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EMOTION PROCESSING IN ADULT SURVIVORS OF CHILDHOOD MALTREATMENT

by

NEGAR FANI

Under the Direction of Erin B. McClure Tone

ABSTRACT

Childhood maltreatment increases risk for Posttraumatic Stress Disorder (PTSD). Maladaptive patterns of attention to threat-related stimuli warrant examination as possible contributing risk factors. It remains unclear whether persistent threat-processing biases are differentially apparent in adults who were maltreated as children and either did, or did not, develop later PTSD. The present study examined associations among attention bias, childhood maltreatment, and PTSD in adults. We hypothesized that attentional bias toward threat significantly mediates associations between childhood maltreatment and adult PTSD symptoms. 183 adults with and without childhood maltreatment histories participated in this study, which involved completion of a range of clinical measures; attention bias was measured by the Dot Probe task. We found that attention bias toward happy faces partially mediated the relationship between childhood maltreatment and PTSD avoidance and numbing symptoms. Childhood

maltreatment, happy face attention bias, and perceived racially discriminative experiences all accounted for significant variance in PTSD symptoms.

INDEX WORDS: Posttraumatic Stress Disorder, Emotion processing, Childhood maltreatment, Dot Probe, Attention bias

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by

NEGAR FANI

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Master of Arts

in the College of Arts and Sciences

Georgia State University

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2009

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Chapter 1: Introduction

Maltreatment in early childhood, in the forms of physical, sexual, or emotional abuse, has become increasingly prevalent (U.S. Department of Health and Human Services, 1996). Childhood maltreatment is associated with a variety of negative outcomes, including drug and alcohol abuse, physical health problems, and risky sexual behavior (Repetti, Taylor & Seeman, 2002). Children who have experienced early life trauma also demonstrate greater vulnerability to Posttraumatic Stress Disorder (PTSD), both in the immediate aftermath of childhood trauma and in the context of adverse events that occur later in development (Bremner et al., 1993; Golier et al., 2003).

PTSD is a complex psychological disorder with debilitating social and occupational consequences. PTSD may develop in response to perceived trauma and is characterized by four types of symptoms: 1) re-experiencing of the traumatic event, 2) avoidance of trauma-related stimuli, 3) emotional numbing, and 4) heightened levels of physiological arousal (American Psychiatric Association, 1994). Prevalence estimates for this disorder have varied across nationwide samples. Kessler and colleagues (1995) found that 60.7% of men and 51.2% of women who participated in the National Comorbidity Survey (NCS) had experienced lifetime trauma and 7.8% of the sample had developed lifetime PTSD (10.4% of women, 5% of men; (Kessler et al., 1995). A recent study of an urban primary care population found that 34% of participants met diagnostic criteria for lifetime PTSD and 23% met criteria for current PTSD (Liebschutz et al., 2007). Clearly, with prevalence estimates in the United States that range from 8 to 34%, PTSD constitutes a major public health concern.

However, epidemiological studies also demonstrate that despite high rates of trauma exposure in the general population, only a minority of individuals who have experienced

traumatic events develop PTSD (Kessler et al., 1995). It remains unclear what elevates risk for the disorder in this subset of individuals. Considerable research has focused on trauma-related factors as risk markers. In survivors of maltreatment for instance, prolonged exposure to and lack of control over the traumatic stressor, high levels of peri-traumatic dissociation, and greater violations of personal integrity have been discussed as factors that may contribute to poorer outcomes (Kendall-Tackett, Williams & Finkelhor, 1993; Spaccarelli 1994). Further, trauma inflicted by humans rather than by objects or natural forces may lead to greater distress and worse long-term outcomes (Vogel & Vernberg, 1993).

Intrapersonal factors, such as information processing styles, may also contribute to risk for maladaptive responses to trauma. Studies of adults with PTSD have found, for example, that negative initial cognitive appraisals of one's own symptoms following a trauma are linked to chronicity of symptoms (Dunmore, Clark & Ehlers, 1999). Further, neuropsychological findings suggest that adults who have endured trauma and developed PTSD demonstrate biases in various types of information processing, including attention, cue interpretation, and memory, when compared with trauma survivors who did not develop PTSD (for a review, see Vasterling & Brailey, 2005). Similar studies of information processing conducted in children who have endured interpersonal trauma have yielded evidence that attentional and interpretive biases characterize members of this population as well (Pine et al., 2005; Pollak et al., 2000).

While distinct lines of research indicate biased information processing in adults with PTSD and in maltreated children, no published studies to date have explicitly examined relationships among childhood maltreatment, adult PTSD, and patterns of information processing, particularly attentional biases. Such research may be especially important in light of evidence that early life trauma has marked and enduring effects on developing information-

processing styles, behavioral responses, and physiology (Heim et al., 1997; Repetti, Taylor & Seeman, 2002; Salmon & Bryant, 2002; Cicchetti & Curtis, 2006). Given that only some individuals who are traumatized during childhood develop disorders such as PTSD, clarification of characteristics, such as patterns of attention that distinguish them from other traumatized peers, may provide a first step toward elucidating factors that increase vulnerability to psychopathology.

Previous studies of attention in PTSD have yielded interesting findings; however, the populations studied and methods employed limit the ecological validity and generalizability of these findings. One widely used attention task, the Stroop paradigm, has significant limitations in that it is not designed to permit directional examination of attention bias and requires verbal, as well as reading, skill. Existing studies have also focused heavily on samples of combat veterans, who represent only one subgroup of individuals with PTSD (McNally et al., 1990; McNally, English & Lipke, 1993; Kaspi, McNally & Amir, 1995; Vrana, Roodman & Beckham, 1995).

The proposed study is therefore designed to examine performance on a more precise and ecologically valid measure of attentional bias in a heterogeneous sample of adults with and without PTSD. More specifically, the goal of this study is to examine associations among attention to threat-related visual cues, childhood maltreatment, and current PTSD symptomatology. The primary hypothesis is that associations between childhood maltreatment and PTSD symptomatology are significantly mediated by the presence of attention bias. As research on attentional patterns in adult survivors of childhood maltreatment is limited and thus precludes formulation of directional hypotheses, exploratory analyses will examine potential differences in direction of bias among participants in this sample.

To provide background for the proposed study, this manuscript opens with a review of emotion-processing theories of PTSD, as well as models of early-stage information processing bias in anxiety, all of which provide a rationale for a focus on visual attention biases. A discussion of the existing literature on attention bias in PTSD follows, along with a review of childhood maltreatment research as it pertains to emotion processing bias.

Emotion Processing Theories of Anxiety and PTSD

Peter Lang, a prominent emotion theorist, highlights the crucial role of visual representations in triggering emotional responses, particularly fear. According to Lang (1977), visual images not only represent feared stimuli, but also hold information about their meaning (Lang, 1977). Additionally, they can signal the physiological responses that stimuli are likely to elicit. In this way Lang introduces the notion of an emotional image as a "propositional construct"—a rich, multifaceted cognitive structure that includes both visual and behavioral elements. He states that while the visual presentation of a feared stimulus is likely to bring about a strong fear response, asking an individual to imagine the stimulus can elicit an equally powerful response. Via the real or imagined stimulus's links to other types of content, such as meaning and expected behavior, it plays an active role in eliciting fear.

Foa and Kozak (1986) elaborate on the "propositional construct" described in Lang's conceptual analysis, differentiating pathological and adaptive responses to emotionally charged images. Specifically, they postulate that, depending on whether the constellation of relationships among stimulus, physiological response, and internalized meaning—the "fear structure"— is adaptive or pathological, it can lead to either realistic or inaccurate and exaggerated perceptions of threat in one's environment. According to the authors, an adaptive fear structure includes a dangerous visual stimulus (e.g., "a real lion is snarling and running toward me") a sympathetic

behavioral response (e.g., racing heart) and a correct evaluation of the situation (e.g., “the lion looks ready to attack me, I must escape”). In contrast, a pathological fear structure contains faulty or biased network associations that involve exaggerated perceptions of threat. Thus, for example, for an individual with a pathological fear structure, an apparently benign stimulus (e.g., a photograph of a lion) might evoke a strong bodily reaction (e.g., racing heart) and incorrect or biased evaluation of threat potential (e.g., “the lion looks ready to attack me, I must escape”). Such biases in information processing may occur at multiple levels—encoding, consolidation, and/or retrieval—and may play a part in maintaining psychopathology by preventing adaptive information from penetrating and correcting the fear structure (Foa, Huppert & Cahill, 2006).

Foa, Steketee, and Rothbaum (1989) suggested that pathological fear structures associated with traumatic events are salient to the development and maintenance of PTSD. For example, a woman who was raped at gunpoint by a man with a dark beard near a Shell gas station might form a new fear structure, in which she associates visual elements from the event (dark beard, gas station) with heightened physiological arousal and the possibility of rape or death. This fear structure, based on associations that will be erroneous under most circumstances, is likely to disrupt her previously-held notions of safety. She may then begin to allocate more attentional resources toward scanning for potential threat cues in her environment and may interpret elements of her environment with greater, possibly unnecessary, caution.

Thus, individuals with PTSD appear to process new information differently from peers without PTSD, in that they perceive mildly threatening or ostensibly benign stimuli as threatening. Due to the existence of pathological cognitive frameworks (fear structures), stimuli that even slightly resemble the original trauma stimulus are likely to evoke exaggerated behavioral and cognitive responses, including hypervigilance and intrusive recollections of the

trauma. Visual cues appear to be especially salient triggers for fear structures in PTSD (Foa & Kozak, 1986); therefore biased attention to and processing of incoming visual information may be particularly relevant to post-traumatic psychopathology.

Foa and colleagues' emphasis on the role of biased perception and interpretation of visual cues in the development of PTSD is consistent with broader information-processing models of anxiety (MacLeod, Mathews, & Tata, 1986; Mogg & Bradley, 1998). Taken as a group, these models contend that biases in attention toward, interpretation of, and response to threat cues characterize individuals with high levels of anxiety, particularly those with clinically significant symptoms. Some models focus on early—pre-attentive and attentive—stages of processing (Williams, Watts, MacLeod & Mathews, 1988; Mathews, 1990; Mogg & Bradley, 1998); others highlight later, more elaborative aspects of threat-cue processing, such as cognitive appraisal and stimulus interpretation (Ehlers & Clark, 2000). Because models that emphasize early information processing biases in anxiety are of particular relevance to the proposed study, we have emphasized these in the present review. Constans (2005) provides a comprehensive review of models that emphasize later information processing in the development and maintenance of PTSD (Constans, 2005).

Bias in Early Stages of Information Processing in Anxiety

In contrast to the existing information processing research on PTSD, current theories of general anxiety have largely emphasized the relevance of *early* stages of information processing in anxious pathology. Theorists have examined how high trait anxious individuals differ from both low trait anxious and mood-disordered individuals, particularly in the way they allocate attentional resources toward incoming information. Similarly, clinical research findings have revealed clear biases in pre-attentive and attentive processes of patients with anxious pathology.

Several prominent theories are presented here, with a particular focus on the unique contributions of each toward understanding aspects of atypical early-stage information processing frequently observed in anxious individuals.

In one of the earliest information processing theories of anxiety, Mathews (Mathews, 1990; Mathews, 1993) described anxiety as an affective state characterized by hypervigilance for threat cues. Such hypervigilance and associated “worry” are, according to this model, inherently adaptive, as they prepare individuals for escape and avoidance of potential danger. They become maladaptive, however, when they occur in the absence of actual threat.

Those with “excessive worry” not only are overly sensitive to cues of threat in their environment, but also choose to attend to stimuli that are congruent with their pessimistic predictions about safety. Such biased attentional allocation can interfere with the individual’s ability to efficiently assign resources toward more productive activities. Mathews postulated that this bias toward threat cues may occur automatically or without the individual’s awareness, making it difficult for anxious individuals to attribute a clear cause to their feelings of impending danger (Mathews, 1990). Mathews (1990) also posited that this processing style distinguishes anxiety from mood disorders such as depression. Whereas anxious individuals are quick to assign priority toward detection of danger in the environment, depressed individuals fail to initiate goals or activities altogether, regardless of the presence or absence of motivating cues in the environment.

Williams and colleagues (1988) put forth a similar model of the association between anxiety and biased attention toward threat cues. In this model, though, they suggest that an interaction between state and trait anxiety leads to greater allocation of attentional resources toward threat stimulus processing (Williams, Watts, MacLeod & Mathews, 1988). Thus,

individuals with anxious predispositions and high levels of psychosocial stress are more likely to develop an information-processing style biased toward attention to threat. Consistent with this idea, research comparing clinically anxious individuals, who frequently demonstrate a combination of state and trait anxiety, with non-anxious controls has largely revealed a processing bias in favor of threat-relevant stimuli in anxious participants (MacLeod, Mathews & Tata, 1986; Mogg, Mathews & Weinman, 1989; MacLeod &Mathews, 1991).

Williams and colleagues (1988) also identified two cognitive mechanisms as instrumental in influencing the direction of attentional bias: the Affective Decision Mechanism (ADM) and Resource Allocation Mechanism (RAM). According to their model, information about a stimulus enters the ADM, which determines the level of threat. This decision is influenced by both the individual's current emotional state and different aspects of the stimulus. The RAM then determines how to allocate attentional resources towards the incoming stimulus; this decision reflects the influence of the individual's trait anxiety level. High trait anxious individuals will direct attention toward threat; low trait anxious individuals will direct attention away from threat. Research in non-clinical samples supports this hypothesis; MacLeod and Rutherford (1992) demonstrated that adults with both low and high trait anxiety demonstrated biases in visual attention that varied as a function of state anxiety. Specifically, under conditions of high state anxiety, low trait anxious individuals showed a bias *away* from threat cues, while high anxious individuals demonstrated a bias *toward* threat cues.

Mogg and Bradley (1998) elaborated on Mathews', Williams', and others' related models of early (pre-attentive and attentive) bias in anxiety, identifying two cognitive systems as critically important to the emergence of biases: the Valence Evaluation System (VES) and the Goal Engagement System (GES). The VES aids in determining the threat value of a stimulus;

this determination is strongly influenced by trait anxiety. While an individual with low trait anxiety may perceive low threat value in a given negative stimulus, a high trait anxious individual may perceive the same stimulus as highly threatening. The GES then determines the action the individual should take—either orient to or ignore the threat. According to this system, subjective evaluation of threat interacts with trait level anxiety to produce an individual's cognitive processing style; high trait anxious individuals often perceive mildly aversive cues as highly threatening, therefore, they are more likely to allocate more attentional resources toward them. The authors conclude by noting that such attention bias toward mild threat cues may be a marker of vulnerability to anxiety rather than an etiological agent for this pattern of symptoms.

Consistent across theoretical models is the idea that anxiety relates to a distinctive style of information processing characterized by preferential or biased processing of threat-related cues. Additionally, theorists appear to agree that varied cognitive mechanisms interact to influence biased processing of threat-relevant cues. More specifically, systems involved in stimulus appraisal and attentional resource allocation are thought to play important roles.

Attentional Bias in PTSD

Although the theoretical literature regarding attentional biases and anxiety has focused primarily on general anxiety, attentional biases to threat-related stimuli have also been documented in adults with more specific types of anxiety, such as that associated with PTSD. In particular, it appears that trauma victims with PTSD demonstrate biases toward threatening stimuli that are relevant to their own traumatic experiences (for a review, see Buckley, Blanchard & Neill, 2000). These biases have been found on tasks that involve both subliminal and supraliminal presentation of stimuli, and thus may reflect both pre-attentive and attentive processes (Buckley, Blanchard & Neill, 2000). Evidence that attentional biases are associated

with PTSD is consistent with Foa and colleagues' (1989) emotion processing theory of emotion in that these biases likely reflect activation of fear structures in response to salient visual stimuli (Foa, Steketee & Rothbaum, 1989). While these selective attentional patterns may be adaptive in the presence of threat, their persistence long after genuine threats have subsided can disrupt adequate processing of adaptive information and perpetuate anxious symptomatology.

Researchers have typically used one of two cognitive paradigms to measure biases in attention to threat in individuals with PTSD: the emotional Stroop task and the dot probe task. Most studies to date have used modified versions of the classic Stroop task (Stroop, 1935). During the Stroop task, a participant views a series of color names, each of which is printed in an incongruent color (e.g., the word "yellow" might be printed in green). The participant must rapidly name the colors of the words presented, inhibiting the tendency to read the words aloud. Longer delays in naming colors of target words in this task are interpreted as a measure of cognitive interference. In other words, the longer it takes a person to perform an ostensibly automatic task such as color naming, the more likely it is that he or she is allocating processing resources toward filtering out the interfering stimulus cue.

PTSD researchers have modified this task to include words related to the traumas their participants have experienced, based on the idea that response latency to naming colors of trauma-related words vs. non-trauma-related words provides a measure of processing bias (Thrasher, Dalgleish & Yule, 1993). In some versions of these tasks, target stimuli have been presented subliminally (using masking techniques) to allow researchers to detect pre-attentive biases. Masking involves very brief presentation (generally 15 milliseconds or less) of a threat-related word, which is quickly replaced by a string of letters (Buckley, Blanchard & Neill, 2000). While cognitive researchers generally regard masking as a reliable method for measuring pre-

attentive processing, some have argued that the Stroop is not an appropriate task for disentangling pre-attentive and attentive processes because its lexical demands may inherently require selective attention and effortful semantic processing (Mogg and Bradley, 1998). Supraliminal versions of the task, in which threat-related words are presented long enough that participants can perceive and read them (typically 500 ms or longer), may thus be more useful in measuring later, more elaborative processes.

Many studies that have used modified Stroop paradigms to examine attentional bias in individuals with PTSD have focused on veteran populations. McNally and colleagues (1990), for example, studied a group of traumatized combat veterans with and without PTSD. They found that the PTSD group, unlike the PTSD-free group, was slower to respond to supraliminally-presented words relevant to the Vietnam War than to other types of emotional words (including positively-valenced words). The PTSD group was also significantly slower than other veterans to name war-related words. These findings have been interpreted as evidence that threat-relevant stimuli disrupted attention for members of the symptomatic group.

These results are similar to those of other authors who have found extended response latencies for threat-related words in veteran populations (McNally, English & Lipke, 1993; Kaspi, McNally & Amir, 1995; Vrana, Roodman & Beckham, 1995). Vrana, Roodman, and Beckham (1995) found that Vietnam veterans with PTSD (versus those without PTSD) not only demonstrated slowed color naming with threat words but also showed a response bias for emotional words on a later free recall task, even after controlling for comorbid depression and medication use. They speculated that the observed recall bias may indicate that response latencies on the Stroop reflect attentional capture, rather than avoidance, of trauma-relevant stimuli in PTSD.

Stroop studies of non-veteran populations have yielded similar evidence of attentional biases in individuals with PTSD. Foa and colleagues (1991) found that rape victims with PTSD took significantly longer to name rape-related words on the Stroop task than did traumatized or nontraumatized controls. These findings are similar to those of Cassiday and colleagues (1992), who also studied rape survivors (Foa et al., 1991; Cassiday, McNally & Zeitlin, 1992). Thrasher, Dalgleish and Yule (1993) likewise found that ferry disaster survivors with more severe PTSD took longer than less severely affected peers to name trauma-specific, but not general, threat words. More recently, Vythilingham and colleagues (2007) used a modified version of the Stroop and found that participants with PTSD demonstrated significantly greater interference with threatening pictures (versus positive or neutral pictures) than traumatized controls and nontraumatized participants. These results provide further evidence of preferential attention to threat-relevant stimuli in individuals with posttraumatic pathology.

In a study of adult survivors of childhood sexual abuse with current PTSD, some of whom had been revictimized later in life, Field and colleagues (2001) found that all participants demonstrated longer response latencies for threat-related words than for neutral words. They also found that revictimized participants demonstrated longer response latencies toward sexual/victimization words than did those who had not been revictimized. This study may provide evidence of a cognitive priming effect in those who have experienced childhood maltreatment; that is, those who have experienced emotional or physical insults earlier in life may be more vulnerable to negative cognitive sequelae following a later trauma. The authors speculated that these results were related to re-activation of earlier fear structures, which may serve to amplify the cognitive consequences of later trauma.

The dot probe or visual probe task (Mogg & Bradley, 1999) is another experimental paradigm that allows measurement of attentional bias toward and away from threat stimuli. In typical dot probe tasks, a series of images appears on a computer screen. First, a pair of stimuli, one neutral and one representing threat, appears for a brief duration (generally 500 to 1500 milliseconds). Upon the offset of these images, a probe (an asterisk or set of dots) appears in place of one image. The viewer must quickly press a button that corresponds to the position of the probe on the screen (left versus right, horizontal versus vertical). Faster responses to probes that replace threatening stimuli are thought to reflect biases in visual attention toward threat cues; faster responses to probes that follow neutral stimuli reflect biases away from threat (Bryant & Harvey, 1997).

The dot probe task offers some advantages over the Stroop task in measuring pre-attentive and attentive processes in traumatized individuals. Unlike the Stroop, the dot probe task does not rely on interference to measure bias in attention allocation; rather, it uses response time to provide a more direct measure of visual attention (Mogg & Bradley, 1998). The dot probe also allows for examination of the direction of this attention: either toward or away from threat. Pictures (such as those of facial expressions) can be used as stimuli in the dot probe paradigm, eliminating the need for more effortful semantic processing that is often required in the Stroop task. The use of pictorial stimuli, such as human facial expressions, also has the advantage of providing a potentially more ecologically valid method of measuring attention bias in individuals who have suffered interpersonal trauma. As such, the dot probe appears to be a more precise, directional measure of bias in visual attention than the Stroop, with the further advantage that it can be modified to include stimuli that are both ecologically valid and salient for a given population.

Researchers have administered variants of the dot probe task to individuals with PTSD in four published studies. In one study involving adult victims of motor vehicle accidents with clinical or subclinical levels of PTSD, Bryant and Harvey (1997) presented word pairs (one neutral/one threat-related or one neutral/one positive) to participants. They found that subjects with PTSD responded more quickly to probes that replaced words related to driving threat than to probes that replaced positive or neutral words, suggesting a bias to attend to threat cues (Bryant & Harvey 1997). In another study, Dalgleish and colleagues (2003) found that children and adolescents with Generalized Anxiety Disorder or PTSD (combined into one group) demonstrated a comparable bias toward threat-related words. Youth with depression and healthy controls, in contrast, did not show evidence of an attentional bias toward threat. While the dot probe is generally regarded as a valid measure of early-stage processing in anxious individuals, it may be difficult to determine whether increased response latencies reflect attentional capture or an inability to disengage from threat cues (Mathews et al., 2003).

Elsesser, Sartory, and Tackenberg (2004, 2005) also administered variations of the dot probe to trauma victims and healthy controls in two recent studies that examined attention allocation and physiological reactivity to trauma-related stimuli. In the first (Elsesser et al., 2004), the authors administered a modified version of the dot probe to healthy controls and survivors of a wide range of traumatic events (67% of whom had experienced recent trauma) with and without Acute Stress Disorder (ASD) or chronic PTSD. This version of the dot probe included unspecified “trauma-relevant,” “generally aversive,” and neutral pictures. Compared to healthy controls, trauma survivors with ASD demonstrated a tendency to direct their attention away from trauma-related pictures, and participants with chronic PTSD tended to direct their attention toward trauma-related pictures (Elsesser, Sartory & Tackenberg, 2004). These

differences were not statistically significant; one possible explanation for this may be that the threat stimuli the authors utilized were overly general with regard to the heterogeneous traumatic events experienced in this sample.

In their 2005 study, the authors administered a similar version of the dot probe to healthy controls and recent trauma survivors at two different time points (baseline and 3 months), and found that trauma survivors took significantly longer to respond to probes following trauma-relevant pictures, in comparison to controls (Elsesser, Sartory & Tackenberg, 2005). Interestingly, attention bias scores indicated that trauma survivors tended to direct their attention away from threat cues at time one and toward threat cues at time two, while an opposite pattern was found in healthy controls. Findings from this study may bear more relevance to acute PTSD than to chronic lifetime PTSD, as only 20% of this sample demonstrated clinical post-traumatic pathology at time two. Indeed, it is possible that patterns of attention may differ between those who have experienced more versus less recent trauma. However, both studies demonstrate that visual attention may be differentially allocated in trauma survivors, and that tendencies to allocate attention away from or toward trauma-relevant stimuli may reflect acute or chronic post-traumatic responses, respectively.

In sum, research findings from these two different attentional paradigms—the modified Stroop and dot probe—have revealed evidence of an attention bias to threat cues in individuals with PTSD. While veterans have been most widely studied, other groups of trauma survivors with PTSD have also demonstrated a tendency to orient to cues of threat in lexically-based tasks. Bias toward and away from threat cues may be differentially apparent in survivors of acute and chronic trauma. One study of individuals with PTSD who were maltreated in childhood showed

attention bias toward trauma-specific stimuli in a revictimized subgroup, suggesting potential cognitive priming effects.

Impact of Early Life Trauma on Emotional Information Processing

In accordance with multiple theories of anxiety and PTSD, evidence clearly indicates associations between pathological responses to trauma and distinctive, potentially maladaptive, patterns of attention to emotionally salient cues. Relatively little research however, has examined how the timing of trauma may influence this relationship. Considerable evidence, for example, suggests that trauma can have particularly pernicious effects on brain development, as well as cognitive, social, and emotional functioning, when it occurs during childhood (Salmon & Bryant, 2002; Teicher et al., 1997). It thus is plausible that early trauma may relate distinctively to the ways in which individuals perceive and attend to emotionally salient cues.

With regard to brain development, early childhood abuse has been hypothesized to produce dramatic alterations in endocrine and neurotransmitter systems, sensitizing affected children toward the later development of PTSD (Teicher et al., 1997). More specifically, the effects of early stress appear to be concentrated in regions of the brain that are involved in emotion processing. The amygdala and the orbitofrontal cortex, which interact to contribute to the fear response and its modulation, show atypical patterns of structure and function in adults who were maltreated in childhood (De Bellis et al., 2002). At least one functional neuroimaging study of childhood abuse survivors with PTSD, for example, revealed altered brain blood flow in a brain region that participates in regulating amygdala activity when adult participants were exposed to scripts of their own early life abuse (Bremner et al., 1999). Thus, it appears that early childhood abuse may have detrimental consequences for brain structures involved with processing of incoming emotional information.

Maltreated children also appear to be highly vulnerable to deficits or delays in cognitive and social skills, which may be mediated at least partly by neural anomalies (Beers & De Bellis, 2002; Cicchetti & Lynch, 1995). Trauma during periods when children's emotion-regulation skills are maturing and their strategies for coping with emotions are limited may have especially profound effects (Salmon & Bryant, 2002). For example, a longitudinal study by Erickson, Egeland and Pianta (1989) found that maltreated children demonstrated more anger, hyperactivity and aggression over time than non-maltreated children; cross-sectional studies of maltreated children have yielded similar results (Kaufman & Cicchetti, 1989; Alessandri, 1991; Haskett & Kistner, 1991). Cummings and colleagues (1994) found that physically abused boys demonstrated more aggression than non-abused boys when an experimental confederate expressed anger toward their mothers. Thus, maltreated children appear to be sensitized toward expressions of anger, which, in turn, can interfere with their adaptive social functioning (Pollak, Cicchetti & Klorman, 1998).

Early trauma may lead to or amplify social-cognitive and emotional difficulties via two primary mechanisms. First, it may impair a child's skill at accurately interpreting cues from adult caregivers. Because children often rely on adult caregivers to aid in their own emotional regulation, it is important that those adults use appropriate language and facial expressions to help the child interpret the situation (Eisenberg, 1998). Caregivers who are abusive may be less likely to model adaptive responses to negative emotion or to respond appropriately to others' expressions of negative affect, thus impairing their children's emotional and social development (Salmon & Bryant, 2002). Second, given children's limited ability to encode information, immature verbal skills, and lack of experience, memories for early life trauma are prone to be poorly constructed and prone to misinterpretation (Vernberg & Varela, 2001; Salmon & Bryant,

2002). Therefore, childhood maltreatment, especially if it is chronic, can lead to the development of a distorted and maladaptive emotion processing style that persists into adulthood (Vernberg & Varela, 2001). In particular, chronic exposure to threat in early life may prime individuals to search maladaptively for signs of threat, even when danger is minimal (Pollak, 2003).

Childhood Maltreatment and Processing of Emotion in Facial Expressions

Pollak and colleagues have generated an impressive number of studies that converge to suggest that attention to and perception of emotional cues such as facial expressions occur atypically in maltreated youth. Pollak has proposed that this atypical pattern of functioning reflects one way in which children adapt to unpredictable and frightening environments (Pollak, 2003). More specifically, for children who live in unstable family environments where inconsistent emotional messages, angry threats, and violence are common, it may be adaptive to allocate attentional resources to identify potential threat in any incoming stimuli. Threatening facial expressions, which may have signaled impending violence in the past, may thus serve as particularly salient predictors of potential harm for individuals who have endured maltreatment and may be especially important to detect. Further, learning that threatening faces warrant immediate attention and response can significantly shape a child's evaluation of social signals in the future (Pollak, 2003). While adaptive in the presence of threat, the persistence of this biased emotion processing style can impair an individual's ability to attend to other salient emotional cues. As such, some researchers have noted that this style of emotion processing, when persistent, can increase risk for development of various types of psychopathology (Cicchetti & Toth, 1995).

In support of the idea that child maltreatment is associated with atypical responses to facial threat, Pollak and colleagues have found differences between maltreated and non-maltreated youth in their processing of angry faces at both behavioral and neural levels. In a behavioral study, Pollak and coworkers presented children with vignettes of a protagonist who experienced an emotional event (Pollak, Cicchetti, Hornung & Reed, 2000). They then asked the children to identify which of five faces (happy, sad, angry, disgusted, fearful) best represented the protagonist's likely feelings. The authors found that physically abused children, compared to neglected and non-maltreated peers, demonstrated a bias to select anger as their response.

Other studies examining face emotion perception in abused children suggest heightened sensitivity toward anger in faces. Pollak and Kistler (2002) presented physically abused and non-abused children with a facial expression discrimination task. Stimuli were drawn from several series of facial expressions that had been morphed along spectra from happy to fearful, happy to sad, angry to fearful, and angry to sad expressions. They thus represented either prototypical or subtle (in some cases highly ambiguous) exemplars of different emotions. The children were required to identify the expression (happy or sad, angry or sad, etc.) represented by faces drawn from various points in the emotional spectra. The authors found that abused children did not differ from non-abused peers in how they categorized expressions drawn from happy-fearful or happy-sad continua. However, they were more likely to categorize ambiguous facial expressions as angry in the angry-fearful and angry-sad continua than were non-abused children. In another study, Pollak and Sinha (2002) presented children with a series of facial expression images that progressively changed from highly degraded to clear and intact and asked them to label the expression as soon as they could identify it. They found that physically abused children were

able to identify angry expressions, but not other emotional expressions, more quickly and accurately than non-abused controls (Pollak & Sinha, 2002).

Other studies from Pollak's group have focused on neural responses to emotional cues. In one such study (Pollak, Cicchetti, Klorman & Brumaghim, 1997), they found evidence of increased brain activity measured via event-related potentials (ERPs), in physically abused children during exposure to angry faces. The abused children demonstrated an increase in P300 ERP signals during the presentation of angry stimuli; this pattern is of interest, because P300 is considered a neural indicator of cognitive resource allocation toward salient stimuli. No such increases were apparent in non-maltreated controls (Pollak, Cicchetti, Klorman & Brumaghim, 1997). A similar electrophysiological study (Pollak, Klorman, Thatcher & Cicchetti, 2001) found that maltreated children demonstrated stronger ERP signals to angry targets than happy or fearful targets. Maltreated children also more accurately labeled angry face stimuli than did controls. These studies further support the idea that abused children may respond preferentially at both neural and behavioral levels to threat-relevant stimuli.

Although Pollak's group has explored numerous aspects of facial expression processing in children with histories of maltreatment, they have not characterized participants in their studies in terms of psychopathology. To date, only two published studies have examined face emotion processing in children with post-traumatic pathology. Pine and colleagues (2005) found that maltreated children (most of whom were diagnosed with PTSD), unlike non-maltreated controls, demonstrated a bias away from threatening faces on the dot probe paradigm. Small group size, however, prevented comparisons between maltreated children with and without PTSD. More recently, Masten and colleagues (in press) found that maltreated children both with and without PTSD reacted more quickly than healthy controls to emotional faces, particularly

fearful faces, during an emotion labeling task (Masten, Guyer et al. in press). There were not enough maltreated participants in this study, however, without diagnoses of PTSD to compare performance between children with and without psychopathology. It is therefore unclear how the presence of PTSD symptoms related to patterns of performance in either study.

In general, it appears that survivors of childhood maltreatment may be predisposed to biases in emotional processing of ecologically salient cues, such as facial expressions. Physiological data reveal patterns of neural sensitivity to angry facial threat cues in maltreated children. Survivors of childhood maltreatment may also overattend to potential threat when interpreting emotional meaning in faces, maintain broader definitions of what constitutes an angry face, and have more difficulty disengaging from angry stimuli. While such increased sensitivity toward threat cues may be adaptive when threat is ongoing, such preferential allocation of information processing resources may impair social-cognitive development at both neural and behavioral levels, potentially increasing individual vulnerability in at least a subset of traumatized individuals toward later psychopathology.

Summary

Childhood maltreatment appears to increase risk for later development of PTSD; however, this disabling disorder occurs in only a minority of individuals exposed to extreme life stressors. PTSD theorists posit that biased information-processing styles may play a role in the development of this disorder; many neuropsychological studies of adults with PTSD have yielded evidence of cognitive biases. However, such studies have generally focused on later, more effortful stages of information processing, such as explicit memory. Those studies that have examined early stages of processing, such as attention, frequently used the Stroop task, an instrument with inherent limitations in measuring visual attention processes. General anxiety

theorists have more frequently studied atypical early-stage processing in anxious individuals, and many have observed a bias in attention to cues of threat, particularly among high trait anxious individuals. Given the volume of existing information-processing research focused on PTSD and generally anxious populations, it is surprising that few studies have aimed to understand how early trauma may relate to the development of atypical information-processing styles and adult psychopathology. Early childhood abuse has been associated with neurological alterations that could affect processing of incoming emotional information and thus increase risk for emotional disorders; social learning theorists have also provided explanations of how maltreated children may acquire maladaptive ways of responding to emotional cues. Indeed, empirical evidence has indicated that abused children show greater sensitivity toward cues of threat in ecologically salient stimuli, such as human facial expressions. It appears crucial, then, to examine how atypical early-stage information-processing mechanisms may be associated with risk for later life pathology in survivors of childhood maltreatment. Given the substantiated empirical associations between PTSD and information-processing bias, and between childhood maltreatment and bias toward threat as presented in human facial expressions, we will examine whether bias toward threat mediates associations between childhood maltreatment history and the presence of PTSD symptoms in a sample of adults.

Chapter 2: Methods

Participants and Procedure

Participants were recruited through an ongoing project at Emory University designed to examine risk factors for PTSD in a highly traumatized, low socioeconomic status, urban population. Participants were recruited from the general medical clinics of Grady Memorial Hospital, a publicly funded, not-for-profit healthcare system that serves economically

disadvantaged individuals in downtown Atlanta. Patients attending these clinics have been found to exhibit high rates of childhood maltreatment and post-traumatic symptoms that vary considerably in severity (Ressler et al., 2007).

Patients were deemed eligible for participation if they were able to give informed consent and understand English, as determined by a study researcher. Participants with current prominent suicidal ideations, medical conditions that contribute significantly to psychiatric symptoms (such as dementia), or a history of schizophrenia or other psychotic disorder as evaluated via the Structured Clinical Interview for the DSM (SCID; First, Spitzer et al. 1995) were excluded.

A total of 183 adult males and females aged 18-65 years participated in this study. Data for 54 of these participants, however, were excluded from analyses due to poor task performance (more than 20% skipped trials or errors) or age (greater than 60 years), yielding a final sample of 129 participants. Demographics and clinical characteristics of the final sample are described in Table 1.

Participants in this sample were primarily female (72%; n=92) and African-American (89.9%; n=116) and were, on average, 39.5 years of age (SD=12.51). Most participants had obtained 12 years or fewer of education (60.5%; n=78) and reported household monthly incomes of less than $1000 (70.2%; n=87). One-third of the participants in this sample reported a previous diagnosis of depression (33.3%; n=43) and/or previous drug or alcohol abuse or dependence (34.6%; n=44); approximately 10% (n=14) of this sample reported a previous diagnosis of PTSD. On average, participants reported mild to moderate current depressive symptoms according to the Beck Depression Inventory (BDI; Beck, 1996).

Measures

Dot Probe Task (Mogg & Bradley, 1999). The dot probe is a computerized behavioral task that requires participants to respond rapidly to a behavioral cue in the presence of distracting information that is emotional or neutral in nature. During each trial of the task, a pair of face photographs (both of the same actor) is presented for 500 milliseconds (ms). After the offset of the face pair, an asterisk is presented in the location that one of the faces occupied. Participants indicate as quickly as possible with a forced-choice button press response whether the asterisk appears on the left- or right-hand side of the screen. In each face pair, one face displays an emotional expression (either threatening or happy) and the other a neutral expression. The task consists of 80 randomly ordered trials (32 positive-neutral face pairs, 32 neutral-threat face pairs, and 16 neutral-neutral face pairs). The probe replaces emotionally-valenced stimuli during half of the trials, and replaces neutral stimuli during the other half of the trials. During neutral-neutral trials, the probe appears on the left or right side of the screen an equal number of times.

Emotion bias scores were calculated by subtracting response time to emotion-incongruent stimuli (probes that replace neutral pictures) from response time to emotion-congruent stimuli (probes that replace happy or threatening pictures). These bias scores can be further decomposed into threat and happy bias scores. Although this task has been widely used in experimental settings, no published data regarding reliability are available. Findings from prior research, however, suggest that the measure validly discriminates between anxious and non-anxious adults and youth (Bradley, Mogg et al. 1999; Wilson and MacLeod 2003; Mogg, Philippot et al. 2004; Pine, Mogg et al. 2005).

MPSS. The Modified PTSD Symptom Scale (MPSS; Falsetti, Resnick et al. 1993) is a brief self-report questionnaire with demonstrated diagnostic validity that was administered to

evaluate for presence and severity of PTSD symptomatology. The MPSS was administered orally by trained clinicians in order to avoid potential literacy problems common to the population under study. The MPSS assesses re-experiencing, avoidance, and arousal symptoms that have occurred in the 2 weeks prior to test administration. The MPSS includes items such as: "Have you had recurrent or intrusive distressing thoughts or recollections about the event(s)?" and "Have you persistently been making efforts to avoid activities, situations, or places that remind you of the event(s)?" Participants will be asked to rate frequency and severity of 18 such symptoms using a Likert-type scale. Frequency ratings range from 0 (not at all) to 3 (5 or more times per week/very much/almost always); severity ratings range from 0 (not at all distressing) to 4 (extremely distressing). A final question assesses how long the symptoms have been present (<1 month to >1 year). Separate severity and frequency scores can be obtained from this measure (only frequency was used in this study), and scores can be classified as either dichotomous or continuous variables. Falsetti and colleagues (1993) report that on this 119-point scale, typical total scores for individuals with PTSD fall between 46 and 71 points. The MPSS has good concurrent validity with the PTSD module of the structured clinical interview for DSM-III-R (Falsetti et al., 1993). The MPSS also has adequate reliability; Foa and colleagues (1993) reported a Cronbach's α of .91 for the total scale and a 1-month retest reliability of .74 (Foa et al., 1993).

CTQ. The Childhood Trauma Questionnaire (CTQ) is a 28-item self-report questionnaire that has shown acceptable reliability and validity in both clinical and community populations (Bernstein et al., 2003). Bernstein and colleagues (2003) found moderate levels of agreement between therapist observation ratings and CTQ scores (as high as .59 for physical abuse) and good internal consistency scores (physical abuse = 0.83 to 0.86, emotional abuse = 0.84 to 0.89,

and sexual abuse = 0.92 to 0.95). The CTQ has also shown adequate convergent validity in that its indices significantly correlate with another measure of childhood trauma, the Childhood Trauma Interview (Bernstein et al., 1994). The CTQ was administered orally by trained clinicians. The CTQ retrospectively measures frequency of childhood traumatic incidents classified into five categories: physical abuse, sexual abuse, emotional abuse, physical neglect, and emotional neglect. Trauma frequency ratings are made on a 5-point Likert scale: never true, rarely true, sometimes true, often true, and always true. Items listed on the CTQ both directly and indirectly query abuse, with statements including “I believe that I was physically abused” and “People in my family hit me so hard that it left me with bruises or marks.”

TEI. The Traumatic Events Interview (TEI) is a clinician-administered questionnaire designed to assess number and type of traumatic incidents the participant has experienced throughout his or her lifetime. The TEI includes a total of 15 questions about a range of potential traumatic events, including “Have you experienced a sudden life-threatening illness?” and “Have you witnessed a family member or friend being attacked without a weapon?” For each question, the TEI queries frequency of occurrence, age at onset of the “worst” incident, feelings of terror, horror, and helplessness (rated on a 0-2 severity scale) at worst incident, and subjective feelings that self or another person may die or be seriously injured at worst incident (rated on a 0-2 severity scale). The TEI was developed for the purposes of the parent project and collection of reliability and validity data is underway (Ressler et al., 2007).

ETI. The Early Trauma Inventory (ETI; Bremner, Vermetten & Mazure, 2000) is a clinician-administered interview created to assess occurrence of various types of childhood maltreatment. The ETI measures onset and frequency of three types of abuse—physical, emotional, and sexual—and also determines the most common perpetrator of the abuse. The ETI

has 32 total items, including questions such as, “Were you ever tied up or locked in a closet?” and “Did you ever experience someone rubbing their genitals against you?” The ETI has also shown good validity and reliability ratings; Bremner, Vermetten & Mazure (2000) reported an inter-rater reliability coefficient of .99, and the measure has demonstrated good validity when correlated with measures of psychopathology, such as the Civilian Mississippi Scale (r=.78) and trauma, such as the Checklist of Traumatic Events (r=.63).

DQ. The Experiences of Discrimination Questionnaire (DQ; Krieger et al., 2005) is a self-administered questionnaire designed to assess perceived racial discrimination. The Discrimination Questionnaire has a total of 28 questions that measure whether or not individuals have experienced racial discrimination within different settings (e.g. at school, while getting a job) and how frequently this discrimination may have occurred (i.e. once, two or three times, four or more times). Krieger and colleagues (2005) found good test-retest reliability coefficients (.70 and higher) and high correlations (up to .72) with indices of another measure of discrimination, the Williams Major and Everyday discrimination measure (Williams et al., 1997).

Data Analysis

Data were analyzed using Baron and Kenny’s (1986) multiple regression approach to assessing for the presence of mediator effects (Baron & Kenny, 1986). The diagram in Figure 1 illustrates the model tested. First, CTQ scores were examined as a predictor of PTSD symptoms (as measured by the MPSS), to establish that there was an effect to mediate (path c). Second, CTQ scores were examined as a predictor of attention bias (path a). Once these paths were established, MPSS score (PTSD symptoms) was regressed on CTQ scores after controlling for the effects of attention bias (path b). If, after entering attention bias scores, an attenuated or

insignificant relationship exists between childhood maltreatment and attention bias, then PTSD symptoms may be seen as a mediator of the relationship between childhood maltreatment and attention bias. As Baron & Kenny (1986) caution, full mediation, in which the effects of path c are reduced to complete non-significance, is uncommon in psychological research. However, significant changes in regression coefficients when potential mediators are added to the model, as measured using the Sobel test, may provide a measure of the strength of the mediator (PTSD symptoms).

Exploratory statistical analyses were also conducted to examine relationships among different types of childhood maltreatment (physical, sexual, and emotional), attention bias (for happy or threatening faces), and different clusters of PTSD symptoms (re-experiencing, avoidance and numbing, hyperarousal). One-way ANOVAs were conducted to examine associations of different types of childhood maltreatment, measured categorically, and attention bias; childhood maltreatment was measured both in terms of severity (absent versus severe) and number of types experienced (e.g., zero, one, two, or three types of emotional abuse experienced). Regression analyses were also conducted to investigate the effects of childhood maltreatment, attention bias, and PTSD symptomatology measured continuously. Given that many participants experienced multiple traumas in their lifetimes, TEI scores (which may influence attention bias scores) were entered as a covariate for all paths of analysis.

Given that the dot probe face stimuli consisted largely of White faces while the majority of participants were African-American, and the presence of empirical evidence suggesting that race and racial attitudes can contribute to cognitive biases (Hugenberg & Bodenhausen, 2003; Richeson & Trawalter, 2008), a separate set of exploratory regression analyses were conducted

to examine the influence of perceived racially discriminative experiences on participants' attentional preference for different facial expressions.

Power Analysis

Sample size was determined based on a power analysis conducted using a computerized power calculator (Bakeman & McArthur, 1999). Prior research examining associations between attention bias and posttraumatic psychopathology in a sample of maltreated and non-maltreated children (Pine et al., 2005) yielded an effect size of d=-.58; effect size has ranged from d=.32 to d=-.46 in other research examining attention bias in adults with and without PTSD (Bryant & Harvey, 1997). In order to achieve an 80% probability of identifying effects of this size when childhood trauma scores and attention bias scores were examined as predictors of PTSD symptomatology and alpha was set at .05, a total sample size of at least 67 participants was required.

Chapter 3: Results

Mediational Analyses

Correlations between attention bias scores and indices of the CTQ and MPSS, as well as other clinical measures, are presented in Table 2. As predicted, all three types of childhood maltreatment, including sexual, physical, and emotional abuse (measured using the CTQ physical, sexual and emotional abuse subscales) correlated significantly and positively with the three clusters of PTSD symptoms (as measured by indices of the MPSS). CTQ total score (values calculated with mean substitution for missing data) was associated most strongly with PTSD hyperarousal symptoms as measured by the MPSS (r = .54, p<.01). While no statistically significant relationships were found between childhood maltreatment and attention bias for threatening faces, attention bias for happy faces was significantly and positively associated with

all childhood maltreatment types. The strongest association was found between happy bias scores and total incidence of childhood maltreatment (CTQ total score (r = .25, p<.01).

According to Baron and Kenny (1986), mediational effects cannot be identified unless statistically significant associations exist among predictor and mediator variables (Path A), mediator and outcome variables (Path B), and predictor and outcome variables (Path C). For this study, we tested the statistical significance of associations between childhood maltreatment and attention bias (for threatening or happy faces, each examined separately) (Path A), attention bias and PTSD symptoms (Path B), and childhood maltreatment and PTSD symptoms (Path C). Statistically significant associations were found between attention bias for happy, but not threatening, faces and the other variables; therefore, mediational analyses were performed using only happy bias scores as the mediating variable (see Figure 1).

As shown in Figure 2, total incidence of childhood maltreatment predicted a significant amount of variance in happy bias scores (Path A; Beta=.25, R square=.06, p<.01). Total incidence of childhood maltreatment also predicted 26.4% of the variance in total PTSD symptoms (Path C; Beta=.51, R square=.26, p<.01) Attention bias for happy faces did not show a statistically significant association with total PTSD symptomatology (r=.15, *ns*).

However, a statistically significant association was found between attention bias for happy faces and PTSD avoidance and numbing symptoms (r=.19, p<.05). Happy bias thus accounted for a statistically significant amount of variance in PTSD avoidance/numbing symptoms (Beta=.19, R square=.04, p<.05). Given these findings, the Path C analysis was repeated to examine associations between childhood maltreatment and PTSD avoidance/numbing symptoms specifically; total incidence of maltreatment explained 20.8% of

the variance in PTSD avoidance/numbing symptoms (Beta=.46, R square=.21, p<.01). Figure 3 describes this alternate statistical model.

Sobel's test for indirect effects, which was used to test the statistical significance of attention bias as a mediating variable, yielded a value of 1.63 (p=.10) for the model in which PTSD avoidance and numbing symptoms served as the outcome variable. Thus, attention bias for happy faces was not found to be a statistically significant mediator of the relationship between childhood maltreatment and PTSD avoidance and numbing symptoms.

Exploratory Analyses

A separate set of analyses was conducted to explore potential differences in attention bias among different groups of participants in this sample, namely, those with and without childhood abuse histories, and among participants with different types of abuse.

Attention bias and severity of childhood maltreatment. One-way ANOVAs were conducted to examine potential differences in attention bias among participants who reported experiencing none, mild, moderate, or severe histories of physical, sexual, or emotional abuse on the CTQ. Post hoc Tukey's tests of honestly significant difference were used to compare mean attention bias scores within each abuse severity subtype. As shown in Table 3, attention bias for happy faces did not differ significantly according to severity of childhood physical abuse, $F(3, 115)=.85$, $p > .05$, or sexual abuse, $F(3, 115)=2.02$, $p > .05$ (see Table 4). However, significant differences in happy bias scores were evident for severity of emotional abuse, $F(3, 115)= 2.92$, $p < .05$ (see Table 5). Post hoc analyses indicated that participants who had experienced severe emotional abuse allocated their attention toward happy faces (Mean bias score=13.86, SD=26.03), while participants without a history of childhood emotional abuse demonstrated an attentional preference away from happy faces (Mean bias score=-9.41, SD=36.72). No

statistically significant associations were found between threat bias and severity of childhood maltreatment, measured categorically.

Attention bias, childhood maltreatment, and adult trauma. Regression analyses were conducted to examine the unique contribution of childhood maltreatment to attention bias toward happy faces after accounting for the contributions of adult trauma. Total incidence of adult trauma contributed a significant amount of variance to happy bias scores (Beta=.25, R square=.06, p<.01); when added to this model, total incidence of childhood maltreatment also significantly contributed to the variance in happy bias scores (Beta=.16, R square=.08, p<.01). These results are detailed in Table 6. When examined individually, subtypes of childhood maltreatment (physical, sexual, and emotional maltreatment, measured continuously) were not statistically significant predictors of attention bias toward happy faces.

Attention bias, trauma, and PTSD. Regression analyses were also conducted to investigate the relationship between attention bias and PTSD symptomatology after controlling for the effects of trauma. While total PTSD symptoms did not predict a significant amount of variance in attention bias toward happy faces (Beta=.15, R square=.02, *ns*), PTSD avoidance and numbing symptoms accounted for a significant amount of variance in happy bias scores (Beta=.19, R square=.04, *p*<.05); these findings are shown in Table 7. This relationship remained significant even after controlling for total amount of trauma experienced (Beta=.03, R square=.06, *p*<.05), or current depressive symptomatology, as measured by the BDI (Beta=.25, R square=.04, *p*=.05). Thus, it appears that attention bias toward happy faces may be associated with post-traumatic psychopathology, particularly avoidance and numbing symptoms.

Childhood maltreatment, attention bias, racial discrimination, the interaction of attention bias and perceived racial discrimination, and PTSD. Finally, total incidence of childhood

maltreatment, perceived racially discriminative experiences, attention bias (for threatening or happy faces), and the interaction of attention bias and perceived racially discriminative experiences were entered hierarchically in a regression equation to examine the associations of these variables with PTSD symptomatology; total childhood maltreatment was entered at step 1, discriminative experiences entered at step 2, attention bias scores entered at step 3, and interaction of attention bias and perceived racial discrimination at step 4. Childhood maltreatment (Beta=.52) and perceived racially discriminative experiences (Beta=.18) together explained 35% of the variance in PTSD symptoms ($p<.01$). When added to this model, attention bias for threatening faces (Beta=.07) produced a significant R square change of.005; addition of the threat bias/perceived racial discrimination interaction term also produced a significant R square change (.041; see Table 8), and all four variables together accounted for 40% of the variance in PTSD symptoms ($p<.01$). The threat bias/racial discrimination interaction term (Beta=.331) accounted for more variance in total PTSD symptomology than threat bias or perceived racial discrimination examined independently. When added to the model at step 3, attention bias for happy faces (Beta=.06, R square=.354, $p<.01$) and the happy bias/racial discrimination interaction term (Beta=.26, R square=.384, $p<.01$; see Table 9) also improved the overall model significantly (R square changes of .004 at step 3 and .030 at step 4), although modestly. Therefore, it appears that the association between childhood maltreatment and PTSD symptoms in this sample may be complicated by both attentional and environmental factors, including attention bias and perceived experiences of racial discrimination.

Chapter 4: Discussion

The findings from this study indicate a complex set of relationships among childhood maltreatment, early-stage information processing, and post-traumatic psychopathology in a sample of highly traumatized, economically disadvantaged adults, most of whom are members of an underserved racial minority group. Our primary analyses examined whether two types of attention bias (bias toward/away from threatening faces, bias toward/away from happy faces) mediated the association between childhood maltreatment and PTSD symptomatology. While neither type of attention bias was found to be a statistically significant mediator according to a conservative test of indirect effects (Sobel test; Baron & Kenny, 1986), regression analyses demonstrated that attention bias toward happy faces and total incidence of childhood maltreatment together explained more variance in PTSD avoidance and numbing symptoms than did childhood maltreatment alone. These effects were found to be significant even after controlling for current depressive symptomatology. Thus, attention bias and childhood maltreatment appear to have distinct associations with PTSD symptomatology, particularly, avoidance and numbing symptoms, in adulthood.

Notably, the patterns of attentional allocation observed in this study diverged from those reported in many earlier studies, including studies of maltreated children and adults with PTSD (Bryant & Harvey 1997; Pollak, 2002). In particular, adult survivors of childhood sexual, physical, or emotional abuse did not demonstrate attentional preference for threatening faces, as was predicted based on prior findings in the literature. Rather, these participants, particularly individuals who had suffered frequent and severe emotional abuse, showed an attentional bias *toward* happy faces, relative to neutral faces, even when adult trauma and comorbid depression

were covaried. Likewise, incidence of traumatic events, including adult trauma measured in isolation, was significantly associated with attention bias toward happy faces.

This pattern of findings is surprising, given that attention bias toward positive social cues has been shown more typically to relate to adaptive emotion regulation. For example, Joorman and Gotlib (2007) found that healthy controls demonstrated a bias toward happy faces on the dot probe task, while depressed participants showed an attention bias toward sad faces. Indeed, findings from one study suggest that selective attention toward positive cues may even enhance emotional functioning in normative samples. Wadlinger and Isaacowitz (2008) found that training a group of undergraduate students to attend to positive cues led to shorter gaze duration toward subsequent negative stimuli. The authors discussed the value of attending selectively toward positive social cues while avoiding negative cues, and stated that this strategy may aid in elevating mood and sustaining positive affect.

One possible explanation for our ostensibly counterintuitive findings is that participants in the present study have learned to attend to positive cues as a means of coping with constant environmental adversity. The majority of participants in this study sample were poor, had had limited access to education, and reported frequently experiencing racial discrimination. Frequency of trauma in this sample was also higher than is typical in populations most widely studied in the PTSD information processing literature. Thus, selective attention for positive cues may be a necessary and fundamental skill that is required for survival in a challenging, frequently punitive, environment in which such positive feedback may be rare, particularly from racial majority group members, like those depicted in most of the study stimuli.

However, we found that this bias toward happy faces was also significantly associated with PTSD symptomatology, even after statistically controlling for the experience of trauma.

Notably, attention bias toward happy faces was associated with avoidance and numbing symptoms. Avoidance of trauma-related cues (both physical reminders and thoughts of the trauma) contributes significantly to the maintenance of PTSD by preventing affected individuals from confronting feared trauma stimuli and thus precludes learning to extinguish exaggerated fear responses (Rothbaum & Davis, 2003). Thus, our findings may suggest that selective attention for positive social cues could play a role in maintaining post-traumatic psychopathology. While an attentional preference for positive social cues be adaptive on a fundamental level, it is possible that by over-attending to these cues an individual may be avoiding other negatively-valenced environmental cues, thereby preventing emotional processing of these salient social signals. As such, this bias in early-stage information processing (even for positive social cues) could limit appropriate processing of all relevant environmental stimuli and promote inaccuracies in later stages of information processing, such as judgment. This tendency for individuals with PTSD symptomatology to over-respond to positive social cues could be biologically mediated; Armony and colleagues (2005) found that increases in amygdala responsivity to unmasked happy faces corresponded with increases in PTSD symptoms. However, whether selective attention for positive social cues represents a risk factor for PTSD or is part of PTSD sequelae remains unclear, due to the cross-sectional nature of this study.

Interestingly, attention bias toward happy faces was not associated with intrusive and hyperarousal PTSD symptoms in our initial analyses, although more inclusive regression analyses (i.e., regression models that included perceived racial discrimination and childhood maltreatment) indicated associations with total PTSD symptomatology. It is possible that attentional bias toward happy cues is related to an emotionally avoidant style; specifically, individuals with these attentional tendencies may experience marked avoidance of physical

reminders of trauma more frequently than cognitive intrusions and hypervigilance. Thus, individuals with this attentional bias may potentially benefit most from PTSD treatment that targets such avoidance, namely, in-vivo exposure therapy.

Negative experiences that extend beyond severe trauma may also have influenced the pattern of findings in the present sample. In particular, perceived racial discrimination may be relevant to understanding patterns of attentional response to the White/Caucasian facial expressions in the dot probe task within our largely (90%) African-American sample. Because participants reported a large number of racially discriminative experiences, presumably at least some of which were at the hands of White/Caucasian individuals, White faces that don't convey unambiguously positive cues (e.g., neutral or angry faces) could represent social threats. Thus, the use of a task that includes almost exclusively White/Caucasian stimuli may have led to biased results.

Social cognitive studies indicate that race, and racial attitudes, can significantly influence performance on face processing tasks. On a basic level, identification of race in faces appears to occur before identification of other salient facial features. Montepare and Opeyo (2002) found, for example, that a sample of mostly White participants identified race more quickly than other aspects of photographed faces, such as age, gender, and facial expression. Additionally, cognitive research suggests an out-group homogeneity bias in face perception—that is, individuals tend to over-generalize features of individuals outside their own racial group and individuate features of in-group members (for a review, see Messick and Mackie, 1989). Racial attitudes also appear to influence face emotion categorization; Hugenberg and Bodenhausen (2003) found that White participants with higher implicit levels of prejudice perceived hostility

in African-American faces longer than in White faces when presented with a morphed hostile to happy face expression continuum.

This cognitive bias may take different directions at earlier versus later stages of attention. Richeson and Trawalter (2008) administered the dot probe to a sample of White undergraduates, using both shorter (30ms) and longer (450ms) stimulus presentation times and neutral versus happy facial expressions from African-American and White actors. They found that participants who were externally motivated to respond nonprejudicially toward African-Americans tended to orient toward neutral African-American faces during shorter stimulus presentations, and away from neutral African-American faces during longer presentations; no attention bias was found for happy faces as a whole. Presumably, the neutral African-American faces were perceived to be more threatening than happy faces.

Thus, it is possible that our findings reflect a similar effect, in which a history of racially discriminative experiences biased participants' categorization of emotional cues displayed on White faces, such that they perceived even neutral faces as threatening. Such a categorization bias could then affect threat bias scores. Impaired discrimination between threatening and neutral emotional signals has been observed previously in individuals with PTSD; Felmingham and colleagues (2003) found that individuals with PTSD demonstrated similar ERPs to angry and neutral faces, while non-traumatized controls had distinctly different ERPs to these stimuli, leading the authors to conclude that the PTSD group had difficulty differentiating these emotional signals.

While our findings did not indicate statistically significant associations between attention bias scores and discriminative experiences, we found that childhood maltreatment, racially discriminative experiences, attention bias, and the interaction of attention bias/perceived racial

discrimination together contributed to a statistically significant amount of variance in PTSD symptoms. As such, it appears that both extrapersonal (adverse childhood experiences, racial discrimination) and intrapersonal factors (attention bias) together strongly predict the incidence of PTSD psychopathology in this sample, which is not surprising given the complicated and frequently difficult life experiences of our participants. Interestingly, the interaction of attention bias toward threat and perceived racial discrimination accounted for more variance in total PTSD symptoms than threat bias or perceived racial discrimination alone, indicating that the effects of each of these variables may amplify the other. These findings suggest that individuals who are generally sensitized toward perceiving hostility in their environment may be more susceptible toward the development of posttraumatic psychopathology after trauma; further exploration of the relationship between perceived race-related threat and attention bias for threatening emotional cues would be a worthwhile endeavor in future research.

Several study limitations are worth noting. First, it is possible that our statistical methods were too conservative to allow us to detect statistical significance of attention bias as a mediator. More liberal methods, such as bootstrapping, could have detected significance in mediational effects (Chernick, 1999). Also, given that dot probe stimuli consisted largely of White faces, and that our study sample was primarily African-American, our results could reflect the influence of variables, such as demographic features, that extend beyond the target variables under study. Replication of the present study with a more diverse dot probe face stimulus set would be helpful to address potential confounding effects of viewing other-race faces and racial discrimination on attention bias, particularly threat bias. The attentional patterns we observed may be demographically mediated; it is possible that completely different attentional tendencies could emerge in a population with markedly different demographic characteristics. Similarly, the

happy face bias we observed may actually be adaptive for our study participants, for whom environmental adversity is frequent—attending to positive social cues may, in fact, be associated with resilience. Finally, the attentional patterns we observed may have been a reflection of stimulus duration; it is possible that shorter (subliminal) or longer (overt) stimulus presentations could elicit distinctly different patterns of attention allocation.

The data reported here indicate that biases in early-stage information processing partially mediate the relationship between childhood maltreatment and some aspects of PTSD symptomatology in our highly traumatized and underprivileged sample. Further studies of individuals with similar demographic characteristics are warranted to better differentiate information-processing mechanisms of psychopathology and resilience for this unique population. The use of a more diverse dot probe face stimulus set and different stimulus onset times can address potential threats to ecological validity and better differentiate attentional patterns at different stages of processing. Psychophysiological methods, such as electroencephalography (EEG) and fMRI can also address underlying biological mechanisms of these processes.

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Appendix A: Figures

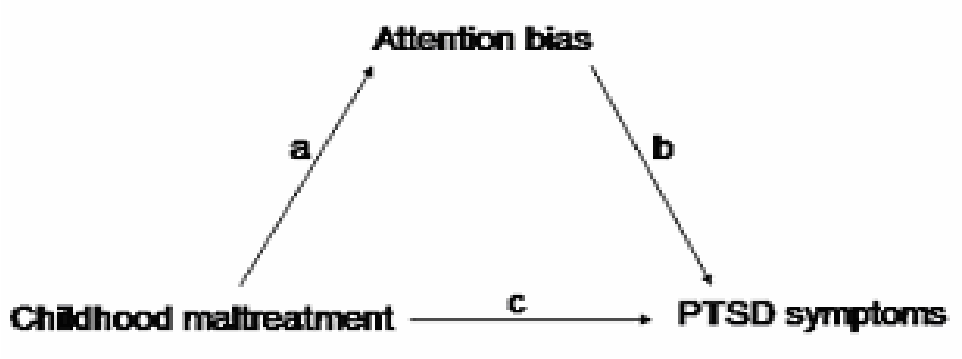

Figure 1. Attention Bias as a Mediator of the Relationship Between Childhood Maltreatment and PTSD

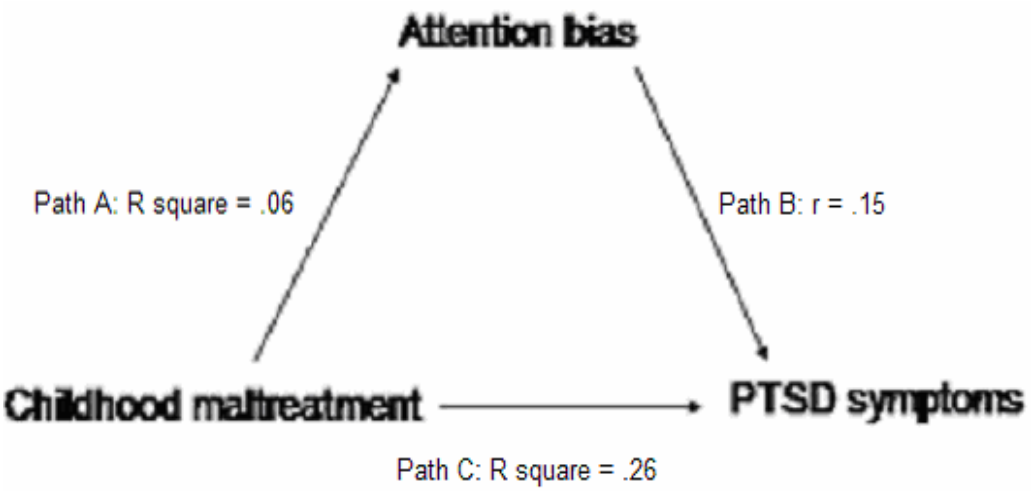

Figure 2. Attention bias for happy faces as a mediator of the relationship between childhood

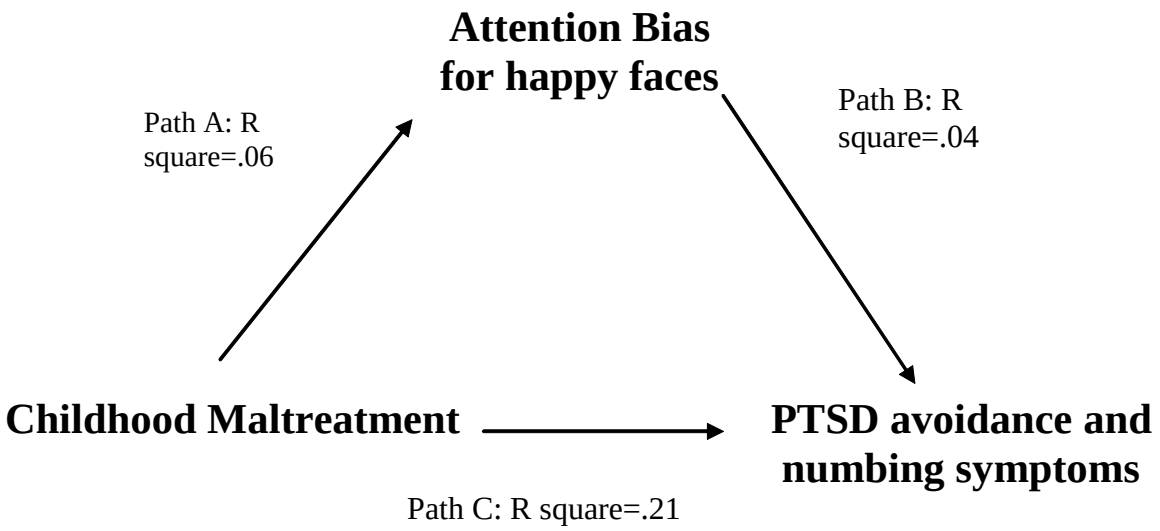

Figure 3. Attention bias for happy faces as a mediator of the relationship between childhood maltreatment and PTSD avoidance and numbing symptoms

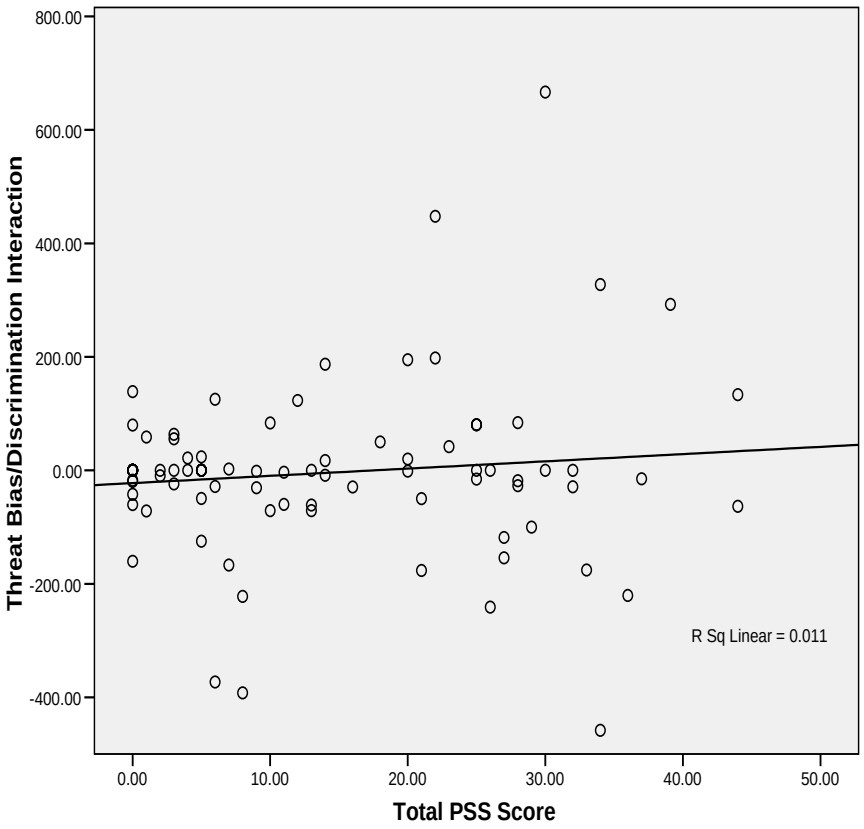

Figure 4. Interaction of perceived racial discrimination and threat bias is significantly associated with total PTSD symptoms

Appendix B: Tables

Table 1.

Demographics and Clinical Characteristics

	Female	Male	Total
Age mean (SD)	38.61 (12.47)	40.9 (12.41)	39.5 (12.51)
Race			
African American or Black	82 (89.1%)	32 (91.4%)	116 (89.9%)
Caucasian or White	7 (7.6%)	3 (8.6%)	10 (7.8%)
Other	3 (3.3%)	0	3 (2.4%)
Education			
< 12th grade	22 (23.9%)	6 (17.1%)	30 (23.3%)
12th grade or GED	32 (34.8%)	16 (45.7%)	48 (37.2%)
some college or tech school	22 (23.9%)	7 (20.0%)	29 (22.5%)
college or tech school graduate	16 (17.4%)	5 (14.3%)	21 (16.3%)
graduate school	0	1 (2.9%)	1 (0.8%)
Household monthly income			
$0 - $249	22 (25.3%)	11 (31.4%)	34 (27.4%)
$250 - $499	9 (10.3%)	4 (11.4%)	13 (10.5%)
$500 - $999	28 (32.2%)	12 (34.3%)	40 (32.3%)
$1000 - $1999	19 (21.8%)	4 (11.4%)	24 (19.4%)
$2000+	9 (10.3%)	4 (11.4%)	13 (10.5%)
Previous psychiatric hospitalization	16 (17.4%)	8 (22.9%)	24 (18.6%)
Previous PTSD diagnosis	12 (13.0%)	2 (5.7%)	14 (10.9%)
Previous depression diagnosis	37 (40.2%)	6 (17.1%)	43 (33.3%)
Past drug or alcohol abuse/dependence	25 (27.2%)	17 (50.0%)	44 (34.6%)
Current substance abuse/dependence	5 (5.4%)	3 (8.6%)	10 (7.8%)
CTQ total score – Mean (SD)	43.99 (22.81)	40.80 (18.02)	42.94 (21.41)
TEI total trauma incidence	3.82 (3.68)	4.10 (3.11)	3.93 (3.52)
TEI trauma incidence in adulthood	2.95 (2.76)	3.57 (2.46)	3.12 (2.68)
PSS total	13.01 (12.16)	14.97 (12.88)	13.63 (12.33)
BDI total score	15.11 (12.88)	11.52 (10.88)	14.10 (12.38)

Table 2.

Intercorrelations Among Attention Bias Scores and Clinical Measures

	2	3	4	5	6	7	8	9	10	11	12	13
1. Threat Bias	-.01	-.13	-.10	-.10	-.11	-.11	-.06	-.13	-.12	-.04	-.14	.04
2. Happy Bias		.25**	.20*	.23*	.22*	.15	.13	.19*	.07	.07	-.01	.14
3. CTQ Total			.78*	.88**	.93**	.51**	.40**	.46**	.54**	.45**	.26**	.24*
4. CTQ Sexual Abuse				.59**	.66**	.37**	.27**	.32**	.42**	.35**	.31**	.08
5. CTQ Physical Abuse					.81**	.49**	.44**	.42**	.48**	.41**	.25*	.21
6. CTQ Emotional Abuse						.52**	.41**	.46**	.56**	.52**	.26**	.31**
7. PSS Total							.85**	.94**	.89**	.69**	.40**	.26**
8. PSS Intrusive Symptoms								.69**	.66**	.51**	.31**	.09
9. PSS Avoidance/Numbing									.75**	.66**	.33**	.30**
10. PSS Hyperarousal										.66**	.47**	.25**
11. BDI Total											.43**	.28**
12. DES Total †												.03
13. Discrimination Questionnaire (number of types experienced)												—

† Dissociative Experiences Scale
* p <.05
** p <.01

Table 3.

Childhood physical abuse is not associated with attention bias for happy faces

Childhood physical abuse	N	Mean attention bias score (SD)
None	65	-10.75 (34.47)
Mild	19	.36 (34.69)
Moderate	13	-4.37 (28.89)
Severe	22	.03 (37.73)

Table 4.

Childhood sexual abuse is not associated with attention bias for happy faces

Childhood sexual abuse	N	Mean attention bias score (SD)
None	76	-11.70 (34.56)
Mild	9	9.09 (48.18)
Moderate	13	-3.08 (26.16)
Severe	21	4.75 (29.40)

Table 5.

Attention bias for happy faces is associated with severe childhood emotional abuse

Childhood emotional abuse	N	Mean attention bias score (SD)
None	66	-9.41 (36.72)
Mild	22	-11.81 (25.37)
Moderate	11	-13.12 (40.92)
Severe	20	13.86 (26.03)

Table 6.

Childhood maltreatment predicts attention bias toward happy faces

		N	Beta	P	R square
Step 1	TEI total adult trauma	113	.25	.007	.06
Step 2	TEI total adult trauma	113	.17	.13	.08
	CTQ total	113	.16	.15	

*Dependent variable = happy bias

Table 7.

PTSD avoidance and numbing symptoms predict attention bias toward happy faces

		N	Beta	P	R square
Step 1	TEI total trauma	116	.24	.011	.06
Step 2	TEI total trauma	116	.16	.15	.07
	PTSD avoidance and numbing	116	.14	.20	

*Dependent variable = happy bias

Table 8.

Childhood maltreatment, perceived racial discrimination, attention bias for threatening faces and the interaction between perceived racial discrimination and threat bias predicts total PTSD symptoms

		N	Beta	P	R square
Step 1	CTQ total	80	.56	.000	.32
Step 2	CTQ total	80	.52	.000	.35
	Amount of racial discrimination experienced	80	.18	.05	
Step 3	CTQ total	80	.54	.000	.36
	Amount of racial discrimination experienced	80	.18	.06	
	Threat bias	80	.07	.45	
Step 4	CTQ total	80	.55	.000	.40
	Amount of racial discrimination experienced		.17	.08	
	Threat bias	80	-.19	.20	
	Threat bias/Discrimination interaction	80	.33	.03	

*Dependent variable = total PTSD symptoms

Table 9.

Childhood maltreatment, racial discrimination and attention bias for happy faces predicts total PTSD symptoms

		N	Beta	P	R square
Step 1	CTQ total	80	.56	.000	.32
Step 2	CTQ total	80	.52	.000	.35
	Amount of racial discrimination experienced	80	.18	.05	
Step 3	CTQ total	80	.52	.000	.35
	Amount of racial discrimination experienced	80	.18	.07	
	Happy bias	80	.06	.52	
Step 4	CTQ total	80	.52	.000	.38
	Amount of racial discrimination experienced	80	.19	.05	
	Happy bias	80	-.13	.35	
	Happy bias/Discrimination interaction	80	.26	.06	

*Dependent variable = total PTSD symptoms