Child Development, September/October 2005, Volume 76, Number 5, Pages 968–977

Physically Abused Children's Regulation of Attention in Response to Hostility

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The present study examines the effects of early emotional experiences on children's regulation or strategic control of attention in the presence of interpersonal hostility. Abused children's reactions to the unfolding of a realistic interpersonal emotional situation were measured through multiple methods including autonomic nervous system changes and overt behavioral performance. Although physically abused and non-physically abused 4-year-old children did not differ in terms of their baseline levels of arousal, marked differences in physically abused children's regulatory responses to background anger emerged. These data suggest that the emergence of anger leads to increases in anticipatory monitoring of the environment among children with histories of abuse. Results are discussed in terms of risk factors in the development of psychopathology.

Although the link between experiences of child abuse and behavioral problems has been well-established (Cicchetti & Manly, 2001), the precise mechanisms linking such early experience to the development of psychopathology are not well understood. We have proposed that attentional effects may account for the interpersonal difficulties observed in abused children. Our view is that the continuing influence of childhood affective experiences across developmental epochs may be understood in terms of the general immaturity and neuro-plasticity of sensory and perceptual systems early in development. The relative immaturity and limited capacity of processing resources available to the young child imposes a maturational limitation on how many stimuli the child can take in and understand. But this same limitation, combined with biological preparedness to track certain associations between stimuli and outcomes, may well help children to begin to learn about their social environment. In short, limited capacity would dictate that some aspects of the environment are privileged and thus filtered or selected over others to facilitate rapid learning. This leaves the developmental organization of emotion systems contingent upon features of input that are most learnable, such as signals that are highly salient, frequent, or highly predictable. For the abused child, what is most predictive in the environment may well be species atypical or culturally aberrant—but these features of the environment are what the child is exposed to and learning from, constituting experience-dependent plasticity (Pollak, 2004).

Recent empirical findings provide preliminary support for this theory. For example, physically abused preschool-aged children perceived angry faces as highly salient relative to other emotions (Pollak, Cicchetti, Hornung, & Reed, 2000), displayed broader perceptual category boundaries for perceiving anger than non-abused children (Pollak & Kistler, 2002), and required less visual information than non-abused children to detect the presence of angry facial expressions (Pollak & Sinha, 2002). Event-related potential (ERP) studies reveal that attention to anger distinguishes physically abused children's neural processing of emotion (Pollak, Cicchetti, Klorman, & Brumaghim, 1997; Pollak, Klorman, Thatcher, & Cicchetti, 2001; Pollak & Tolley-Schell, 2003). The tendency of abused children to attend to anger does not itself seem pathognomic because it is adaptive for salient stimuli to elicit attention. Therefore, the present study examines an issue of greater concern: these children's ability to successfully regulate these processes.

This research was supported by a grant from the National Institute of Mental Health (R01-MH61285) to Seth Pollak. Shira Vardi was supported by a University of Wisconsin Hilldale Undergraduate Research Fellowship. We gratefully acknowledge the technical support provided by Dirk Wilker, Jerry Bialzik, Greg Kant, and Andrew Mulder. We also appreciate the assistance of Ari Neulight, Sarah Pluck, and the many research assistants who aided in the collection of these data. This research would not have been possible without the collaboration of Robert Lee, Ami Orlin, and Judy Bordson of Child Protective Services, Wisconsin Department of Health and Human Services. Finally, we are indebted to the families and children who generously gave their time to collaborate in this research. A preliminary report of these data was presented at the Biennial Meeting of the Society for Research in Child Development, Tampa, FL (April, 2003).

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 0009-3920/2005/7605-0002

We focus on physical abuse, specifically, because the phenomenon provides a way to index a child's emotional experience, and it now appears that it is the experience of abuse, rather than a predisposition for psychopathology, that accounts for the behavioral problems in children (Jaffee, Caspi, Moffitt, & Taylor, 2004; Kendler et al., 2000; MacMillan et al., 2001). Although less is known about underlying developmental mechanisms, many observations of children's emotional development suggest that affective processes are affected by the experience of abuse. Most germane to the present study are observations that physically abused children display both interpersonal withdrawal and aggression (Jacobson & Straker, 1982; Hoffman-Plotkin & Twentyman, 1984; Rogosch, Cicchetti, & Aber, 1995), attribute hostility to others (Weiss, Dodge, Bates, & Pettit, 1992), and display contextually inappropriate affect and behavior (Klimes-Dougan & Kistner, 1990; Main & George, 1985). Physically abused children also tend to readily assimilate and remember pictures of angry facial expressions and cues related to aggression, even when those cues are task-irrelevant (Pollak & Tolley-Schell, 2003; Rieder & Cicchetti, 1989).

Ruff and Rothbart (1996) and Posner and Rothbart (2000) have described neurodevelopmental changes in children's ability to regulate the behaviors that are associated with the maturation of brain areas that underlie attention. As the anatomy and circuitry of attentional networks relating to orienting and regulation mature, children are provided with increasingly elaborate and flexible mechanisms for self-regulation. According to this view, children begin to acquire successful strategies including switching one's attention to a different aspect of an unpleasant situation, avoiding a situation, or involving oneself in a distracting activity. In contrast, ineffective strategies lead to increased attention to negative stimuli, resulting in over-arousal and inappropriate or maladaptive behaviors (Eisenberg, Fabes, Nyman, Bernzweig, & Pinuelas, 1994). Here, we focus on attention regulation because the ability to shift attention toward or away from different aspects of the environment is adaptive, allowing the individual to control an emotional response (as when we avert our gaze from something that is disgusting or distract ourselves with mundane or pleasant tasks to avoid worrying about impending concerns). Yet such attentional regulation may be in conflict with affective systems whose adaptive value resides precisely in their drawing attention to salient, unexpected, or potentially threatening aspects of the environment. In short, reflexive affective systems serve adaptive ends by alerting us to potential danger while voluntary attentional systems allow us to regulate our encounters with such stimuli. One possibility is that rather than using their attentional resources to attenuate emotional reactivity, physically abused children overly attend to threatening cues, perhaps at the expense of other contextually relevant information (Dodge, Pettit, Bates, & Valente, 1995; Pollak & Tolley-Schell, 2003).

The present study was designed to explore how exposure to interpersonal anger affected physically abused children's attention regulation. We were especially interested in evaluating children's regulation during the unfolding of a realistic emotional situation, as assessed through multiple methods including autonomic nervous system changes and overt behavioral performance. Our prediction was that physically abused children's behavior would change as anger was introduced into the environment, even though the anger was not directed toward the child. Regulatory responses to the emergence of anger were indexed by the children's ability to remember information about the angry exchange, effects on the children's behavioral performance such as changes in their accuracy or response time, and markers of children's orienting and responses to anger such as heart rate (HR) deceleration and increases in arousal. The data obtained from the present study should address differences in children's tendency to orient and maintain attention to background anger as well as children's ability to control or shift attention away from anger. Such regulatory skills have important implications for understanding the development of psychopathology.

Method

Participants

The sample consisted of 11 physically abused (6 boys, 5 girls) and 22 non-abused (16 boys, 6 girls) 4- and 5-year-old children. Physically abused children were recruited by letters forwarded by the Dane County (WI) Department of Human Services to families with substantiated cases of child physical abuse. Only children who experienced direct physical abuse from a parent were included in this study. Non-physically abused children were recruited by flyers posted in the same neighborhoods from which abused children were drawn. Samples were matched in terms of children's sex, race, and age as well as on family demographic variables (see Table 1). All participants were screened for normal (or corrected to normal) vision and hearing. To supplement

Table 1
Mean (Standard Deviation) of Psychodemographic Characteristics of Sample

	Physically abused	Control
Age, years	4.9 (0.6)	5.0 (0.5)
Children in family	2.6 (0.9)	2.7 (1.2)
SES	38.6 (13.7)	44.3 (10.7)
Race (%)		
African American	55	14
Asian	0	14
White	45	72
Single parent (%)	45.5	33.6

Note. There were no statistically significant group differences between any variable reported in Table 1. Socio-economic status (SES) computed by Hollingshead (1975).

the maltreatment information obtained from social service agencies, parents completed the Parent–Child Conflict Tactics Scale (PCCTS; Straus, Hamby, Finkelhor, Moore, & Runyan, 1998). The PCCTS measures the extent to which a parent has carried out specific acts of physical aggression toward the child. A Physical Abuse summary score was calculated by summing scores on three subscales (Minor Physical Assault, Physical Assault-Maltreatment, Severe Physical Maltreatment) of the PCCTS. Parents of children in the control group endorsed far fewer aggressive behaviors toward children ($X = 2.86$, $SD = 2.78$) as compared with physically abusive parents ($X = 25.91$, $SD = 19.41$), $t(31) = 5.54$, $p < .001$. Not included in the sample reported in this paper are data from an additional 21 children (14 boys, 7 girls; 9 control, 3 abused, 9 uncertain abuse status). These children could not perform the behavioral task ($n = 4$), refused to complete the task ($n = 3$), had physical/sensory problems that prevented them from performing the task ($n = 2$), or had invalid physiological data because of excessive movement ($n = 4$). One child in the control group had invalid SCL data because of equipment malfunction, but behavioral data and HR data were retained. We also excluded from the final sample any potential control participant with unsubstantiated child abuse reports or unclear abuse histories ($n = 8$), resulting in a conservative criterion for inclusion in the non-abused groups. Parents received detailed information about the study protocol before giving informed consent. After being shown the study apparatus, children verbally assented to participation. Children were rewarded with age-appropriate prizes, and families received $20 for their participation in the study in addition to the cost of transportation.

Stimuli and Apparatus

Background conversation. Two professional actors recorded a 7 min scripted conversation in a professional recording studio. The conversation transitioned into four periods: (1) a neutral, pre-anger *baseline* period in which the two co-workers meet and engage in casual conversation, (2) an *active anger* period in which the two characters intensely argue, (3) a period of silent *unresolved anger* during which one character abruptly leaves the room, and (4) a *resolution* period, in which the two characters apologize to each other. The conversation was presented by means of a compact disc player placed in a room adjacent to where the child was located; an opening in the wall connected the two rooms.

Behavioral task. Children completed the Connors' Continuous Performance Test—Kiddie Version (Conners, 2001). The test is an adaptation, for 4–5-year-olds, of the Connors CPT, a well-validated measure of sustained attention (McGee, Clark, & Symons, 2000). During the task, pictures of different objects appear at the center of the computer screen and the child is instructed to press the space bar in response to every picture except for a soccer ball, in which case a response is withheld. The task lasts 7.5 min, and consists of 10 trial blocks.

Memory task. Children's memory for details from the background conversation was measured using both free and cued recall. Children's responses were audio recorded for accuracy, and were later transcribed and coded. Each set of responses was coded by two raters for the total number of details recalled from the scene and the total number of erroneously recalled material.

Procedure

Thirty minutes before each family's arrival, a space heater was placed in the experiment room to facilitate the adequate release of sweat for electrodermal responses. Upon arrival, the child was assessed with the Edinburgh Handedness Inventory to determine the child's dominant hand (the hand used for responding; the non-dominant hand was used for psychophysiological recording). The sites for EDA electrode attachment were then cleaned with soap and water, and the sites for HR electrode attachment (the child's leg) were cleaned with rubbing alcohol. Children were seated in child-size chairs, with their non-dominant hand placed on a hand rest to avoid movement. Next, an experimenter introduced the CPT task. Practice trials were administered to ensure that all children understood the task. During the final practice session, a second experimenter in another room began speaking as part of a mock telephone call to accustom the child to noise from the adjacent room. The experimenter acknowledged the noise from the adjacent room and encouraged the child to attend to the CPT task.

Thirty seconds after the CPT task began, the recorded conversation began; the CPT task and recorded conversation ended simultaneously 7 min later. After the electrodes were removed from the child, and his or her hands and legs were cleaned, the memory task was administered. Children were told that the voices that they had heard during the task were part of the experiment, and they were shown the CD player. Children were asked what they remembered from the conversation and, following the free responses, were cued with five standard questions; their responses were audio-taped. At the end of the session, children were debriefed with their parents in the room and allowed to play back part of the recorded conversation if they wished to ensure that no real anger had transpired during their visit to the laboratory.

Measures

Psychophysiological measures. HR deceleration is a widely used index of attentional orienting designed to facilitate sensory intake of relevant environmental stimuli (Lacey & Lacey, 1970; Obrist, 1976; for a review see Ohman, Hamm, & Hugdahl, 2000). In this vein, HR deceleration is typically observed when individuals direct attention toward the environment in anticipation of important future events (Bohlin, & Kjellberg, 1979; Van der Molen, Somsen, & Jennings, 1996). HR deceleration in children has been observed in situations requiring tonic orienting designed to gather salient information from the environment, including the presentation of interadult angry interactions (El-Sheikh, Cummings, & Goetsch, 1989; El-Sheikh, & Harger, 2001; van-Goozen, Matthys, Cohen-Kettenis, Buitelaar, & van-Engeland, 2000). HR was measured with Beckman Ag–AgCl cup electrodes, attached with double-sided adhesive collars and filled with Quik-Gel conductive gel. One electrode was attached approximately one inch above the ankle of the dominant leg, inner surface, one electrode was attached approximately one inch below the elbow of the non-dominant arm, inner surface, and a third electrode was attached on the forehead and served as a ground. The analog HR waveform was sampled with Neuroscan amplifiers at 1000 Hz and bandpass filtered (10–30 Hz; 24 dB/octave). The HR waveform was scored with software (Rypstat & Curtin, 2003) that detected R-spikes in the waveform to determine HR in beats per minute within 1 s intervals. Analyses were performed on HR change scores in 20 s epochs (calculated as the epoch mean minus 50 s pre-anger baseline mean) within each of the three target periods (i.e., active anger, unresolved anger, and resolution). There were five epochs within the anger and silence periods (100 s total in each period) and two epochs within the resolution period (40 s total). The last 50 s of the initial neutral, pre-anger period was selected as a baseline for both HR and SCL measure because it represented the most stable baseline after the children adjusted to the task and environment (Eisenberg et al., 1988). No significant Group differences were observed during this baseline period for either HR, $t(31) = .10$, *ns*, or SCL, $t(30) = .09$, *ns*. Greater HR deceleration (i.e., negative change scores from baseline) is indicative of greater orienting to environmental stimuli.

Children's emotional arousal was measured by indexing their skin conductance level (SCL). SCL is a direct index of sympathetic nervous system activity and reflects arousal through changes in the relative activity of the eccrine sweat glands, which are innervated solely by the sympathetic branch of the autonomic nervous (Dawson, Schell & Filion, 2000). Increases in SCL are indicative of increases in ongoing emotional arousal (Bohlin 1976; Levenson & Gottman, 1983; see Dawson et al., 2000 for review). Although there is only a modest amount of such research with young children (Fowles, Kochanska, & Murray, 2000; Shields, 1983; Venables & Mitchell, 1996), there is evidence that SCLs change as young children are presented with anger (El-Sheikh, & Harger, 2001) and negative mood induction using film clips (Cole, Zahn-Waxler, & Fox, 1996; Fabes, Eisenberg, & Karbon, 1994). SCL was measured with Beckman Ag–AgCl cup electrodes, attached with double-sided adhesive collars to the thenar and hypo-thenar eminences of the palm of the non-dominant hand, and filled with a skin conductance gel (.5% saline). A constant current of .5 A was applied across the electrodes. SCL was sampled with Neuroscan amplifiers at 1000 Hz and low-pass filtered (30 Hz; 24 dB/octave). The SCL scoring procedure was comparable with that reported for HR. Specifically, analyses were performed on SCL change scores in 20 s epochs (calculated as the epoch mean minus 50 s baseline mean) within each of the three target periods. As with HR, there were five epochs within the active anger and unresolved anger periods (100 s total in each period) and two epochs within the resolution period (40 s total). SCL data were not available for 1 participant from the non-abused control group because of equipment malfunction.

Behavioral performance scoring. Children's hit rate and reaction time for each sub-block of the CPT task were calculated. Only the sub-blocks that occurred in entirety during one of the four segments of the background conversation are reported here. Two blocks each occurred during the pre-anger baseline, active anger, and unresolved anger segments; one block occurred during the resolution segment.

Memory for background information. Audio tapes of each child's responses were transcribed verbatim with children's identity and group status masked. Two experimenters scored each transcript, recording the number of details correctly recalled from the background conversation. Children's factual errors (details that occurred during the conversation but were wrong, such as stating that three people were involved in the scene, rather than two) and confabulations (details wholly unrelated to the scene, such as stating that one character assaulted the other) were also scored. Each child's total number of utterances was also noted to examine possible group differences in expressive language. In the very few cases where there was disagreement about scoring, the experimenters discussed the responses in question with a third experimenter until consensus was reached.

Results

Physiological Measures

Separate "within-period" analyses were conducted for HR and SCL within each of the three target periods (active anger, unresolved anger, and resolution). For each measure and period, a multivariate repeated measures ANOVA was conducted with Group (Physically abused vs. Non-abused) as a between-subject factor and Time (in 20 s epochs) as a within-subject factor. For the active anger and unresolved anger periods, there were five 20 s epochs, with two 20 s epochs during the resolution period. Multiple degree of freedom Time effects in active and unresolved anger periods were analyzed with polynomial trend contrasts to facilitate examination of the shape and time-course of participant's physiological response in these extended periods. Initial analyses included Age and Sex as covariates, but neither of these covariates was significantly related to either HR or SCL. Therefore, they were not retained in final analyses.

Additional "cross-period" analyses of HR were conducted to examine HR decelerations that were observed across (1) the active anger to unresolved anger period and (2) the unresolved anger to resolution period. Each of these analyses included Group as a between-subject factor and Period (last epoch of previous period vs. first epoch of current period) as a within-subject factor.

HR. HR change scores were examined to determine whether groups differed with regard to attentional orienting to the information being presented in the taped conversation. HR change scores for physically abused and non-abused participants across all epochs within the three target periods are displayed in Figure 1.

Within-period analyses of the active anger period revealed a significant cubic Time effect, with a large initial HR deceleration (i.e., HR lower than baseline period, reflecting an attentional orienting response) within the active anger period, $F(1, 31) = 6.74$, $p < .01$. Although the pattern of means suggested an earlier resolution of this HR deceleration in the non-abused group, no significant Group main effect or Group $\times$ Time was observed. A one-sample t test against zero confirmed that the overall HR deceleration observed throughout the active anger period for both groups ($M = -2.0$) was significant, $t(31) = 4.24$, $p < .001$.

Cross-period analyses examining HR change scores across the last epoch of the active anger period to the first epoch of the unresolved anger period

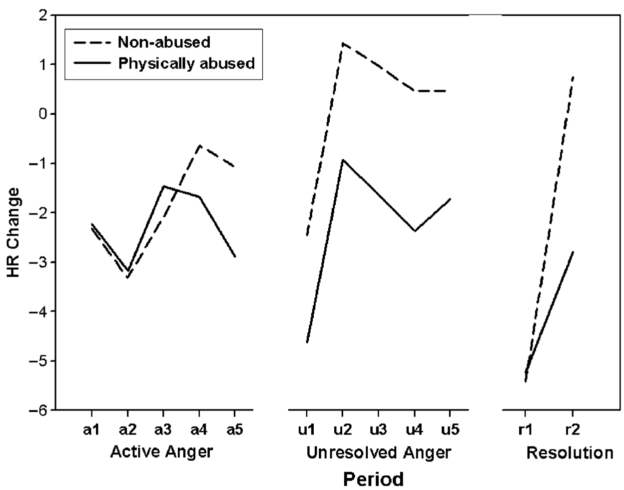

Figure 1. Heart rate (HR) change scores (in beats per minute) are displayed by Period (active anger, unresolved anger, and resolution), Epoch (20 s intervals within periods) and Group (abused vs. non-abused). Change scores were calculated relative to each participant's baseline activity. A1 – A5 represent the five 20 s epochs in the active anger period. U1 – U5 represented the five 20 s epochs in the unresolved anger period. R1 – R2 represent the two 20 s epochs in the resolution period.

documented a significant overall deceleration for all participants across these two periods (*M*s = -1.7 vs. -3.2), $F(1, 31) = 5.85$, $p < .05$. However, Group did not moderate the magnitude of this deceleration (i.e., The Group × Period interaction was not significant).

Within-period analyses in the unresolved anger period detected significant quadratic, $F(1, 31) = 7.57$, $p < .01$, and cubic, $F(1, 31) = 4.21$, $p < .05$, Time effects, resulting from the eventual recovery from the initial large HR deceleration at the onset of the unresolved anger period. A significant overall Group main effect was also observed within this period, $F(1, 31) = 4.36$, $p < .05$, reflecting greater overall HR deceleration across the entire unresolved anger period in the physically abused group ($M = -2.3$) compared with non-abused children ($M = .2$). In addition, a follow-up one-sample *t* test against zero confirmed that this mean deceleration of 2.3 bpm (relative to baseline) over the entire unresolved anger period displayed by the physically abused group was significant, $t(10) = 2.89$, $p < .05$.

Cross-period analyses across unresolved anger and resolution periods documented a significant overall HR deceleration at the start of the resolution period ($M = -5.4$) relative to the end of the unresolved anger period ($M = -.3$), $F(1, 31) = 19.62$), $p < .001$. Group did not significantly moderate the size of this deceleration.

Within-period analyses in the resolution period detected a significant overall Time effect in this period, $F(1, 31) = 27.91$, $p < .001$, because of a recovery from the initial large HR deceleration by the second time interval. However, a Group × Time interaction was also observed, $F(1, 31) = 5.25$, $p < .05$, indicating that the recovery from this HR deceleration was greater in the non-abused than in the abused children. Specifically, follow-up analyses indicated that the non-abused children displayed a significant simple Time recovery effect, $F(1, 21) = 41.96$, $p < .001$. However, the simple Time recovery effect was not significant for the abused children, $F(1, 10) = 3.55$, *ns*.

SCL. SCL change scores were examined to evaluate potential group differences in emotional arousal response to the taped conversation. SCL change scores for physically abused and non-abused participants across all epochs within the three target periods are displayed in Figure 2. During the active anger period, a significant Group × quadratic Time interaction was observed, $F(1, 30) = 4.22$, $p < .05$. Follow-up analyses revealed that the non-abused children displayed a significant quadratic Time effect, $F(1, 20) = 5.60$, $p < .05$, indicating the large increase in SCL during the latter half of the anger period, reflecting the emotional arousal response to the intense argument in the taped conversation. In contrast, this quadratic Time effect was not significant in the abused children. Only a significant linear Time effect was observed, $F(1, 10) = 6.54$, $p < .05$, indicating a relatively steady decline in SCL across the active anger period for physically abused children.

A significant Group × quadratic Time effect was observed during the unresolved anger period, $F(1, 30) = 9.44$, $p = .004$. Follow-up analyses revealed a significant quadratic Time effect in the physically abused children, $F(1, 10) = 8.44$, $p < .01$, indicating a large increase in SCL mid-way through the unresolved silence period. In contrast, the non-abused children only displayed a significant linear Time effect, $F(1, 20) = 4.70$, $p < .05$, indicating a steady decline from the earlier emotional arousal response during the active anger period.

No significant Group, Time, or Group × Time effects were observed for SCL during the resolution period.

Behavioral Measures

CPT attentional performance. Attentional performance measures from the CPT (hit rate and response time) were each analyzed, separated within multivariate repeated measures ANOVAs, with Group (Physically abused vs. Non-abused) as a between-subject factor and Period (active anger, unresolved anger, and resolution) as a within-subject factor. Age and Sex were included as covariates in initial

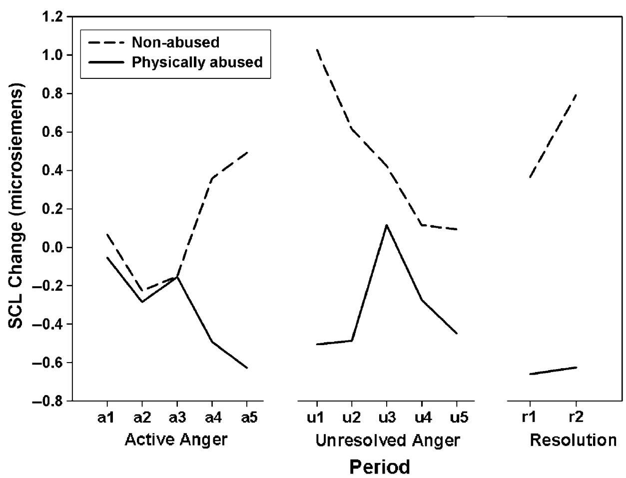

Figure 2. Skin conductance level (SCL) change scores (in microsiemens) are displayed by Period (active anger, unresolved anger, and resolution), Epoch (20 s intervals within periods), and Group (abused vs. non-abused). Change scores were calculated relative to each participant's baseline activity. A1 – A5 represent the five 20 s epochs in the active anger period. U1 – U5 represented the five 20 s epochs in the unresolved anger period. R1 – R2 represent the two 20 s epochs in the resolution period.

analyses, but no significant effects of Sex were observed. Therefore, only age was retained as a covariate in final analyses.

For hit rate, a significant effect of the Age covariate was observed, $F(1, 30) = 10.08$, $p = .003$, with increasing age associated with increases in hit rate on the CPT. No significant effects involving Group or Period were observed. These data suggest that participants in both groups were similarly attending to the behavioral task.

For response time, a significant effect of the Age covariate was also observed, $F(1, 30) = 10.22$, $p = .003$, with increasing age associated with faster response times. In addition, a significant effect of Period was also observed, $F(2, 29) = 4.13$, $p < .05$. Follow-up pairwise comparison across the three periods indicated that children were significantly faster during the resolution period ($M = 728$ ms; $SD = 255$ ms) than during both the active anger period ($M = 982$ ms; $SD = 309$ ms), $t(32) = 4.35$, $p < .001$, and the unresolved anger period ($M = 994$ ms; $SD = 247$ ms). No significant difference in response times between active anger and unresolved anger periods was observed. No significant main effect of Group or Group $\times$ Period interaction was observed. Again, these data suggest that participants in both groups were comparably attending to the task.

Memory. Performance measures on the memory test (verbal responsiveness, total correct details recalled, total errors) were each analyzed separately within one-way ANCOVAs with Group (Physically abused vs. Non-abused) as a between-subject factor. Initial analyses included Age and Sex as covariates. Only significant covariates were retained in the final analyses reported here.

For verbal responsiveness, a significant effect of the Sex covariate was observed, $F(1, 29) = 4.93$, $p < .05$, with boys providing more total verbal response ($M = 91.2$; $SD = 45.6$) than girls ($M = 54.5$; $SD = 35.5$). No significant effect of Group was observed for verbal responsiveness.

For total correct details recalled, a significant effect of the covariate Age was observed, $F(1, 29) = 7.51$, $p < .01$, with increasing age associated with increased correct recall of details. No significant effect of Group was observed. For total errors, there were no significant Group or covariate effects.

Discussion

The present study sought to clarify and extend previous work suggesting that physically abused children develop perceptual sensitivity to anger. First, we sought to further examine the ways in which physically abused children can regulate attentional processes when confronted with anger or threat. Second, because prior research suggested that physically abused children would be especially sensitive to anger, the anger-related stimuli presented to children occurred in the background and were irrelevant to the child's purported task and not personally meaningful. This created a relatively conservative test of children's attentional regulation. The present data suggest that once anger was introduced, abused children maintained a state of anticipatory monitoring of the environment. In contrast, non-abused children were initially more aroused by the introduction of anger, but showed better recovery to baseline states once anger was resolved.

We observed differences in children's attentional orienting responses to anger. As used in this study, decelerations of HR may be conceptualized as a measure of tonic orienting—a state in which the organism is actively gathering information from the environment. Orienting is a term often applied when preattentive processes make a "call" for additional controlled processing of a stimulus (Ohman et al., 2000). Such orienting processes are thought to reflect a change from automatic to controlled processing based upon the novelty or significance of the eliciting stimulus. In the present study, abused children displayed HR deceleration relative to baseline, consistent with a view that these children were "on alert," perhaps waiting for indications that the angry altercation might escalate. Consistent with this view, we observed periods of HR deceleration at the start of each period (active anger, unresolved anger, and resolution), further suggesting that orienting to new information is driving the response.

We found no differences in the baseline level of emotional arousal between the groups of physically abused and non-abused children. Nor did physically abused children show increased levels of arousal during exposure to background anger. While increased skin conductance is widely interpreted as an index of increased anxiety, there have been slightly different interpretations of hypo-reactivity. Decreased electrodermal activity has been associated with both decreased fearfulness and decreased effortful control in young children (Fowles et al., 2000). However, in the Fowles et al. study, this relationship between low electrodermal activity and decreased effortful control held only for the overall level of children's electrodermal activity, not for children's responsiveness to emotional stimuli. One possibility is that in the Fowles et al. study, emotional responses were elicited by film clips that were familiar to the participants, so that their responses reflected habituation. Another possibility, which seems most consistent with the present data, is that fear and inhibitory control are distinct neural systems. For example, Derryberry and Rothbart (1997) have proposed that a Fear system is reactive, inhibiting approach to threatening aspects of environment, yet the Inhibitory Control system is an active attentional system that suppresses and activates different adaptive responses.

In this regard, two observations are noteworthy. First, abused children showed less of an arousal response during the onset of active anger than did controls—perhaps reflecting that the intensity of our stimuli is less than what these children are exposed to in their home environments. Second, abused children showed a greater arousal response during the period of silent, unresolved anger that was not observed in controls. In short, these data are consistent with the idea that abused children attended to the onset of anger, but the relative intensity of that anger did not overly concern them. However, when the interpersonal situation became quiet, unresolved, and somewhat ambiguous, abused children became more concerned than their non-abused peers. Perhaps given their histories, such experiences are particularly frightening for abused children.

This study contains a number of important features, limitations, and suggestions for future research. The limited number of children in the abuse group reflects our attempt to examine a sample of young children who experienced verified, severe physical abuse in the absence of other forms of maltreatment. Yet, the small, specialized sample reduced statistical power. This constrained our ability to conduct post hoc examinations of additional individual difference variables, but also speaks to the magnitude of the effects reported here. A second issue concerns the relative sensitivity of the measures used in this study. Both groups of children performed the attentional task with comparable levels of accuracy, indicating that children were sufficiently motivated to perform the experimental task. That nearly all participants performed at ceiling levels also suggests that the task was not challenging enough to reveal group differences; therefore, it may be useful to further examine the inconsistencies between the physiological and behavioral measures of attention to determine whether increasing task demands would lead children's attentional performance to covary with physiological measures of orienting. It may be the case that physically abused children were able to sustain behavioral performance by successfully devoting attentional resources to both the task and the background conversation. As measures of HR and skin conductance provide relatively gross measures of children's physiological activity, future studies using more precise measures of central and autonomic nervous system function will help resolve questions about the inconsistencies between measures of attention, the nature of the affect experienced by the abused children, and the relative timing of attentional and affective processes.

A third interpretive problem in studies of the effects of emotion on attention is that the stimuli selected to be "distractors" are not always relevant to the affective history and concerns of the individual. Thus, negative findings may result because stimuli are not sufficiently salient to influence attention and positive findings cannot address whether attentional effect are specific to certain types of emotional stimuli or whether they reflect general fragility of some individuals' attentional networks. Therefore, a key aspect in designing such studies is matching stimuli to salience for a clinical group (for example, presenting rape-related stimuli for rape victims, social/interpersonal stimuli for persons with social phobia, etc). We addressed this issue by using interpersonal hostility—an issue that is salient and theoretically meaningful for children who have experienced abuse. Children are sensitive to anger between adults (Cummings, 1987; El Sheikh, Ballard, & Cummings, 1994) and this is especially true for physically abused children (Cummings, Hennessy, Rabideau, & Cicchetti, 1994; Hennessy, Rabideau, Cicchetti, & Cummings, 1994). However, our experiment did not appear to elicit differential affective responses from children. It may be the case that compared with what our sample of severely abused children has experienced, the level of anger conveyed in our stimuli was too mild to elicit an emotion response. One future direction might involve increasing the affective intensity of the stimuli (insofar as is ethical) or systematically manipulating whether or not the focus of the anger is directed to the child.

From a developmental perspective, the critical question raised by studies of physically abused children's information processing is how perceptual and attentional processes influence children's behavioral regulation. It is generally believed that negative stimuli are particularly salient and thus help capture and direct attentional resources. However, it might also be that control of attention may buffer rather than exacerbate the effects of stressful stimuli. In other words, the ability to rapidly disengage from negative stimuli might aid adaptive self-regulation (Ellenbogen, Schwartzman, & Stewart, 2002). Our view is that predispositions to attend and learn about emotionally salient events, in tandem with developmental constraints on perceptual systems, lead children in abusive contexts to over process environmental signals associated with harm.

Abused children appear to cope with their stressful environments by becoming experts at threat detection. But such a skill may develop at a cost. While it is adaptive for salient environmental stimuli to elicit attention, successful self-regulation includes flexibility and control over these processes. We suspect that failure of regulatory capacities is a proximal link between early experience and abused children's troubles. These studies suggest new ways of understanding the neural mechanisms through which early experience contributes to the development of psychopathology.

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