( $\alpha=0.75$ , mean = 9.92, S.D. = 2.92).

#### Predictors

**Childhood maltreatment.** The remaining 25 items from the CTQ asked participants to rate statements about

**Table 1.** Prevalence of childhood maltreatment

	Physical abuse		Emotional abuse		Physical neglect		Emotional neglect		Sexual abuse	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
None	73.9%	77.6%	69.1%	59.9%	80.8%	82.2%	56.8%	63.6%	91.3%	86.4%
Low	17.1%	11.4%	21.6%	22.7%	12.0%	9.3%	31.2%	22.4%	4.2%	3.6%
Moderate	6.2%	6.3%	4.7%	8.6%	5.4%	5.2%	7.9%	7.2%	2.7%	4.7%
Severe	2.8%	4.7%	4.6%	8.8%	1.8%	3.3%	4.1%	6.8%	1.7%	5.3%

Clinical cut-offs for each type of childhood maltreatment are as follows – none: emotional abuse (5–8), physical abuse (5–7), sexual abuse (5), emotional neglect (5–9), physical neglect (5–7); low: emotional abuse (9–12), physical abuse (8–9), sexual abuse (6–7), emotional neglect (10–14), physical neglect (8–9); moderate to severe: emotional abuse ( $\geq 13$ ), physical abuse ( $\geq 10$ ), sexual abuse ( $\geq 8$ ), emotional neglect ( $\geq 15$ ), physical neglect ( $\geq 10$ ).

their childhood experiences of five types of maltreatment, including physical neglect (e.g. ‘I didn’t have enough to eat’;  $\alpha=0.75$ ), emotional neglect (e.g. ‘I felt unloved’;  $\alpha=0.92$ ), physical abuse (e.g. ‘I was punished with a belt, a board, a cord, or some other hard object’;  $\alpha=0.75$ ), emotional abuse (e.g. ‘People in my family said hurtful or insulting things to me’;  $\alpha=0.87$ ) and sexual abuse (e.g. ‘Someone tried to make me do sexual things or watch sexual things’;  $\alpha=0.95$ ), on a 5-point Likert scale (i.e. 1=never true to 5=very often true). Prevalence rates for each type of childhood maltreatment are shown in Table 1. We excluded sexual abuse from the analyses as it has the lowest prevalence rates and weak correlations with other types of childhood maltreatment ( $r$  ranges from 0.29 to 0.31).<sup>†</sup> Cumulative prevalence rates of the other types of childhood maltreatment indicated that 44.8% of participants did not experience any of the four types of maltreatment and 23.3% reported at least one incident of moderate-to-severe abuse or neglect. For analyses, a total childhood maltreatment score was computed by summing responses to the 20 items measuring physical neglect, emotional neglect, physical abuse and emotional abuse ( $\alpha=0.93$ ). Scores for subtypes of maltreatment were created using the sum of the five items assessing each type of maltreatment respectively. Mean CTQ scores and prevalence rates are similar to those observed in other community-based samples (Bernstein & Fink, 1998).

*SIP (HAB and NER).* HAB and NER were measured by the Social Information Processing-Attribution and Emotional Response Questionnaire (SIP-AEQ; Coccaro et al. 2009). Based on similar protocols used in studies of children (Crick, 1995; Crick et al. 2002; Fite et al. 2008; Lansford et al. 2010), the SIP-AEQ consists of written descriptions of eight vignettes describing

ambiguous social situations, designed specifically for adults. Each vignette was followed by two questions assessing direct (e.g. ‘This person wanted to physically hurt me’) and indirect (e.g. ‘This person wanted to make me look bad’) hostile intent. Responses were given in a 4-point Likert scale ranging from 0=not at all likely to 3=very likely. The scale score for HAB was computed by summing responses of the two questions across all eight vignettes ( $\alpha=0.87$ ). Direct and indirect hostile intent correlated  $r=0.77$  ( $p<0.001$ ). The test–retest correlation of HAB over an average of 23.5 months (s.d.=14.7) in a subsample of  $n=336$  individuals from the current study was 0.65 ( $p<0.001$ ).

Each of the eight vignettes was also followed by two items reflecting anger (i.e. ‘How likely is it that you would be angry if this happened to you?’) and embarrassment or upset (i.e. ‘How likely is it that you would be embarrassed if this happened to you?’), measured using a 4-point Likert scale (i.e. 0=not at all likely to 3=very likely). A total NER score was created using the sum of the responses of the two items across all eight vignettes ( $\alpha=0.85$ ). Angry and embarrassed responses correlated  $r=0.50$  ( $p<0.001$ ). The test–retest correlation of NER was 0.71 ( $p<0.001$ ).

### Outcome

*Adult aggression.* Adult aggression was measured by the aggression subscale of the Lifetime History of Aggression Questionnaire (LHA; Coccaro et al. 1997), a measure of trait tendency to engage in aggressive behavior that is generally stable over the lifetime. The LHA measure has been used in prior research with both clinical and normal subjects (e.g. Coccaro et al. 1997; Lee et al. 2009; Almeida et al. 2010; Coccaro & Kavoussi, 2010). The LHA captures both clinical and sub-clinical levels of aggression and was specifically designed to minimize the typically non-normal

<sup>†</sup> The notes appear after the main text.

distribution of aggressive behavior (Coccaro *et al.* 1997). The aggression subscale of LHA (LHA-AGG) contains five items related to adult frequency of temper tantrums, general fighting, specific physical assault, specific property assault and verbal assault (e.g. 'Since you were 18 years old, how many times had you gotten into physical fights with other people'). Each item was rated on a 5-point Likert scale, ranging from 0=no occurrences to 5=more occurrences than can be counted. The LHA-AGG has good concurrent validity (with both Buss-Durkee Hostility Inventory and Overt Aggression Scale-Modified), internal consistency, inter-rater reliability and test-retest reliability (Coccaro *et al.* 1997). A total aggression score was computed by summing the responses of the five items ( $\alpha=0.75$ ). LHA aggression scores >12 indicate clinically significant levels of lifetime aggression (Coccaro *et al.* 1997); 18.8% of current participants had scores >12, which is in between rates observed in samples of healthy volunteers and samples of patients with personality disorders (e.g. Coccaro *et al.* 1997, 2010; Lee *et al.* 2009).

#### Plan of analyses

Multi-level modeling using SPSS (Peugh & Enders, 2005) was implemented to account for non-independence between participants in the same family. Specifically, participants were identified by their own personal ID and by the family ID they shared with their co-twins. By incorporating the family ID as a random effect, the variance in aggression can be decomposed into variance attributable to differences between individuals and variance due to differences between families, the latter of which are accounted for by the random effect (Teachman & Crowder, 2002). The multi-level approach thus accounts for the clustered data and allows the model to produce accurate standard errors and significance tests (Papp, 2004). All study constructs were assessed at the individual level.

Three hierarchical models were specified: an unconditional means model estimating the proportion of variability in aggression that exists between individuals (Model 1); a model examining main effects of total childhood maltreatment and measures of SIP (Model 2); a model exploring interactions between total childhood maltreatment and SIP measures (i.e. childhood maltreatment  $\times$  HAB, childhood maltreatment  $\times$  NER; Model 3). Analyses in Model 3 were repeated for each individual subtype of maltreatment. Total childhood maltreatment, physical abuse, emotional abuse and physical neglect were positively skewed and were log transformed for analyses. To control for the effects of age, gender, SES and social desirability, measures of childhood

maltreatment, SIP and aggression were first regressed onto these variables. Standardized residual scores were then used in multi-level modeling analyses. Hierarchical models were compared using change in log likelihood ( $-2LL$ ) statistics, which follows a  $\chi^2$  distribution. A significant decrease in  $-2LL$  indicates that the test model fit significantly better than the comparison model. Significant interactions were plotted and interpreted using methods outlined by Preacher *et al.* (2006) for calculation of simple slopes at different levels of the moderator variables (Aiken & West, 1991), specifically designed for interpretation of interactions with clustered data.

## Results

### Descriptive statistics and correlations

Table 2 shows descriptive statistics and Pearson correlations between measures of childhood maltreatment, SIP and adult aggression. Measures of childhood maltreatment and SIP were all positively associated with adult aggression. Measures of HAB and NER were strongly correlated, but were only modestly related to childhood maltreatment. Subtypes of childhood maltreatment were strongly correlated.

### Total childhood maltreatment

Results for total childhood maltreatment are shown in Table 3. Findings from Model 1 revealed statistically significant variability in adult aggression between individuals ( $\sigma^2=0.69$ ,  $p<0.001$ ) and between families ( $\tau_{00}=0.31$ ,  $p<0.001$ ), supporting the use of multi-level modeling to correct for sample non-independence. Model 2, including main effects of total childhood maltreatment and SIP measures, fit significantly better than Model 1. Higher levels of HAB and NER were associated with higher levels of adult aggression. Total childhood maltreatment was significantly and positively associated with adult aggression controlling for HAB and NER. The moderating effects of total childhood maltreatment on relationships between SIP measures and adult aggression were tested in Model 3, which had a significantly better fit than Model 2. Total childhood maltreatment moderated the relationship between NER and adult aggression ( $\beta=0.06$ ,  $p=0.002$ ) but not the HAB-aggression link ( $\beta=-0.03$ ,  $p=0.12$ ).

To explore the significant interaction effects, we plotted the relationship between NER and adult aggression as a function of different levels of total childhood maltreatment in Fig. 1a. The simple slopes of NER on adult aggression were estimated at a low level of total childhood maltreatment (1.5 s.d. below



**Table 2.** Descriptive statistics and intercorrelations among main study variables

	1	2	3	4	5	6	7	8
1. Aggression								
2. HAB	0.18***							
3. NER	0.17***	0.53***						
4. Total maltreatment	0.26***	0.18***	0.10***					
5. Physical abuse	0.26***	0.10***	0.02	0.72***				
6. Emotional abuse	0.26***	0.16***	0.13***	0.89***	0.60***			
7. Physical neglect	0.16***	0.17***	0.05***	0.74***	0.47***	0.55***		
8. Emotional neglect	0.19***	0.17***	0.09***	0.90***	0.50***	0.70***	0.64***	
Mean	7.56	14.68	25.49	31.04	6.86	8.54	6.29	9.35
S.D.	4.53	5.95	6.75	10.98	2.55	3.93	2.25	4.22
Min.	0.00	0.00	0.00	20.00	5.00	5.00	5.00	5.00
Max.	25.00	39.00	48.00	98.00	24.00	25.00	24.00	25.00

HAB, Hostile attribution biases; NER, negative emotional responses.

Correlation statistics between adjusted variables are reported.

\*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

**Table 3.** Multi-level regression predicting adult aggression by total childhood maltreatment, HAB and NER

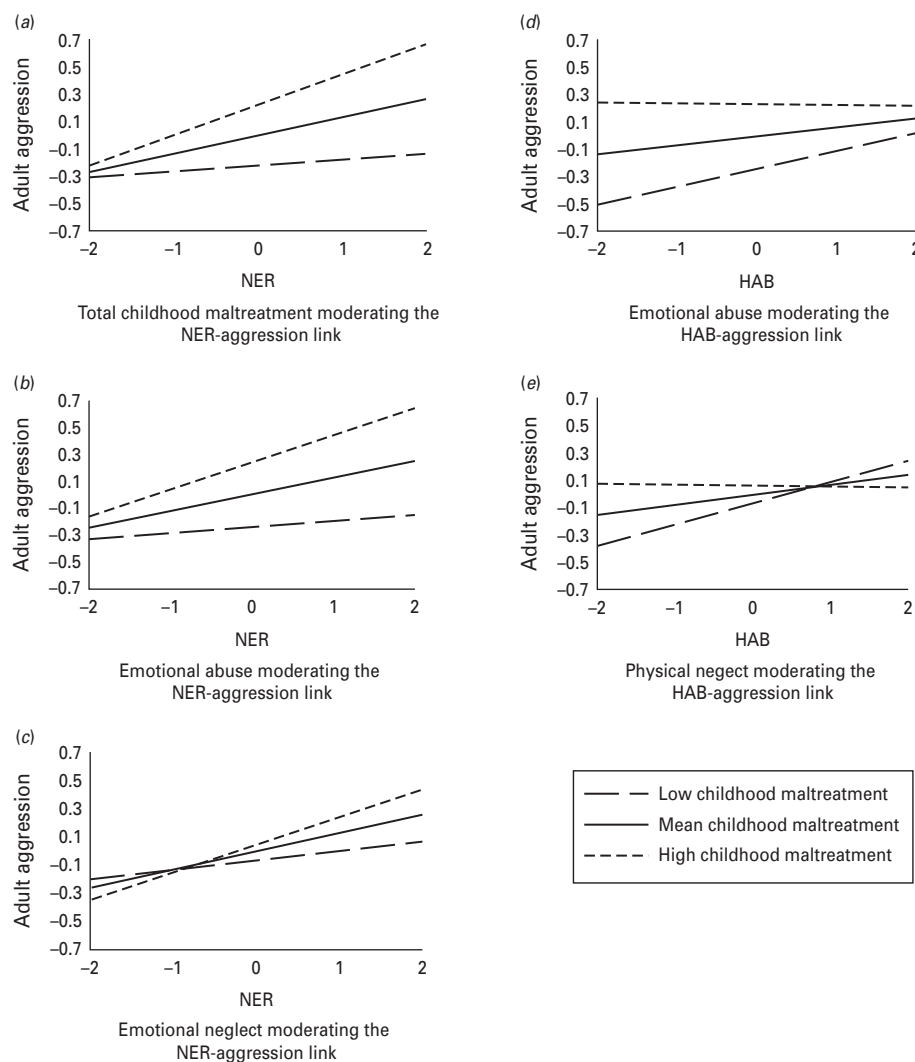
	Model 1		Model 2		Model 3	
	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.
Fixed effect						
Intercept	-0.00	0.02	-0.00	0.02	-0.00	0.02
HAB			0.06**	0.02	0.06**	0.02
NER			0.13***	0.02	0.13***	0.02
Childhood maltreatment			0.14***	0.02	0.14***	0.02
HAB*Maltreatment					-0.03	0.02
NER*Maltreatment					0.06**	0.02
Random effect						
Residual	0.69***	0.03	0.66***	0.03	0.65***	0.03
Intercept	0.31***	0.03	0.28***	0.03	0.28***	0.03
ICC	0.69					
Model fit						
-2LL		7703.29		7549.34		7539.90
Comparison model				1		2
$\Delta$ -2LL				153.95***		9.44**
$\Delta$ df				3		2
Variance explained						
Level 1				4.6%		4.9%

HAB, Hostile attribution biases; NER, negative emotional responses; ICC, intraclass correlation; -2LL, log likelihood.

\*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

the mean), the mean level of total childhood maltreatment and a high level of total childhood maltreatment (1.5 S.D. above the mean). Significant positive associations between NER and adult aggression were found for individuals with the mean ( $\beta = 0.13$ , S.E. = 0.02,  $p = 0.000$ ) and high ( $\beta = 0.22$ , S.E. = 0.04,  $p = 0.000$ ) levels

of childhood maltreatment but not for individuals with the low level of childhood maltreatment ( $\beta = 0.04$ , S.E. = 0.04,  $p = 0.264$ ). Therefore, the relationship between NER and adult aggression was stronger for individuals with higher levels of total childhood maltreatment.



**Fig. 1.** Prototypical plots for moderating effects of childhood maltreatment on relationships between measures of social information processing and adult aggression. Relationships between standardized variables are plotted. Simple slopes of negative emotional responses (NER) were not significant at low levels of total childhood maltreatment, emotional abuse, and emotional neglect. Simple slopes of hostile attribution biases (HAB) were not significant at high levels of emotional abuse and physical neglect.

### Subtypes of childhood maltreatment

Interaction effects between individual subtypes of childhood maltreatment and measures of SIP were also tested. Findings (Table 4) indicated significant interactions of emotional abuse ( $\beta=0.05$ ,  $p=0.007$ ) and emotional neglect ( $\beta=0.04$ ,  $p=0.041$ ) with NER and significant interactions of emotional abuse ( $\beta=-0.04$ ,  $p=0.027$ ) and physical neglect ( $\beta=-0.05$ ,  $p=0.010$ ) with HAB. Fig. 1*b, c* shows that NER had significantly positive associations with adult aggression at the mean and high levels of, but not at the low level of, emotional abuse (low:  $\beta=0.04$ ,  $S.E.=0.04$ ,  $p=0.226$ ; mean:  $\beta=0.12$ ,  $S.E.=0.02$ ,  $p=0.000$ ; high:  $\beta=0.20$ ,  $S.E.=0.04$ ,  $p=0.000$ ) and emotional neglect (low:  $\beta=0.07$ ,  $S.E.=0.04$ ,  $p=0.058$ ; mean:  $\beta=0.13$ ,  $S.E.=0.02$ ,

$p=0.000$ ; high:  $\beta=0.19$ ,  $S.E.=0.04$ ,  $p=0.000$ ). In contrast, Fig. 1*d, e* exhibits that HAB predicted increased levels of adult aggression at the low and mean levels of, but not at the high level of, emotional abuse (low:  $\beta=0.13$ ,  $S.E.=0.04$ ,  $p=0.000$ ; mean:  $\beta=0.07$ ,  $S.E.=0.02$ ,  $p=0.003$ ; high:  $\beta=-0.00$ ,  $S.E.=0.04$ ,  $p=0.964$ ) and physical neglect (low:  $\beta=0.16$ ,  $S.E.=0.04$ ,  $p=0.000$ ; mean:  $\beta=0.07$ ,  $S.E.=0.02$ ,  $p=0.000$ ; high:  $\beta=-0.01$ ,  $S.E.=0.04$ ,  $p=0.839$ ).

### Discussion

The current study examined associations between childhood maltreatment, two aspects of SIP (i.e. HAB and NER) and aggressive behavior in a sample of

**Table 4.** Multi-level regression predicting adult aggression by subtypes of childhood maltreatment, HAB and NER

	Physical abuse		Emotional abuse		Physical neglect		Emotional neglect	
	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.
Fixed effect								
Intercept	0.00	0.02	-0.00	0.02	0.01	0.02	-0.00	0.02
HAB	0.07**	0.02	0.07**	0.02	0.07***	0.02	0.07***	0.02
NER	0.14***	0.02	0.12***	0.02	0.13***	0.02	0.13***	0.02
Childhood maltreatment	0.17***	0.02	0.16***	0.02	0.04*	0.02	0.04*	0.02
HAB $\times$ maltreatment	0.00	0.02	-0.04*	0.02	-0.05*	0.02	-0.00	0.02
NER $\times$ maltreatment	0.04	0.02	0.05**	0.02	0.03	0.02	0.04*	0.02
Random effect								
Residual	0.66***	0.03	0.65***	0.03	0.67***	0.03	0.66***	0.03
Intercept	0.26***	0.03	0.28***	0.03	0.29***	0.03	0.30***	0.03
Variance explained								
Level 1		3.5%		5.0%		3.2%		3.6%

HAB, Hostile attribution biases; NER, negative emotional responses.

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

adults. Effects of both overall levels and subtypes of childhood maltreatment (physical abuse, emotional abuse, physical neglect, emotional neglect) were considered. Our work extends previous research in three important ways. First, the study examined associations between childhood maltreatment, SIP and aggression using an adult sample. Second, the current study examined associations between childhood maltreatment and aggression controlling for both cognitive (i.e. HAB) and emotional (i.e. NER) processes of SIP. Third, to the authors' knowledge, the current study is the first to explore the moderating effects of childhood maltreatment on associations between SIP and aggressive behavior.

We found that childhood maltreatment predicted adult aggression above and beyond the effects of HAB and NER. Consistent with findings from previous work, greater childhood maltreatment was associated with higher levels of aggressive behavior in adulthood (Widom, 1989; Nicholas & Bieber, 1996; Loos & Alexander, 1997; Frazzetto *et al.* 2007; Berzenski & Yates, 2010). Moreover, consistent with studies in childhood and adolescence (Dodge *et al.* 1990; Weiss *et al.* 1992; Dodge *et al.* 1995; Calvete & Orue, 2011), the relationship between childhood maltreatment and aggression persisted after controlling for SIP. Prior studies have generally not considered the relationship between childhood maltreatment and adult aggression independent of SIP, nor have they integrated emotional process into the SIP model. Our study addressed these limitations and provided evidence for a significant association between childhood maltreatment and adult aggression controlling for both the cognitive and emotional aspects of SIP. Taken

together, findings from the current study and previous work suggest that childhood maltreatment may have long-term risks on the development of aggressive behavior.

The current study also explored another possible mechanism through which childhood maltreatment may be linked to later aggression. Specifically, we tested whether childhood maltreatment amplified the risk effects of HAB and NER on adult aggression. Our hypothesis was that formerly abused or neglected adults would show greater correlations between deficits in SIP and aggression because they are more likely to generate aggressive responses to negative cognitions and emotions activated in the social interaction. We found that childhood maltreatment moderated the associations between both aspects of SIP and aggression in adults. Consistent with our hypotheses, NER was more strongly correlated with increased levels of aggression for adults who experienced higher levels of childhood maltreatment. In contrast, NER did not predict aggression among individuals with low levels of childhood maltreatment. Moderating effects of childhood maltreatment on the relationships between NER and aggression were found for both overall levels of childhood maltreatment and for emotional abuse and neglect, but not for physical abuse and neglect. The observed moderating effects of childhood maltreatment on the NER-aggression link support assumptions of the self-trauma model (Briere, 2002), demonstrating that formerly abused or neglected adults may be more likely to externalize negative emotions because maltreatment impedes development of emotion regulation. These results are also consistent with evidence from neurobiological studies that



indicated effects of childhood stressors on abnormalities in the brain structures that undergird emotional processing (Teicher, 2000; Teicher *et al.* 2002; Bremner, 2003; Majer *et al.* 2010). However, our finding that emotional maltreatment but not physical maltreatment moderated relationships between NER and aggression implies that emotional abuse and neglect may be more strongly associated with adjustment problems in emotional domains than are physical abuse and neglect.

Results of the current study also provide evidence for moderating effects of childhood maltreatment on the relationship between HAB and aggression. Although the association between HAB and aggression did not vary as a function of the overall levels of childhood maltreatment, it was moderated by emotional abuse and physical neglect. However, unexpectedly, HAB had a stronger association with aggression among adults who experienced lower levels of emotional abuse or physical neglect during childhood. Moreover, HAB did not predict levels of aggression for adults with high levels of emotional abuse or physical neglect experiences. The observed interactions between childhood maltreatment and HAB could be related to links between childhood maltreatment and impulsivity. Findings from neurobiological studies suggest that childhood maltreatment may result in poor impulse control (e.g. Teicher *et al.* 2002; Majer *et al.* 2010). Aggressive behavior can be explained by both cognitively controlled factors (e.g. SIP) as well as automatic and thoughtless processes, such as impulsivity (Berkowitz, 2008). Furthermore, behavioral decisions may become automatic and involve minimal cognitive processing at high levels of impulsivity (Fontaine & Dodge, 2006). Therefore, it is possible that individuals who experienced higher levels of childhood maltreatment are more likely to react automatically to negative emotions, instead of generating responses based on cognitively processed information (e.g. cognitive attribution of intentions), because they have higher levels of impulsivity. On the other hand, given that interactions between childhood maltreatment and HAB were not supported for overall levels of childhood maltreatment, and moderating effects are in the opposite direction of our results on NER, we cannot rule out the possibility of a stochastic effect, so these results should be interpreted with caution.

### Conclusions and limitations

Results from the current study support significant associations between childhood maltreatment and aggressive behavior in adulthood, even after controlling for deficits in social-emotional information processes.

The findings also provide insight into another mechanism by which early life maltreatment may be linked to adult aggression, namely, via modification of relationships between SIP and aggression. Our study is the first to examine the moderating effects of childhood maltreatment on the SIP-aggression links. Thus, the interactions between childhood maltreatment and the two aspects of SIP found in the current study should be replicated in other samples. While interactions were found for certain maltreatment subtypes, but not others, prior studies (including the present study) have documented a strong overlap between different types of childhood maltreatment (Higgins & McCabe, 2000) and it has been proposed that understanding the impact of the overall degree rather than the specific type of maltreatment may be of greater importance for research on childhood maltreatment (Higgins, 2004). Thus, variations in moderating effects across different types of childhood maltreatment observed in the current study should not be over-emphasized, especially given the lack of comprehensive theory and consistent empirical evidence for the specific consequences of the subtypes of maltreatment (Higgins, 2004). Nevertheless, findings from the current study suggest that, in order to thoroughly capture relationships between childhood maltreatment, SIP and aggression, future research should take into account moderating effects of different aspects of early life maltreatment on the SIP-aggression links.

The study has several limitations. First, the sample is modestly skewed towards younger, female, and unmarried adults. Likewise, given the racial/ethnic distribution of Pennsylvania during the subjects' birth years, results may not generalize to minorities. Second, the present study only taps into two aspects of the full SIP model, and our measure of SIP was based on forced-choice items. Furthermore, both the self-trauma model and findings from the neurobiological studies highlight the importance of emotion regulation. Our aggression measure also did not provide a precise assessment of different forms of aggression (e.g. reactive vs. proactive aggression, direct vs. indirect aggression). Thus, the moderating effects of childhood maltreatment on the SIP-aggression links should be further explored by including other aspects of SIP, by using measures that capture the spontaneous patterns of SIP in the real world, by considering the role of emotion regulation, and by examining variations in these effects across different forms of aggression.

Our study also used a cross-sectional design and relied on adults' retrospective reports of childhood maltreatment. Because data on childhood maltreatment, SIP and aggression were collected at the same point in time, causal relationships between these study

constructs cannot be addressed. Aggressive individuals could develop more negative patterns of SIP. Self-reports of childhood maltreatment may also be biased by patterns of HAB and NER, as individuals with greater deficits in SIP may be more likely to remember instances of abuse and neglect and/or to perceive childhood maltreatment that has not occurred. However, it is unclear how these issues would bias the interaction effects between childhood maltreatment and SIP observed in the present study. Retrospective reports of childhood maltreatment are also subject to recall bias. For example, there is evidence that effects of childhood maltreatment on drug abuse are strongest in studies using retrospective self-reports, compared with prospective studies using official records (Widom *et al.* 1999). However, cases reported to child protection agencies are more likely to be from the low SES families and to represent very severe maltreatment, which limit the generalizability of the findings based on official records. The CTQ is a well-established assessment of childhood maltreatment known for its validity and reliability and allows for assessment of a broad range of childhood maltreatment in both clinical and general population samples. Nevertheless, future longitudinal prospective studies that span childhood to adulthood are needed to more thoroughly examine causal relationships between childhood maltreatment, SIP and adult aggression.

### Clinical implications

The present study is the first analysis of moderating effects of childhood maltreatment on SIP-aggression links in a large population-based sample of adults. Our findings have important clinical implications. The associations between childhood maltreatment and adult aggression observed in the current study suggest that early prevention of aggressive behavior may be especially important for children who experienced maltreatment and that knowing patients' history of childhood neglect or abuse may facilitate treatment of aggressive behavior in adults. Furthermore, the moderating effects of childhood maltreatment on the SIP-aggression links highlight the importance of developing effective prevention and intervention programmes based on SIP, with special focus on emotional processes, for individuals who experienced childhood maltreatment to help them develop more appropriate responses to social and emotional stimuli.

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### Declaration of Interest

None.

### Note

- <sup>1</sup> Analyses have been repeated for sexual abuse. Results provided no evidence for interaction effects between this type of childhood maltreatment and both aspects of SIP.

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