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Angry or Neutral, It Does Not Matter to Me: Implicit Processing of Facial Emotions Is Not Related to Peer Victimization Experiences

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The aim of this study was to examine whether prolonged victimization relates to differential processing of emotions. Based on the social information processing theory, it was hypothesized that prolonged victimization would modulate emotion processing, such that victimization relates to a heightened attentional focus toward negative facial expressions and increased amygdala activation in response to negative facial expressions. We targeted a unique sample of 83 children (M_{age} = 10.6, 49.4% girls) whose victimization history in the past 2 years was available. An Emotional Dot-Probe Task and an Emotion Processing fMRI Task were administered to the participants. Findings included that victimization did not relate significantly to a heightened attentional focus on happy, angry, or fearful expressions. Viewing facial expressions resulted in the activation of the posterior medial frontal cortex, bilateral insula, bilateral fusiform face area, and the right amygdala and hippocampus, which was not related to victimization, nor was victimization related to activation in the amygdala or the social brain regions (medial prefrontal cortex, temporoparietal junction, precuneus, posterior superior temporal sulcus) when viewing specific emotional (happy, angry, afraid, sad) expressions. Together, these results do not provide evidence that implicit emotion processing without social context relates to victimization. Future research should replicate these results and further examine emotion processing in relation to severe victimization experiences and support systems, such as friendships or parenting, on emotion processing.

Keywords: victimization, bullying, emotion processing, expressions, social information processing

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Late childhood to adolescence is a highly sensitive period for social development where peers become increasingly important. Therefore, being bullied by peers, that is, being the receiver of repeated intentionally aggressive or hurtful behavior by one or more powerful peers (Olweus, 1993), is a particularly important stressor. Victimization is related to decrements in both short- and long-term well-being (Arseneault, 2018), such as higher levels of internalizing (Reijntjes et al., 2010) and externalizing problems (Reijntjes et al., 2011). Victims of bullying also have negative social–cognitive styles, meaning that they generally interpret social situations more negatively, indicated by stronger hostile attribution biases or judging peers as less trustworthy (Kellij et al., 2022). However, we still know little about attentional processes in relation to victimization whereas the emotional expressions of others are crucial for interpreting social situations (Damon et al., 2020; Grossmann, 2015). A better understanding of attentional aspects of social information processing in relation to victimization is promising for understanding the mechanisms that might underlie prolonged victimization and its

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links with adverse outcomes. Therefore, in this study, we aimed to examine attentional processing of emotional cues and their behavioral and neural underpinnings in relation to victimization.

The social information processing (SIP) theory describes the processes that guide social behavior in interactions with others (Crick & Dodge, 1994) and provides a guideline for the various steps that contribute to social behavior. According to this model, the first step in processing social cues is encoding, which involves attention to and registration of social cues. Next, the (attended) social cues need to be interpreted together. Afterward, appropriate and fitting behavior for the situation need to be thought of (goal setting, generating possible responses, evaluating which response would be best, and executing that best response). Last, there is the database, existing of schemas, knowledge, and memories, which influences each cycle of encoding, interpretation, and response and is updated during each new cycle. As all steps build one upon another, it is important to examine how victimization might relate to social behavior from the very first step, that is, encoding.

One aspect of face-to-face social interaction that conveys crucial information about the other person's thoughts and motivations is their facial expression (Adolphs, 1999). Within social scenes, people are highly attentive to other persons (Birmingham et al., 2008; Foulsham & Sanderson, 2013; Shen & Itti, 2012). The specific expressions that are attended to can, according to the SIP model, influence the understanding of the social situation and, therefore, crucially influence the perceiver's social behavior yet can also be influenced by previous experiences (database). Victims have been found to have a more negative social–cognitive style (Kellij et al., 2022), which may already start in the encoding phase, being more inclined to attend to threatening cues, are likely to lead to perceiving more threats (and less safety) and to base interpretations of social situations primarily on these threatening cues. If this happens repeatedly, it may lead to a more threatening worldview, which (in turn) influences future social interactions and may increase the focus on negative social cues (Kellij et al., 2022). Initially, victims may not have such a focus. It is likely to be a consequence of repeated (victimization) experiences that tune their attentional focus to negative social cues. In addition, being attuned to threats may be an adaptive response to become aware of threats early and to prevent (further) escalation. To find possible targets for interventions regarding the SIP of victims, we need to understand when victims start to diverge in their SIP and thus further examine the encoding phase. One of the first social cues to notice in social situations are facial expressions of others. Therefore, the main aim of our study was to examine how (prolonged) peer victimization experiences relate to the processing of facial expressions both at the behavioral level (attention) and neural level (brain activity).

Attention to Facial Expressions

Measurements of attention toward facial expressions can be used to assess encoding of facial expressions. Attention to facial expressions has been typically assessed by the Emotional Dot-Probe paradigm (MacLeod et al., 1986). In this paradigm, participants are presented with two parallel pictures of an emotional and a neutral face, after which a target appears at the location of one of these pictures. Participants are asked to react to the target stimulus as quickly as possible as in this task attention is measured through reaction times. The underlying assumption is that participants react faster to targets that appear at the location of the facial stimulus that they were already attending to. If participants are faster in responding to targets at the location of the emotional stimulus than that of the neutral stimulus, they likely attended primarily to the emotional stimuli. When participants are consistently faster in reacting to one of the two simultaneously presented facial stimuli, this is called an attentional bias.

Based on the SIP theory, certain emotional expressions might be particularly salient for individuals based on their previous experiences. For example, traumatic experiences related to an attentional bias for negative facial expressions (Gibb et al., 2009; Kaiser et al., 2020). Similarly, lonely individuals have an attentional bias toward negative facial expressions (Vanhalst et al., 2017) and anxious individuals show a larger attentional bias toward threatening stimuli than nonanxious individuals (Bar-Haim et al., 2007; Frewen et al., 2008; Yiend, 2010). Anxious children seem to have attentional biases toward general threats, such as physical threats like theft or social threats like rejection (Dudeney et al., 2015; Puliafico & Kendall, 2006). This bias may extend to negative facial expressions as a large study ($N = 1{,}291$, aged 6–18) found a small yet significant effect toward angry faces (compared to neutral faces) for children with anxiety symptoms (Abend et al., 2018). Additionally, there is evidence that anxiety in youth relates to different neural processing of disgusted (vs. neutral) expressions of others as indicated by increased N2 amplitudes (EEG) to a target location congruent with the disgusted expression and increased P3a amplitude to incongruent disgusted expression and target location (Wauthia et al., 2022). Taken together, studies on anxious youth seem to indicate attentional biases toward threat. To date, only one study has examined associations between attentional biases and bullying victimization experiences (Iffland & Neuner, 2022). In this study, neutral faces were used, half of which were associated with neutral (audio) statements (e.g., The bus is stopping), and half of which were associated with negative and socially threatening statements about the participant (e.g., You're ridiculous) during a conditioning task. When these conditioned neutral faces were used in a Dot-Probe paradigm, victimization was associated with an attentional bias toward neutral faces associated with negative statements but not with neutral statements. These findings suggest that victims are more likely to attend to negative or socially threatening cues, which may extend to negative facial expressions and particularly threatening ones such as angry expressions. In our study, we aimed to extend these prior findings and hypothesized that (prolonged) victimized children are more inclined to attend to negative than neutral facial expressions.

Neural Responses to Facial Expressions

The human brain processes all incoming stimuli and is key to the human experience. Prior research has identified the amygdala as a relevant brain region in emotion processing, in relation to both passive perception, implicit processing of facial expressions, and explicit judgements of emotions (Dricu & Frühholz, 2016). Importantly, the amygdala is implicated during both positive and negative emotion processing, suggesting that it responds to the salience of stimuli and not necessarily to the valence (Goossens et al., 2009; Matsuda et al., 2013; Romund et al., 2016). A recent literature review indicated that victimization may enhance neural sensitivity to social stimuli (Cubillo, 2022). However, to our knowledge, there are only two studies that specifically examined the relation between amygdala responses and victimization in youth (participants aged 12–15 years). In one study on (relational) victimization and emotion processing of fearful and angry faces (vs. a control condition), a Picture-Matching Task was used. Findings included that victimization related positively to increased amygdala activity in response to angry facial expressions and decreased activity to fearful expressions (Swartz et al., 2019). Contrasting results were found in a second study, where no association between amygdala activity and victimization was found during the judgment of positive and negative emotional expressions (Baird et al., 2010). However, these studies both examined short-term victimization experiences and either examined a limited range of emotional expressions (Swartz et al., 2019) or was likely underpowered due to a small sample size (Baird et al., 2010: $N = 14$, age 13–15 years).

More research exists on emotion processing in relation to mood disorders. For example, young individuals (12–24 years old) with depression (vs. healthy controls) showed greater amygdala activity in response to negative facial expressions (Hall et al., 2014; Mingtian et al., 2012). Likewise, in populations with (sub)clinical anxiety, higher levels of amygdala activation to threatening facial stimuli have been found (Frewen et al., 2008) and during facial processing in general (Gentili et al., 2016). Given that victims of bullying in general have higher levels of anxiety and depressive symptoms (Christina et al., 2021), amygdala activation during emotion processing in victims may align with the findings for anxious and depressive individuals. In addition, negative social cues may be more salient to victims (Kellij et al., 2022), which might be reflected in higher amygdala activity when processing negative facial expressions (Goossens et al., 2009; Matsuda et al., 2013; Romund et al., 2016). Therefore, we hypothesized that (prolonged) victimization experiences would relate to increased amygdala activation during the processing of negative emotions.

A limitation in previous neuroscientific research involves the social context. Often different emotions are examined together and contrasted with nonsocial trials (e.g., shape processing), in other words examining a social versus a nonsocial scene. Understanding nuances in social scenes is key for social cognition and functioning. The so-called “social brain” refers to brain regions that are important for social cognition and has been suggested to include the medial prefrontal cortex (mPFC), temporoparietal junction (TPJ), precuneus, and posterior superior temporal sulcus (pSTS; Becht et al., 2021; Mills et al., 2014). A meta-analysis indicates that the mPFC and pSTS are involved when individuals explicitly judge emotional expressions (emotion recognition), and the pSTS is also involved when expressions are passively viewed (Dricu & Frühholz, 2016). Given the importance of emotion processing for social cognition, especially differentiating between specific emotions, the social brain might be a key area in differentiating between specific emotions. As stated previously, victimization seems to enhance neural sensitivity to social stimuli (Cubillo, 2022); therefore, victimization may relate to social brain activity during specific emotion processing (neutral vs. specific emotion). Previous research on emotion processing and victimization only examined social versus nonsocial contrasts (Baird et al., 2010; Swartz et al., 2019) and, therefore, may not have found involvement of the social brain. The specific effect of different emotional expressions, which are crucial for social cognition and may very well relate to social brain activity, has not been examined yet for victims. Thus, in this study, we aimed to extend the prior findings on neural emotion processing by examining whether emotion processing in the amygdala and social brain is modulated by victimization experiences.

The Present Study

Taken together, the aim of our study was to examine the relation between prolonged victimization experiences and implicit emotion processing, both at the behavioral level in terms of attentional focus and at the neural level of brain activity during emotion processing. Based on the SIP theory, we expected that experiences of prolonged victimization would modulate emotion processing. To test this expectation, we targeted a unique sample of children whose victimization history in the past 2 years was available. In line with prior findings, we hypothesized that prolonged victimization would relate to a stronger (behavioral) attentional bias toward negative emotional stimuli as assessed by shorter reaction times to negative than neutral facial expressions. At the neural level, we hypothesized that prolonged victimization would relate to a stronger amygdala response when processing emotional and particularly negative facial expressions. Finally, due to a lack of previous research on the social brain, we explored whether victimization related to heightened responses in the social brain when processing negative facial expressions.

Method

Participants

A total of 83 children (49.4% girls, $M_{age} = 10.6$, range = 7.9–12.8 years) took part in this study who attended elementary schools that participated in the KiVa antibullying program. Children could be included if they were at least 8 years old and provided information on self-reported victimization at least twice in the past 2 years (see the Procedure section below). Children were excluded if they had MRI contraindications (e.g., braces or metal implants) or had epilepsy or took psychotropic medications that could not be skipped for 24 hr. The majority of participants came from highly educated families: 25 participants (30.1%) had caretakers who both had a master’s degree or higher, 28 participants (33.7%) had caretakers with at least a bachelor’s degree, 20 participants (24.1%) had caretakers who had finished the senior general track (or higher) in secondary school or tertiary vocational training, and 10 participants (12%) had caretakers who had finished the vocational track of secondary school or the first 3 years of the senior general track (or higher) in secondary school.

Ten children could not be included in the analyses of the Emotional Dot-Probe Task. For three participants, responses were not recorded due to a technical problem, and the other seven did not have enough correct trials per emotion to calculate general bias scores. The final sample for the behavioral analyses included 73 children (45.2% girls, $M_{age} = 10.7$ years).

Twelve children were excluded from the fMRI analyses. Four children were not able to do the fMRI scans due to anxiety in the scanner environment, and eight participants were excluded due to excessive movement during scanning. The final sample for fMRI analyses thus included 71 children (46.5% girls, $M_{age} = 10.6$ years). Due to the overlap between dropouts in the behavioral and neural analyses, there were in total 64 participants included in both the behavioral and neural analyses (43.8% girls, $M_{\text{age}} = 10.7$ years).

Procedure

Participants were recruited from elementary schools within 100 km of Leiden (The Netherlands) that participated in the KiVa antibullying program. The KiVa program includes a semiannual data collection where children fill out questionnaires on victimization and bullying. First, during the COVID-19 winter of 2020–2021, all 152 schools with the program were contacted and asked to send a letter and a short video about our research project to the parents of all children in Grades 6–8 (U.S. Grades 4–6): five schools (3.3%) could not be reached, 104 schools (68.4%) declined participation, and 43 schools (28.3%) sent the email. Parents could then sign up their children for participating in the study and provide us with consent to access their child's data on bullying and victimization from prior years We received 168 responses: 156 permissions granted (92.8%), 10 permissions denied (6.0%), and two no answer given (1.2%). Among the 156 children who were signed up for participation, we invited children with at least two self-reported measures of victimization in the past 2 years to participate in the study at our lab. A total of 83 children from 23 schools participated between January 2021 and March 2022 in the study (53.2% of all signed up children).

The lab visit started with an information session, where informed consent was obtained from the parents and from participants who were 12 years old ($n = 5$). During this information session (±45 min), participants were also familiarized with the scanning environment in a mock scanner and practiced the MRI Tasks. Afterward, the scanning session (±60 min) took place, followed by several questionnaires and behavioral tasks on the computer (±70 min). The participants received a goody bag with some toys, a compensation of €50, and reimbursement of travel costs. This project received ethical approval from the Medical Ethical Committee Leiden-The Hague-Delft (METC-LDD; Protocol number NL71576.058.19).

Measures

Victimization

The Olweus' Bully/Victim questionnaire was used to measure victimization. The questionnaire provided participants with the definition of bullying, after which participants are asked to indicate how often they were bullied in the past couple of months on a 5-point scale: 1 = *not at all*, 2 = *once or twice*, 3 = *two or three times per month*, 4 = *about once a week*, or 5 = *several times per week*. Next, participants were asked five questions about how often they were bullied in terms of specific types of victimization (i.e., verbal, physical, relational, material, and online).

Victimization was assessed biannually, in the fall and the spring, as part of the antibullying program at school. We also assessed victimization on the day of scanning in the lab. Scale scores were calculated by averaging all six victimization questions. The reliability of the Victimization scale for each wave and the lab visit was high (Cronbach's α ranging between .82 and .91). To calculate the prolonged victimization score of an individual, we averaged all available victimization scores of that individual (see the Open Science Framework at https://osf.io/x32g9/ for the validation of this chosen method). The concurrent victimization score was calculated by averaging all victimization questions administered during the lab visit. An average score of 1 indicates that the individual was not victimized, a score of 2 indicates monthly victimization, and a score of 3 or higher indicates that the individual is victimized weekly or more often across a period of 2 years. For the sensitivity analyses, we categorized participants with prolonged victimization scores of 2 or higher as highly victimized (monthly) and participants with prolonged victimization scores of less than 1.05 as nonvictimized.

Emotional Dot-Probe Task

Attention to emotional stimuli was assessed by the reaction times in the Emotional Dot-Probe Task (Bradley et al., 1998; MacLeod et al., 1986). Four facial expressions (happy, angry, afraid, neutral) of 24 child models (12 girls, 12 boys) from the Dartmouth Database of Children's Faces (Dalrymple et al., 2013) were used in the task. We created 24 neutral–neutral, 24 angry–neutral, 24 happy–neutral, and 24 afraid–neutral pairs of facial expressions (96 pairs in total) in E-Prime 3.0. Each pair was presented twice (with each emotional expression shown once on the left and once on the right), resulting in a total of 192 trials. The trial order was random and divided into three equally long blocks of approximately 2.5 min. Each trial (see Figure 1) started with a fixation cross (jittered between 400 and 800 ms), followed by the pair of facial expressions presented horizontally (100 ms). After the presentation of the facial expressions, a target stimulus of two dots appeared (1,700 ms), either where the emotional expression (congruent trial, see Figure 1 Panel A) or the neutral expression (incongruent trial, see Figure 1 Panel B) was precedingly presented. Participants had to respond whether the target two dots were presented horizontally ("··") or vertically (":") using their right or left index finger. The 100-ms presentation time of facial expressions was chosen to prevent participants from making saccades between the simultaneously presented facial expressions and, hence, to measure implicit attentional capture by facial expressions.

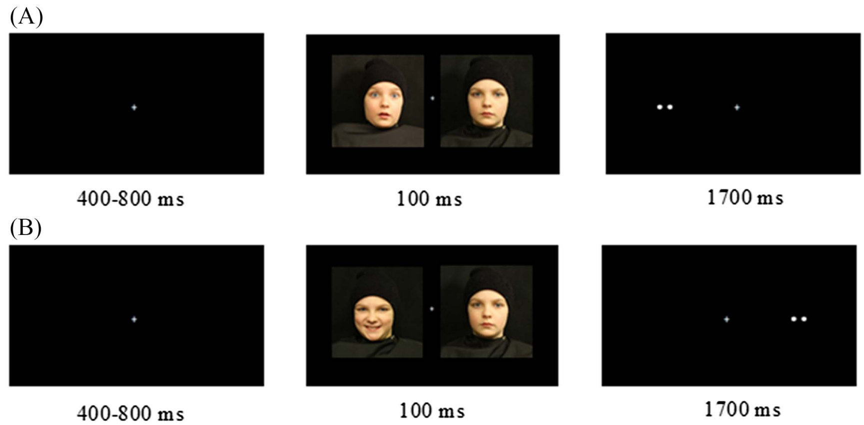
Bias Score Calculation

Attention bias scores were calculated by subtracting the average congruent trial reaction time (RT) from the average incongruent trial RT (i.e., bias score = average RT incongruent trial−average RT congruent trial). These scores can be calculated per emotion (in this article: happy, afraid, angry). Scores larger than 0 indicate an attentional bias *toward* the specific emotion (i.e., faster on congruent trials), thus, a focus on emotions. Scores smaller than 0 indicate attentional bias *away* from emotion (i.e., faster on incongruent trials), thus, a focus on neutral expressions. Only trials with correct responses to the target and with RTs between 100 and 1,500 ms were included in the calculation of the bias scores (Zvielli et al., 2015).

Psychosocial Symptoms

To measure psychosocial symptoms, the short version of the Strengths and Difficulties Questionnaire for children was administered (Goodman, 2001). This questionnaire consists of five items

Figure 1
Emotional Dot-Probe Trial Examples



Note. Example trials of the Dot-Probe Task. Panel A shows an example of a congruent trial (target appears behind the emotional stimulus) with an afraid–neutral pair. Panel B shows an example of an incongruent trial (target appears behind the neutral expression) with a happy–neutral pair. Pictures of faces adapted from "The Dartmouth Database of Children's Faces: Acquisition and Validation of a New Face Stimulus Set," by K. A. Dalrymple, J. Gomez, and B. Duchaine, 2013, *PLOS ONE*, *8*(11), Article e79131 (https://doi.org/10.1371/journal.pone.0079131). CC BY-NC. See the online article for the color version of this figure.

on a scale of 1 = *not true*, 2 = *a little true*, and 3 = *certainly true*, assessing symptoms such as rumination and somatization.

Emotion Processing fMRI Task

At the neural level, emotion processing was assessed using an event-related Emotion Processing Task (van Harmelen et al., 2013) programmed in E-Prime 3.0. On each trial of the task (see Figure 2), participants first saw a black screen (jittered between 500 and 1,500 ms), followed by a face with an emotional expression or a scrambled face with an arrow pointing to the left or right on it (i.e., the control condition) for 2,500 ms. During this stimulus presentation, participants were asked to indicate either the sex of the face in the picture (i.e., a boy or a girl) or the direction of the arrow on the scrambled face (i.e., left or right), using their right or left index finger. In total, there were 166 trials (66 trials with scrambled faces and 100 trials with an emotional face). For the emotional expressions, there were 20 different face models (i.e., 20 different children) each with five different facial expressions (angry, happy, sad, afraid, and neutral). These trials were presented in two runs of approximately 5 minutes each.

MRI Data Acquisition

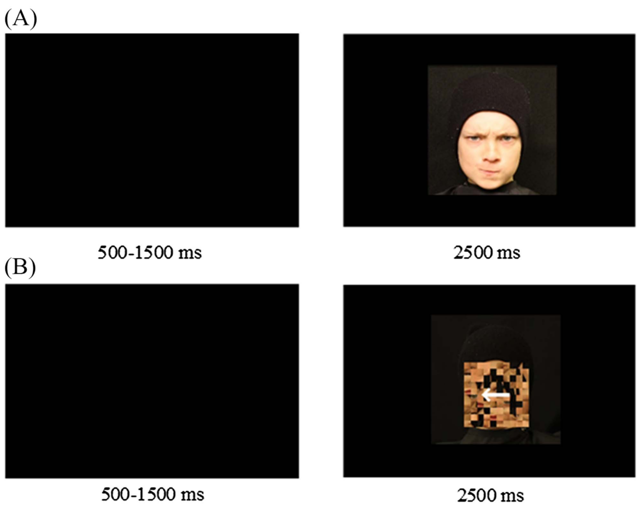
MRI scans were acquired using a 3T Philips Achieva MRI scanner with a standard whole-head coil at the Leiden University Medical Center. The scanning protocol included a localizer scan, a high-resolution 3D T1 scan for anatomical reference (repetition time = 7.9 ms, echo time = 2.5 ms, flip angle = 8°, 240 × 240 × 155 slices, voxel size = 1.04 × 1.04 × 1.10 mm, field of view = 250.00 × 195.83 × 170.50 mm), and functional T2* weighted gradient echo planer images (repetition time = 2.2 s, echo time = 30 ms, 40 transverse parallel slices of 2.75 mm, field of view = 220 × 220 × 120.72 mm, two discarded dummy scans at the start) during two functional runs of 135 volumes each. The stimuli were presented on a screen behind the MRI scanner that was visible through a mirror on the head coil. To minimize head movement, we placed foam pads on both sides of the participant's head inside the head coil. If the participant felt too much pressure and was highly uncomfortable, the foam pads were removed again.

fMRI Preprocessing

Image preprocessing and parts of the analyses were conducted using SPM12 software (https://www.fil.ion.ucl.ac.uk/spm/). Functional images were slice-time corrected (middle slice as reference), realigned to compensate for rigid body motion, spatially normalized to echo planer images T1 templates and resampled to volumes of 3 mm cubic voxels and smoothed with a Gaussian filter of 8 mm full-width at half maximum. All results were reported in Montreal Neurological Institute 305 stereotactic space.

We analyzed the fMRI data using an event-related design. Data were modeled as a series of zero-duration events at the onset of facial stimuli and convolved with a canonical hemodynamic response function. Trials on which the respondent failed to respond were modeled as invalid and excluded from further analyses. Regressors were defined for six events (i.e., neutral, happy, afraid, angry, sad expressions, and control stimuli of scrambled faces) in a general linear model. The model contained a basic set of cosine functions for a high-pass filter (120 Hz) and a covariate controlling for run effects. The least squares parameter estimates of the height of the best fitting canonical hemodynamic response function for each separate condition were used in pairwise contrasts at the subject level. The resulting images were used in higher level group analyses. Whole-brain one-tailed *t* tests were performed in SPM12. Whole-brain analyses were conducted at family-wise error corrected voxel-level

Figure 2
fMRI Task Emotion Processing Example Trials



Note. Example trials of the Emotion Processing fMRI Task. Panel A shows an example of the emotional expression condition (here "angry"), where the respondent is asked to indicate the gender of the depicted child. Panel B shows an example of the control condition with a scrambled face, where the respondent is asked to indicate the direction of the arrow shown. Pictures of faces adapted from "The Dartmouth Database of Children's Faces: Acquisition and Validation of a New Face Stimulus Set," by K. A. Dalrymple, J. Gomez, and B. Duchaine, 2013, *PLOS ONE*, *8*(11), Article e79131 (https://doi.org/10.1371/journal.pone.0079131). CC BY-NC. See the online article for the color version of this figure.

threshold of $p < .001$ and a minimum cluster size of 10 adjoining voxels. Region of interest (ROI) extraction from whole-brain analyses was done with the Marsbar anatomical toolbox (Brett et al., 2002). ROI activity values (whole-brain analyses clusters and predefined ROIs) were calculated with SPM12 and exported to SPSS27 for further analysis.

Statistical Analyses

Behavioral Dot-Probe Task

We conducted a repeated measures analysis of covariance (ANCOVA) with emotion bias scores (three levels) as repeated measures and prolonged victimization and age (compensating for age effects on sustained attention) as covariates. The analysis was repeated with adjusted outliers (M ± 1.5 interquartile range) as a robustness check. Next, as a sensitivity check, we examined whether there was a difference between highly victimized and nonvictimized participants with a repeated measures ANCOVA with emotion bias scores (three levels: happy, angry, afraid) as the within-subjects variable, victimization group (two levels: high vs. low) as between-subjects factor, and age as covariate. As another sensitivity check, we repeated the analyses using concurrent victimization scores obtained during the lab visit. As a further exploratory sensitivity check, we reran the analyses separately for each of the types of victimization included in the questionnaire (name calling, social exclusion/neglect, gossip/reputation, physical harm, cyberbullying, and a general victimization question).

fMRI Task

We first examined neural activity associated with emotion processing based on the face (i.e., all emotional expressions) versus control (i.e., scrambled faces) contrast in a whole-brain analysis. We then exported neural activity from clusters obtained in this contrast (SPM12's MarsBaR toolbox: Brett et al., 2002) and examined their links with prolonged victimization scores in a multivariate regression analysis. Due to a few extreme outliers in the data, we reported the results of the analyses with the outliers adjusted. As a sensitivity check, we examined differences between highly and nonvictimized children with a repeated measures analysis of variance, with the exported activity clusters (face vs. control) as repeated measures and victimization as between-subjects factor. As another sensitivity check, we repeated all analyses using concurrent victimization scores obtained during the lab visit.

Next, we examined neural activity associated with the processing of specific emotions by contrasting emotional faces (i.e., angry, happy, sad, afraid) with neutral faces. We also examined these contrasts within several regions of interest: the bilateral amygdala (Brett et al., 2002) and six regions of the social brain (Mills et al., 2014), namely, the mPFC, the precuneus, pSTS (lateralized), and TPJ (lateralized). We used SPM12's Marsbar toolbox to extract brain activity from these ROIs for each emotion contrasted with the neutral facial expression (i.e., happy–neutral, angry–neutral, afraid–neutral, sad–neutral). We performed two sets of repeated measures ANCOVAs, one conducted for the amygdala with emotion (four levels: angry, happy, sad, afraid) as within-subjects variable and prolonged victimization as covariate and a second analysis conducted for the social brain regions where we included emotion (four levels: angry, happy, sad, afraid) and social brain region (six levels: mPFC, precuneus, right and left pSTS, right and left TPJ) as within-subjects variables and prolonged victimization as covariate. Last, we explored specific expression versus control contrasts (i.e., happy–control, angry–control, afraid–control, sad–control, neutral–control) with separate repeated measures ANCOVAs using neural activity as within-subjects factors and prolonged victimization as between-subjects factor, for all mentioned ROIs (whole brain, amygdala, social brain). We repeated the analyses with victimization as between-subjects factor in repeated measures analyses of variance and with concurrent victimization scores as sensitivity checks. We reported all analyses with the outliers winsorized.

Transparency and Openness

The larger project (https://osf.io/vnxtq) and the present study (https://osf.io/az7n6) have been preregistered on the Open Science Framework; see https://osf.io/wb74c for deviations from the preregistration. We report our detailed inclusion procedure that determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study. Data, matlab scripts and SPSS syntax are available by contacting the corresponding author.

Results

Descriptives

Figure 3 displays the distribution of prolonged and concurrent victimization. Prolonged victimization ranged between 1.00 and

4.11, with an $M = 1.43$ ($SD = 0.53$) for the participants included in the Dot-Probe Task and an $M = 1.44$ ($SD = 0.54$) for the participants included in the fMRI analyses. Both prolonged and concurrent victimization correlated significantly and positively with psychosocial symptoms as measured with the short version of the Strengths and Difficulties Questionnaire ($r_{\text{prolonged}} = .35$, $p < .01$, $r_{\text{concurrent}} = .48$, $p < .001$, respectively). Especially the Strengths and Difficulties Questionnaire items "I am often unhappy, down or in tears" correlated highly with victimization ($r_{\text{prolonged}} = .52$, $p < .001$, $r_{\text{concurrent}} = .60$, $p < .001$) as did "I am afraid of a lot of things, I am quickly anxious" ($r_{\text{prolonged}} = .22$, $p = .047$, $r_{\text{concurrent}} = .35$, $p < .001$). In the Emotional Dot-Probe Task, participants ($n = 73$) had on average 88.3% of the trials correct regarding the orientation of the dots ($SD = 7.00$ percentage points, range = 63.0%–99.0%). RTs ranged between 652.5 and 1162.3 ms ($M = 849.7$ ms, $SD = 107.2$ ms), and participants failed to respond on 0–61 trials ($M = 5.66$, $SD = 9.09$). There was a significant negative correlation between concurrent victimization and the angry bias score (see Table 1), yet it was rendered nonsignificant when controlled for age. During the Emotion Processing fMRI Task, participants included in fMRI analyses failed to respond to an average of 2.51 trials ($SD = 3.35$) and had most of the control trials correct ($M = 97.0\%$, $SD = 10.7$ percentage points).

Behavioral Results

To examine whether a history of victimization was related to a (behavioral) attentional bias, we conducted a repeated measures ANCOVA with the emotion bias scores (happy, angry, afraid) as within-subjects variable and age and prolonged victimization as covariates. All multivariate tests were nonsignificant, emotion: $F(2, 69) = 0.09$, $p = .912$, partial $\eta^2 < .01$; Emotion × Age: $F(2, 69) = 0.09$, $p = .914$, partial $\eta^2 < .01$; Emotion × Victimization: $F(2, 69) = 1.38$, $p = .259$, partial $\eta^2 = .04$. Inspecting the between-subjects effects also proved nonsignificant, age: $F(1, 70) = 0.33$, $p = .566$, partial $\eta^2 = .01$; victimization: $F(1, 70) = 1.28$, $p = .261$, partial $\eta^2 = .02$. Repeating the analyses without adjusted outliers, with the victimization group (highly and nonvictimized) and using the concurrent victimization scores also yielded similar nonsignificant results (see Supplemental Material 1). Repeating the analyses for the separate victimization type questions led to similar nonsignificant results, with one exception: The analyses for the social exclusion or neglect question led to a significant interaction effect with emotion for both prolonged victimization and concurrent victimization, Prolonged Exclusion/Neglect × Emotion: $F(2, 69) = 4.00$, $p = .023$, partial $\eta^2 = .10$; Concurrent Exclusion/Neglect × Emotion: $F(2, 69) = 6.45$, $p = .003$, partial $\eta^2 = .16$, and similar nonsignificant main effects (see Supplemental Material 1).

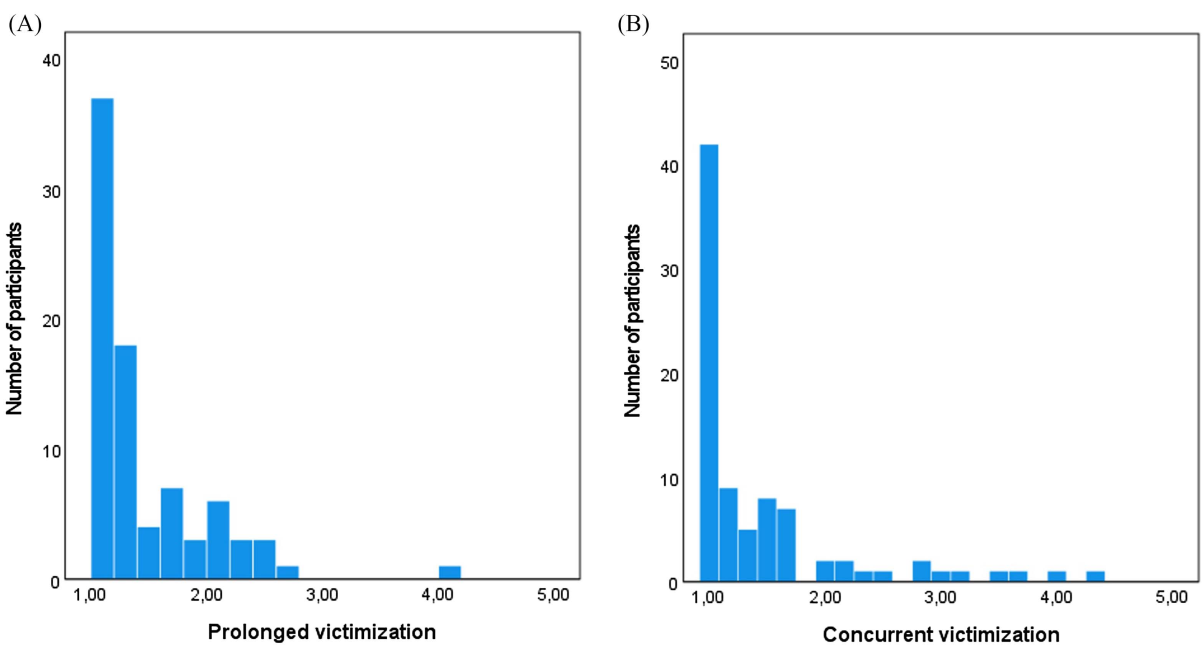
Neural Results

Whole-Brain Analysis: General Emotion Processing

We first examined neural activation during emotion processing with the face (i.e., all emotional expressions) versus control (i.e., scrambled faces) contrast in a whole-brain analysis. The results showed that clusters were active in the posterior medial frontal cortex (pMFC), bilateral insula, bilateral fusiform face area (FFA), and a cluster involving the amygdala and hippocampus in the right hemisphere (see Table 2 and Figure 4).

We then extracted activation from these clusters and conducted a multivariate regression analysis with neural activity from each

Figure 3
Distribution of Victimization Scores



Note. Histograms of prolonged (past 2 years) and concurrent (obtained during the lab visit) victimization scores. See the online article for the color version of this figure.

Table 1
Descriptives and Correlations of Attentional Bias Scores and Victimization

Variable	*n*	*M* (*SD*)	1	2	3	4	5	6
1. Prolonged victimization	83	1.46 (0.53)	—	.77***	−.08	−.23	.06	.35**
2. Concurrent victimization	83	1.46 (0.75)		—	−.02	−.24*	.06	.48***
3. Happy BS	74	4.83 (63.34)			—	−.02	.13	−.02
4. Angry BS	73	−15.55 (68.76)				—	−.14	.16
5. Afraid BS	74	9.45 (67.55)					—	.25*
6. SDQ	83	1.50 (0.41)						—

Note. BS = bias score; SDQ = Strengths and Difficulties Questionnaire five-item version.
* $p < .05$. ** $p < .01$. *** $p < .001$.

cluster as a separate dependent variable and prolonged victimization as the independent variable. The results for the analyses with winsorized outliers showed that prolonged victimization was not significantly related to neural activation during face processing, Multivariate test: $F(6, 64) = 0.77$, $p = .594$, partial $\eta^2 = .07$; right FFA: $F(1, 69) = 1.38$, $p = .244$, partial $\eta^2 = .02$; left FFA: $F(1, 69) = 0.03$, $p = .865$, partial $\eta^2 < .01$; amygdala/hippocampus: $F(1, 69) = 0.73$, $p = .396$, partial $\eta^2 = .01$; pMFC: $F(1, 69) = 0.26$, $p = .614$, partial $\eta^2 < .01$; left insula: $F(1, 69) = 0.55$, $p = .462$, partial $\eta^2 = .01$; right insula: $F(1, 69) = 2.35$, $p = .130$, partial $\eta^2 = .03$. Similar results were found when the outliers were not winsorized and when the highly victimized children were compared with the nonvictimized children (see Supplemental Material 2). We repeated the analyses for concurrent victimization, which led to similar nonsignificant results, with the one exception that, the repeated measures analysis of variance (adjusted outliers) with concurrent highly and nonvictimized children as between-subjects factor, the highly victimized had slightly lower overall neural activity levels, $F(1, 46) = 4.43$, $p = .041$, partial $\eta^2 = .09$; for details see Supplemental Material 2.

ROI Analyses: Emotion-Specific Processing

To examine neural processing for specific emotions, we extracted the amygdala activity for each emotion contrast (i.e., happy–neutral, angry–neutral, sad–neutral, afraid–neutral) and used these as within-subjects factors in a repeated measures ANCOVA, with prolonged victimization as covariate. The analyses with adjusted outliers showed nonsignificant multivariate test, amygdala: $F(3, 67) = 0.65$, $p = .589$, partial $\eta^2 = .03$; interaction: $F(3, 67) = 0.52$, $p = .671$, partial $\eta^2 = .02$, and between-subjects results, $F(1, 69) = 1.01$, $p = .319$, partial $\eta^2 = .01$. Similar results were found when the outliers were not adjusted and when the highly victimized children were compared with the nonvictimized children (see Supplemental Material 2). We repeated the analyses for concurrent victimization, which led to similar nonsignificant results (see Supplemental Material 2).

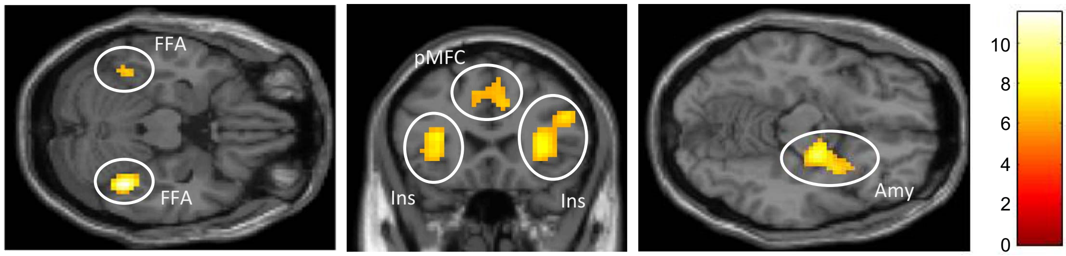
We also extracted neural activity from the social brain regions (bilateral mPFC, bilateral precuneus, lateralized TPJ, lateralized pSTS) for each emotion contrast (i.e., happy–neutral, angry–neutral, sad–neutral, afraid–neutral) and used these as within-subjects factors in a 6 (social brain region) × 4 (emotion) factorial repeated measures ANCOVA, with prolonged victimization as covariate. Neither the multivariate tests nor the between-subjects effects proved significant in the analyses with adjusted outliers, Multivariate tests brain region: $F(5, 65) = 1.07$, $p = .387$, partial $\eta^2 = .08$; Brain Region × Victimization: $F(5, 65) = 1.05$, $p = .396$, partial $\eta^2 = .08$; emotion: $F(3, 67) = 0.68$, $p = .568$, partial $\eta^2 = .03$; Emotion × Victimization: $F(3, 67) = 0.97$, $p = .414$, partial $\eta^2 = .04$; Emotion × Brain Region: $F(15, 55) = 1.73$, $p = .071$, partial $\eta^2 = .32$; three-way interaction: $F(15, 55) = 1.41$, $p = .177$,

Table 2
Clusters of Activities in the Whole-Brain Analysis Facial Expression Versus Scrambled Face Contrast

		Cluster level		Peak level				
						MNI coordinate		
Brain region	L/R	*p* (FWE)	*K*	*p* (FWE)	*T*	*x*	*y*	*z*
FFA	R	<.001	69	<.001	11.53	42	−49	−22
FFA	L	<.001	15	<.001	6.73	−39	−46	−19
Hippocampus	R	<.001	141	<.001	9.29	21	−10	−13
Amygdala	R			<.001	9.24	24	−1	−19
Olfactory	R			<.001	6.74	27	11	−13
Insula	R	<.001	352	<.001	7.98	33	23	5
Frontal inferior operculum	R			<.001	7.89	51	17	26
Frontal inferior triangular	L	<.001	125	<.001	7.70	−33	23	14
Insula	L			<.001	7.35	−33	23	2
pMFC (bilateral)		<.001	256	<.001	7.66	6	14	50
SMA	L			<.001	7.53	−6	14	47
SMA	R			<.001	7.37	3	8	56

Note. L/R = left or right hemisphere; FWE = family-wise error; *K* = voxels in the cluster; MNI = Montreal Neurological Institute; FFA = fusiform face area; pMFC = posterior medial frontal cortex; SMA = supplementary motor area.

Figure 4
Neural Activation During Emotion Processing (Faces vs. Control Contrast)



Note. Clusters of brain activity in the face (i.e., emotion processing including all facial expressions) versus control (i.e., control condition of scrambled faces) contrast. The bilateral fusiform face area (FFA) is represented in the left panel, the bilateral insula (Ins) and posterior medial frontal cortex (pMFC) in the middle panel, and the right amygdala–hippocampus (Amy) cluster in the right panel. See the online article for the color version of this figure.

partial $\eta^2 = .28$; between-subjects victimization: $F(1, 69) = 0.02$, $p = .884$, partial $\eta^2 < .01$. Results were similar without outliers adjusted, when highly victimized were compared with nonvictimized children and when we repeated the analyses with concurrent victimization (see Supplemental Material 2).

Last, to examine whether our results could have been nonsignificant due to limited neural activity differences between emotional and neutral expressions, we explored expression–control contrasts separately for the whole-brain activity clusters that were found in the face–control contrast, the predefined amygdala, and social brain ROIs. These analyses also led to nonsignificant findings (see Supplemental Material 3).

Discussion

The overarching aim of our study was to examine how prolonged experiences of bullying victimization in 8- to 12-year-olds shape attentional processes to facial expressions of unfamiliar peers, both through implicit behavioral responses and neural correlates. Based on the SIP theory and previous research, we hypothesized that emotional and particularly negative facial expressions would attract more attention in victimized children. Similarly, we hypothesized that amygdala activation, which is expected in the processing of emotional stimuli, would be stronger in victimized children. Given the social relevance of facial expressions, we also explored the involvement of the social brain regions in emotion processing in relation to victimization. In contrast to our expectations, we did not find significant associations between prolonged victimization and implicit emotion processing of peers at the behavioral or neural level.

Neural Processing of Implicit Emotion Processing

We examined the underlying neural processing of facial expressions of others. We found that children, regardless of victimization, showed heightened activation in the amygdala and bilateral fusiform areas, as well as in the bilateral insula and the pMFC, during face processing (vs. scrambled face control trials). These results support the validity of the fMRI Task we employed as they were in line with previous results (Dricu & Frühholz, 2016; Tso et al., 2018).

We also examined whether the bilateral amygdala, social brain, and the clusters of brain activity involved in the processing of facial expression (as obtained from the whole-brain analysis: amygdala, bilateral fusiform areas, bilateral insula, pMFC) were differentially involved in the processing of separate emotions. We found no significant differences, neither when the emotional expressions were contrasted with neutral expressions, nor when they were contrasted with the control trials. These findings corroborate previous indications of amygdala implication in the salience of emotional stimuli over valence (Goossens et al., 2009; Matsuda et al., 2013; Romund et al., 2016).

Moreover, our findings also did not provide evidence of differential neural processing between distinct emotions. This finding is roughly in line with other findings. Although a meta-analysis found significant increases in activation for all emotional versus neutral facial expressions (Liu et al., 2021), other meta-analyses on specific emotional versus neutral facial expressions found a large overlap between the involved brain regions (Fusar-Poli et al., 2009) or minimal differences: Only very small regions were rendered significant in contrasts of one versus all other emotions (P. Xu et al., 2021). Furthermore, in our study, we examined implicit processing, as opposed to explicit processing (e.g., labeling emotions). The literature is still somewhat mixed, yet it seems that there are no large increases in activation during implicit emotion processing (Fusar-Poli et al., 2009; Liu et al., 2021), but more likely decreases in activation compared to explicit processing (Fusar-Poli et al., 2009). Higher levels of neural activity for explicit versus implicit tasks have also been found for other aspects of facial depictions like the attractiveness of faces (Iaria et al., 2008). Focusing on unattended aspects, neither increases nor decreases in neural activity have been found during changes in unattended aspects of pictures (Mayer & Vuong, 2013). In line with this finding, attended features have been found to have higher (fMRI) decoding accuracy rates than unattended features (Li et al., 2016). Therefore, in this study the absence of differences between emotions in elicited brain activity might be explained by the examination of implicit emotion processing through specific emotion versus neutral contrasts. To conclude, explicit processing seems to have a more prominent presence in the mind and in neural activity compared to implicit processing. Explicit attitudes related more strongly to behavioral responses than implicit attitudes

(Karpinski & Hilton, 2001). Similarly, explicit emotion processing may relate more strongly to behavioral responses and warrants examination in future studies.

Victimization and Implicit Emotion Processing

We did not find support for the hypothesis that victimization modulates neural activity for processing faces and emotional expressions, neither for prolonged nor current victimization. We also did not find support for the hypothesis that victims would have an implicit attentional bias toward negative facial expressions. Different explanations can underlie these nonsignificant findings.

First, the lack of social context in the tasks may have influenced the results. The Emotional Dot-Probe Task did not involve social aspects, such as responding to the depicted faces. Participants had to respond to the orientation of the dots instead of aspects of the faces, which rendered the faces irrelevant. However, SIP theory implies that individuals will focus on stimuli that are relevant to them. The facial expressions in the Emotional Dot-Probe Task may therefore not have attracted attention, especially given the high performance of the young participants (average accuracy: 88%, average RT: ±850 ms). Furthermore, both the behavioral and fMRI tasks were devoid of social context: Only faces with expressions were present (and target dots in the behavioral task), and there was no depicted social environment or background story. Possibly the mere showing of unknown peers' faces was not specific enough to elicit differential (neural and behavioral) emotion processing for victims, especially while bearing in mind that in SIP theory social cues have meaning together and not in isolation. Indeed, in earlier studies, social context did matter for SIP. For example, a congruent facial expression and background led to more accurate and faster classification of expressions (Milanak & Berenbaum, 2014; Q. Xu et al., 2017) and increased event-related potential amplitudes (Q. Xu et al., 2017) compared to an incongruent expression and background. Subtler differences have been found as well, such as that the respondent's interpretation of the feelings of the depicted person was more in line with the written scenario than the facial expression of the depicted person (Mendolia, 2022). Together, the current nonsignificant behavioral and neural results provide indications that victimization may not relate to significant substantial fundamental differences in implicit emotion processing yet do not eliminate the possibility that differential emotion processing may come into play when emotions take place in a social context, such as in real-life peer interactions.

Second, only very severe and long-term victimization may relate to general implicit emotion processing differences. This would be consistent with the exploratory sensitivity analyses that we conducted on the type of victimization and attentional bias scores. We found that victimization by exclusion had an interaction effect with attentional bias scores for negative expressions. As victimization experiences increased, attentional bias scores for negative expressions began to deviate from 0. In addition, in the present study, we generally averaged across victimization questions (over time and across different types), which, in addition to the less severely victimized sample, likely moderated the extreme victimization scores. Examples of this can be found in the literature: A study with severely (physically and sexually) assaulted adolescents found greater activity in the salience network, including the anterior insula, during emotion processing (Cisler et al., 2019). Most victims in this study were monthly victimized, and only few victims were more often victimized. In addition, all our participants had (at least one) parent(s) willing to accompany them to our facilities for a 3.5-hr visit during the COVID-19 pandemic, which is indicative of having supportive parents. In contrast, persistent victims have been found to have generally lower quality parent–child relationships (Kaufman et al., 2018). Such a positive parental and home environment might counteract the relation between victimization experiences and emotion processing, which could have contributed to the nonsignificant findings.

Third, the developmental stage of our participants may have been of influence. Previous research on emotion processing has been primarily based on studies with adult samples, especially neuroscientific studies (Fusar-Poli et al., 2009; Liu et al., 2021; P. Xu et al., 2021). Moreover, previous research regarding the modulation of mood disorders on neural processing during emotion processing has also mostly examined adults or young adults (e.g., Gentili et al., 2016). A change on neural and behavioral levels of basic attentional processing, such as implicit emotion processing, may require either extremely severe experiences or long continuation of adverse social experiences. Likely, changes first start in a specific situation, and with the continuation of social experiences, it may extend to a broader range of situations and then slowly integrate in fundamental cognitive functioning. Examining late childhood might be too early to detect differentiation on very basic levels of cognitive functioning, like implicit attention.

Finally, it could be that there is no association between victimization history and implicit emotion processing of others' emotions. Explicit processing may generally relate more strongly to neural activation processing (Fusar-Poli et al., 2009; Iaria et al., 2008; Li et al., 2016; Mayer & Vuong, 2013) and behavioral responses (Karpinski & Hilton, 2001) than implicit processing. Unconscious registration of emotions of others may therefore not significantly bait emotional responses of victims. Victims seem to generally have a more negative social–cognitive style, including but not limited to perceiving peers more negatively, attributing more hostile intentions to others' actions, and expecting rejection (Kellij et al., 2022). However, it likely does not derive from differential implicit emotion processing of others. In other words, differences in later SIP phases are unlikely to depend on general implicit emotion processing differences.

Limitations, Strengths, and Concluding Remarks

This study is among the first to examine the associations between victimization experiences in childhood and both behavioral and neural emotion processing. One strength of our study is that we recruited participants with existing data on prior victimization experiences across 2 years. Being able to access existing reports of victimization enabled us to examine effects of prolonged victimization without relying on recall and, hence, reducing memory effects on reports of past victimization. A second strength is the large sample size among elementary school children. A third strength includes the overall robust task effects (i.e., high accuracy in the Dot-Probe Task and activation patterns consistent with the literature during emotion processing in the fMRI task). A final strength of our study is the use of facial expressions of peers (and not adults) in our experimental tasks, which had only been done twice before (Baird et al., 2010; Wauthia et al., 2022). Peers are becoming increasingly important for children in the final years of elementary school (Nelson et al., 2016). Facial expressions of peers might therefore be differentially processed than adult expressions. For example, it was shown that adolescents pay more attention to subtle differences in the emotional expressions of peers but not of adults (Sandre et al., 2022), and children are more distracted by the faces of peers than of adults (Ebner & Johnson, 2010). The behavioral and neural processing of peers' faces (instead of adult faces) might therefore be different in children. These strengths and the task design of our study support the confidence in our conclusions regarding the role of victimization experiences in emotion processing of peers' expressions.

Our study also had some limitations. First, there was a mismatch between the examined emotions in the behavioral and fMRI asks. We did not use sadness in the Emotion Dot-Probe Task to prevent exhaustion of the participants as they already were challenged by the current duration of the experimental task. Future research could include more emotions to further examine implicit emotion processing in relation to victimization. Second, the recruitment and data collection took part during the COVID-19 pandemic, when we were not able to contact parents face-to-face at school information evenings. Our recruitment relied on emails sent out by schools and on parents who read and responded to emails from schools, which likely contributed to the higher socioeconomic status levels in our sample. These circumstances likely led to a skewed sample with relatively few severely victimized (i.e., victimization on a weekly or more frequent basis) participants. Future research should aim to tackle the challenge of including a more diverse group of participants who have more severe victimization experiences and who might also have less optimal parental and home environments.

Conclusion

This study focused on emotion processing and how it relates to prolonged victimization experiences (over 2 years) in 8- to 12-year-old children. The results provided first indications that victimization experiences may not be accompanied by differential implicit processing of emotional expressions of peers. In other words, the mere emotional expression of unknown peers during implicit processing seemed to not be processed differently by victims, neither on a neural nor on a behavioral level. Differences in later SIP phases are, therefore, unlikely to depend on general implicit emotion processing differences. To be able to fully rule out implicit emotion processing differences in prolonged victims, future research should focus on social context (e.g., emotional expressions of classmates), more severe prolonged victimization (e.g., weekly or daily), and support systems of victims (e.g., tough home situation). For now, victims in general, both concurrent and prolonged, seem to implicitly process emotional expressions of peers' faces similarly to their non- or less victimized peers.

References

Abend, R., de Voogd, L., Salemink, E., Wiers, R. W., Pérez-Edgar, K., Fitzgerald, A., White, L. K., Salum, G. A., He, J., Silverman, W. K., Pettit, J. W., Pine, D. S., & Bar-Haim, Y. (2018). Association between attention bias to threat and anxiety symptoms in children and adolescents. *Depression and Anxiety*, *35*(3), 229–238. https://doi.org/10.1002/da.22706

Adolphs, R. (1999). Social cognition and the human brain. *Trends in Cognitive Sciences*, *3*(12), 469–479. https://doi.org/10.1016/S1364-6613(99)01399-6

Arseneault, L. (2018). Annual research review: The persistent and pervasive impact of being bullied in childhood and adolescence: Implications for policy and practice. *Journal of Child Psychology and Psychiatry*, *59*(4), 405–421. https://doi.org/10.1111/jcpp.12841

Baird, A. A., Silver, S. H., & Veague, H. B. (2010). Cognitive control reduces sensitivity to relational aggression among adolescent girls. *Social Neuroscience*, *5*(5–6), 519–532. https://doi.org/10.1080/17470911003747386

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*(1), 1–24. https://doi.org/10.1037/0033-2909.133.1.1

Becht, A. I., Wierenga, L. M., Mills, K. L., Meuwese, R., van Duijvenvoorde, A., Blakemore, S. J., Güroğlu, B., & Crone, E. A. (2021). Beyond the average brain: Individual differences in social brain development are associated with friendship quality. *Social Cognitive and Affective Neuroscience*, *16*(3), 292–301. https://doi.org/10.1093/scan/nsaa166

Birmingham, E., Bischof, W., & Kingstone, A. (2008). Gaze selection in complex social scenes. *Visual Cognition*, *16*(2–3), 341–355. https://doi.org/10.1080/13506280701434532

Bradley, B. P., Mogg, K., Falla, S. J., & Hamilton, L. R. (1998). Attentional bias for threatening facial expressions in anxiety: Manipulation of stimulus duration. *Cognition and Emotion*, *12*(6), 737–753. https://doi.org/10.1080/026999398379411

Brett, M., Anton, J.-L., Valabregue, R., & Poline, J.-B. (2002). Region of interest analysis using the MarsBar toolbox for SPM 99. *NeuroImage*, *16*(2), Article S497.

Christina, S., Magson, N. R., Kakar, V., & Rapee, R. M. (2021). The bidirectional relationships between peer victimization and internalizing problems in school-aged children: An updated systematic review and meta-analysis. *Clinical Psychology Review*, *85*, Article 101979. https://doi.org/10.1016/j.cpr.2021.101979

Cisler, J. M., Esbensen, K., Sellnow, K., Ross, M., Weaver, S., Sartin-Tarm, A., Herringa, R. J., & Kilts, C. D. (2019). Differential roles of the salience network during prediction error encoding and facial emotion processing among female adolescent assaulted victims. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, *4*(4), 371–380. https://doi.org/10.1016/j.bpsc.2018.08.014

Crick, N. R., & Dodge, K. A. (1994). Review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin*, *115*(1), 74–101. https://doi.org/10.1037/0033-2909.115.1.74

Cubillo, A. (2022). Neurobiological correlates of the social and emotional impact of peer victimization: A review. *Frontiers in Psychiatry*, *13*, Article 866926. https://doi.org/10.3389/fpsyt.2022.866926

Dalrymple, K. A., Gomez, J., & Duchaine, B. (2013). The Dartmouth Database of Children's Faces: Acquisition and validation of a new face stimulus set. *PLOS ONE*, *8*(11), Article e79131. https://doi.org/10.1371/journal.pone.0079131

Damon, F., Méary, D., de Haan, M., & Pascalis, O. (2020). Building a face-space for social cognition. In J. Decety (Ed.), *The social brain: A developmental perspective* (pp. 23–40). The MIT Press. https://doi.org/10.7551/mitpress/11970.003.0004

Dricu, M., & Frühholz, S. (2016). Perceiving emotional expressions in others: Activation likelihood estimation meta-analyses of explicit evaluation, passive perception and incidental perception of emotions. *Neuroscience and Biobehavioral Reviews*, *71*, 810–828. https://doi.org/10.1016/j.neubiorev.2016.10.020

Dudeney, J., Sharpe, L., & Hunt, C. (2015). Attentional bias towards threatening stimuli in children with anxiety: A meta-analysis. *Clinical Psychology Review*, *40*, 66–75. https://doi.org/10.1016/j.cpr.2015.05.007

Ebner, N. C., & Johnson, M. K. (2010). Age-group differences in interference from young and older emotional faces. *Cognition and Emotion*, *24*(7), 1095–1116. https://doi.org/10.1080/02699930903128395

Foulsham, T., & Sanderson, L. A. (2013). Look who's talking? Sound changes gaze behaviour in a dynamic social scene. *Visual Cognition*, *21*(7), 922–944. https://doi.org/10.1080/13506285.2013.849785

Frewen, P. A., Dozois, D. J. A., Joanisse, M. F., & Neufeld, R. W. J. (2008). Selective attention to threat versus reward: Meta-analysis and neural-network modeling of the dot-probe task. *Clinical Psychology Review*, *28*(2), 307–337. https://doi.org/10.1016/j.cpr.2007.05.006

Fusar-Poli, P., Placentino, A., Carletti, F., Landi, P., Allen, P., Surguladze, S., Benedetti, F., Abbamonte, M., Gasparotti, R., Barale, F., Perez, J., McGuire, P., & Politi, P. (2009). Functional atlas of emotional faces processing: A voxel-based meta-analysis of 105 functional magnetic resonance imaging studies. *Journal of Psychiatry & Neuroscience*, *34*(6), 418–432.

Gentili, C., Cristea, I. A., Angstadt, M., Klumpp, H., Tozzi, L., Phan, K. L., & Pietrini, P. (2016). Beyond emotions: A meta-analysis of neural response within face processing system in social anxiety. *Experimental Biology and Medicine*, *241*(3), 225–237. https://doi.org/10.1177/1535370215603514

Gibb, B. E., Schofield, C. A., & Coles, M. E. (2009). Reported history of childhood abuse and young adults' information-processing biases for facial displays of emotion. *Child Maltreatment*, *14*(2), 148–156. https://doi.org/10.1177/1077559508326358

Goodman, R. (2001). Psychometric properties of the Strengths and Difficulties Questionnaire. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(11), 1337–1345. https://doi.org/10.1097/00004583-200111000-00015

Goossens, L., Kukolja, J., Onur, O. A., Fink, G. R., Maier, W., Griez, E., Schruers, K., & Hurlemann, R. (2009). Selective processing of social stimuli in the superficial amygdala. *Human Brain Mapping*, *30*(10), 3332–3338. https://doi.org/10.1002/hbm.20755

Grossmann, T. (2015). The development of social brain functions in infancy. *Psychological Bulletin*, *141*(6), 1266–1287. https://doi.org/10.1037/bul0000002

Hall, L. M. J., Klimes-Dougan, B., Hunt, R. H., Thomas, K. M., Houri, A., Noack, E., Mueller, B. A., Lim, K. O., & Cullen, K. R. (2014). An fMRI study of emotional face processing in adolescent major depression. *Journal of Affective Disorders*, *168*, 44–50. https://doi.org/10.1016/j.jad.2014.06.037

Iaria, G., Fox, C. J., Waite, C. T., Aharon, I., & Barton, J. J. S. (2008). The contribution of the fusiform gyrus and superior temporal sulcus in processing facial attractiveness: Neuropsychological and neuroimaging evidence. *Neuroscience*, *155*(2), 409–422. https://doi.org/10.1016/j.neuroscience.2008.05.046

Iffland, B., & Neuner, F. (2022). Peer victimization influences attention processing beyond the effects of childhood maltreatment by caregivers. *Frontiers in Psychology*, *13*, Article 784147. https://doi.org/10.3389/fpsyg.2022.784147

Kaiser, D., Jacob, G. A., van Zutphen, L., Siep, N., Sprenger, A., Tuschen-Caffier, B., Senft, A., Arntz, A., & Domes, G. (2020). Patients with borderline personality disorder and comorbid PTSD show biased attention for threat in the facial dot-probe task. *Journal of Behavior Therapy and Experimental Psychiatry*, *67*, Article 101437. https://doi.org/10.1016/j.jbtep.2018.11.005

Karpinski, A., & Hilton, J. L. (2001). Attitudes and the implicit association test. *Journal of Personality and Social Psychology*, *81*(5), 774–788. https://doi.org/10.1037/0022-3514.81.5.774

Kaufman, T. M. L., Kretschmer, T., Huitsing, G., & Veenstra, R. (2018). Why does a universal anti-bullying program not help all children? Explaining persistent victimization during an intervention. *Prevention Science*, *19*(6), 822–832. https://doi.org/10.1007/s11121-018-0906-5

Kellij, S., Lodder, G., van den Bedem, N., Güroğlu, B., & Veenstra, R. (2022). The social cognitions of victims of bullying: A systematic review. *Adolescent Research Review*, *7*(3), 287–334. https://doi.org/10.1007/s40894-022-00183-8

Li, Y., Long, J., Huang, B., Yu, T., Wu, W., Li, P., Fang, F., & Sun, P. (2016). Selective audiovisual semantic integration enabled by feature-selective attention. *Scientific Reports*, *6*, Article 18914. https://doi.org/10.1038/srep18914

Liu, M., Liu, C. H., Zheng, S., Zhao, K., & Fu, X. (2021). Reexamining the neural network involved in perception of facial expression: A meta-analysis. *Neuroscience and Biobehavioral Reviews*, *131*, 179–191. https://doi.org/10.1016/j.neubiorev.2021.09.024

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*(1), 15–20. https://doi.org/10.1037/0021-843X.95.1.15

Matsuda, Y. T., Fujimura, T., Katahira, K., Okada, M., Ueno, K., Cheng, K., & Okanoya, K. (2013). The implicit processing of categorical and dimensional strategies: An fMRI study of facial emotion perception. *Frontiers in Human Neuroscience*, *7*, Article 551. https://doi.org/10.3389/fnhum.2013.00551

Mayer, K. M., & Vuong, Q. C. (2013). Automatic processing of unattended object features by functional connectivity. *Frontiers in Human Neuroscience*, *7*, Article 193. https://doi.org/10.3389/fnhum.2013.00193

Mendolia, M. (2022). Type of task instruction enhances the role of face and context in emotion perception. *Journal of Nonverbal Behavior*, *46*(1), 99–114. https://doi.org/10.1007/s10919-021-00383-1

Milanak, M. E., & Berenbaum, H. (2014). The effects of context on facial affect recognition. *Motivation and Emotion*, *38*(4), 560–568. https://doi.org/10.1007/s11031-014-9401-x

Mills, K. L., Lalonde, F., Clasen, L. S., Giedd, J. N., & Blakemore, S. J. (2014). Developmental changes in the structure of the social brain in late childhood and adolescence. *Social Cognitive and Affective Neuroscience*, *9*(1), 123–131. https://doi.org/10.1093/scan/nss113

Mingtian, Z., Shuqiao, Y., Xiongzhao, Z., Jinyao, Y., Xueling, Z., Xiang, W., Yingzi, L., Jian, L., & Wei, W. (2012). Elevated amygdala activity to negative faces in young adults with early onset major depressive disorder. *Psychiatry Research: Neuroimaging*, *201*(2), 107–112. https://doi.org/10.1016/j.pscychresns.2011.06.003

Nelson, E. E., Jarcho, J. M., & Guyer, A. E. (2016). Social re-orientation and brain development: An expanded and updated view. *Developmental Cognitive Neuroscience*, *17*, 118–127. https://doi.org/10.1016/j.dcn.2015.12.008

Olweus, D. (1993). *Bullying at school. What we know and what we can do*. Blackwell.

Puliafico, A. C., & Kendall, P. C. (2006). Threat-related attentional bias in anxious youth: A review. *Clinical Child and Family Psychology Review*, *9*(3–4), 162–180. https://doi.org/10.1007/s10567-006-0009-x

Reijntjes, A., Kamphuis, J. H., Prinzie, P., Boelen, P. A., van der Schoot, M., & Telch, M. J. (2011). Prospective linkages between peer victimization and externalizing problems in children: A meta-analysis. *Aggressive Behavior*, *37*(3), 215–222. https://doi.org/10.1002/ab.20374

Reijntjes, A., Kamphuis, J. H., Prinzie, P., & Telch, M. J. (2010). Peer victimization and internalizing problems in children: A meta-analysis of longitudinal studies. *Child Abuse & Neglect*, *34*(4), 244–252. https://doi.org/10.1016/j.chiabu.2009.07.009

Romund, L., Raufelder, D., Flemming, E., Lorenz, R. C., Pelz, P., Gleich, T., Heinz, A., & Beck, A. (2016). Maternal parenting behavior and emotion processing in adolescents—An fMRI study. *Biological Psychology*, *120*, 120–125. https://doi.org/10.1016/j.biopsycho.2016.09.003

Sandre, A., Morningstar, M., Farrell-Reeves, A., Dirks, M., & Weinberg, A. (2022). Adolescents and young adults differ in their neural response to and recognition of adolescent and adult emotional faces. *Psychophysiology*, *59*(9), Article e14060. https://doi.org/10.1111/psyp.14060

Shen, J., & Itti, L. (2012). Top-down influences on visual attention during listening are modulated by observer sex. *Vision Research*, *65*, 62–76. https://doi.org/10.1016/j.visres.2012.06.001

Swartz, J. R., Carranza, A. F., & Knodt, A. R. (2019). Amygdala activity to angry and fearful faces relates to bullying and victimization in adolescents.

Social Cognitive and Affective Neuroscience, *14*(10), 1027–1035. https://doi.org/10.1093/scan/nsz084

Tso, I. F., Rutherford, S., Fang, Y., Angstadt, M., & Taylor, S. F. (2018). The "social brain" is highly sensitive to the mere presence of social information: An automated meta-analysis and an independent study. *PLOS ONE*, *13*(5), Article e0196503. https://doi.org/10.1371/journal.pone.0196503

van Harmelen, A. L., van Tol, M. J., Demenescu, L. R., van der Wee, N. J. A., Veltman, D. J., Aleman, A., van Buchem, M. A., Spinhoven, P., Penninx, B. W. J. H., & Elzinga, B. M. (2013). Enhanced amygdala reactivity to emotional faces in adults reporting childhood emotional maltreatment. *Social Cognitive and Affective Neuroscience*, *8*(4), 362–369. https://doi.org/10.1093/scan/nss007

Vanhalst, J., Gibb, B. E., & Prinstein, M. J. (2017). Lonely adolescents exhibit heightened sensitivity for facial cues of emotion. *Cognition and Emotion*, *31*(2), 377–383. https://doi.org/10.1080/02699931.2015.1092420

Wauthia, E., D'Hondt, F., Blekic, W., Lefebvre, L., Ris, L., & Rossignol, M. (2022). Neural responses associated with attentional engagement and disengagement from threat in high socially anxious children: Evidence from temporal-spatial PCA. *PLOS ONE*, *17*(1), Article e0261172. https://doi.org/10.1371/journal.pone.0261172

Xu, P., Peng, S., Luo, Y. J., & Gong, G. (2021). Facial expression recognition: A meta-analytic review of theoretical models and neuroimaging evidence. *Neuroscience and Biobehavioral Reviews*, *127*, 820–836. https://doi.org/10.1016/j.neubiorev.2021.05.023

Xu, Q., Yang, Y., Tan, Q., & Zhang, L. (2017). Facial expressions in context: Electrophysiological correlates of the emotional congruency of facial expressions and background scenes. *Frontiers in Psychology*, *8*, Article 2175. https://doi.org/10.3389/fpsyg.2017.02175

Yiend, J. (2010). The effects of emotion on attention: A review of attentional processing of emotional information. *Cognition and Emotion*, *24*(1), 3–47. https://doi.org/10.1080/02699930903205698

Zvielli, A., Bernstein, A., & Koster, E. H. W. (2015). Temporal dynamics of attentional bias. *Clinical Psychological Science*, *3*(5), 772–788. https://doi.org/10.1177/2167702614551572

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