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Content specificity of attentional bias to threat in post-traumatic stress disorder

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ABSTRACT

Background: Attentional bias to affective information and reduced cognitive control may maintain the symptoms of post-traumatic stress disorder (PTSD) and impair cognitive functioning. However, the role of content specificity of affective stimuli (e.g., trauma-related, emotional trauma-unrelated) in the observed attentional bias and cognitive control is less clear, as this has not been tested simultaneously before. Therefore, we examined the content specificity of attentional bias to threat in PTSD.

Methods: PTSD participants (survivors of a multistory factory collapse, n = 30) and matched controls (n = 30) performed an Eriksen Flanker task. They identified the direction of a centrally presented target arrow, which was flanked by several task-irrelevant distractor arrows pointed to the same (congruent) or opposite direction (incongruent). Additionally, participants were presented with a picture of a face (neutral, emotional) or building (neutral = normal, emotional = collapsed multistory factory) as a task-irrelevant background image.

Results: We found that PTSD participants produced overall larger conflict effects and longer reaction times (RT) to emotional than to neutral stimuli relative to their healthy counterparts. Moreover, PTSD, but not healthy participants showed a stimulus specific dissociation in processing emotional stimuli. Emotional faces elicited longer RTs compared to neutral faces, while *emotional buildings* elicited faster responses, compared to *neutral buildings*.

Conclusions: PTSD patients show a *content-sensitive* attentional bias to emotional information and impaired cognitive control.

1. Introduction

Traumatic life-threatening events, such as warfare, car accidents, or a building collapse often leave emotional scars and might lead to post-traumatic stress disorder (PTSD). PTSD is an anxiety disorder characterized by flashbacks and memories of a traumatic event that can significantly disrupt patients' executive and attentional processes. For instance, PTSD relative to healthy controls showed worse performance on the color–word Stroop task, which is thought to be a measure of inhibitory function and executive control (Lagarde, Doyon, & Brunet, 2010). With regard to attentional processes, accumulating evidence suggest that people with PTSD experience an attentional bias to emotional information. They seem to orient their attention toward emotional stimuli (Morey, Petty, Cooper, Labar, & McCarthy, 2008; Morey et al., 2009; Pannu Hayes, Labar, Petty, McCarthy, & Morey, 2009; Bremner, 2001; Shin et al., 2001) and have difficulties disengaging their attention away from emotional stimuli (Pineles, Shipherd, Welch, & Yovel, 2007; Pineles, Shipherd, Mostoufi, Abramovitz, & Yovel, 2009, see Clarke, Macleod, & Guastella, 2013 for a critique of an unwarranted dissociation between allocation and disengagement of attention in anxious individuals). As a result, PTSD may result in an interplay between facilitated "emotional" processing networks that bias attention toward particular stimuli, and reduced "inhibitory" networks that may fail to redirect attention to the task at hand (Aupperle et al., 2012). Moreover, evidence showed that attentional biases may maintain PTSD symptoms, impede information processing, and disrupt cognitive abilities (Weber, 2008).

However, it is not completely clear whether attentional bias in PTSD

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varies as a function of emotional content (i.e., *trauma-related* or *trauma-unrelated* stimuli). Some studies suggested that attentional bias in PTSD might be specific to the trauma-related information (Fleurkens, Rinck, & van Minnen, 2011; Ashley, Honzel, Larsen, Justus, & Swick, 2013). For instance, specific interference effects were observed for trauma-related words in rape victims (Foa, Feske, Murdock, Kozak, & Mccarthy, 1991; Cassiday, Mcnally, & Zeitlin, 1992). These findings are in line with several cognitive models that emphasize the role of previous experience and memory during threat processing (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007).

Conversely, other studies reported equal attentional interference by emotional *trauma-unrelated* stimuli (Litz et al., 1996; Vythilingam et al., 2007; Kimble et al., 2010). For example, Litz et al. (1996) found that Vietnam veterans who suffered from PTSD showed an emotional Stroop interference effect for both high-threat military words and high-threat education words in comparison with low-threat military words and low-threat education words. This finding suggests a generalized interference by salient affective stimuli, irrespective of content. Furthermore, recent reviews (Shin & Liberzon, 2010; Liberzon & Sripada, 2008; Francati, Vermetten, & Bremner, 2007) and meta-analyses (Etkin & Wager, 2007) demonstrated a hyperactivation within the limbic regions of in PTSD patients (particularly in amygdala and insula). This implies that PTSD individuals may show an automatic and content-unspecific attentional bias to any threatening stimuli (Litz et al., 1996; Vythilingam et al., 2007; Kimble et al., 2010).

Finally, several studies have failed to replicate the finding of greater interference for trauma-related words in PTSD (Freeman & Beck, 2000; Devineni, Blanchard, Hickling, & Buckley, 2004; Wittekind, Jelinek, Kellner, Moritz, & Muhtz, 2010). Overall, due to inconsistencies in previous findings, the role of attentional bias specificity in PTSD is poorly understood. In this context, the goal of this study was twofold: (i) we intended to identify the presence of a deficit in cognitive control among individuals with PTSD, and if so (ii) further examine whether any such deficit may vary as a function of stimulus type (trauma-related and emotional trauma-unrelated).

The PTSD group consisted of the survivors from the Rana Plaza building collapse[1] (Fitch, Villanueva, Quadir, & Alamgir, 2015) as well as age- and education-matched healthy controls. Importantly, a unique factor of the current sample is the homogeneity of PTSD group. Previous studies on content specificity of attentional bias tested PTSD participants who have been exposed to a variety of traumatic events, and it was also difficult to control for the onset of trauma between participants. Alternatively, trauma experience in the current PTSD group relates to a single event and, thus, current sample overcomes this problem.

Participants were presented with an arrow Flanker task (Ridderinkhof, Band, & Logan, 1999) and were asked to identify whether the centrally presented arrow was pointing to the left or to the right while ignoring two adjacent arrows on either side, pointing in the same (congruent trial) or in the opposite direction (incongruent trials). Participants were asked to make a decision by pressing either the right or left button. Most importantly for the purpose of the study, in each trial either a picture of a face (neutral, emotional) or a building (control = intact buildings, collapsed Rana Plaza) was presented as a background image and was task-irrelevant.

Based on the existing evidences, we hypothesized that PTSD patients would show larger conflict effect, compared to the healthy controls (Lagarde et al., 2010). We expect a number of possible outcomes with regard to the influence of trauma-specific and non-specific threatening information on cognitive conflict processing. For example, emotional stimuli might not influence conflict processing at all, considering that these stimuli are entirely task-irrelevant (Freeman & Beck, 2000; Devineni et al., 2004). It is more likely, however, that both trauma-related and threat-general stimuli would interfere with cognitive control (Litz et al., 1996; Vythilingam et al., 2007; Kimble et al., 2010). More specifically, we expect trauma-specific stimuli to elicit greater interference effect compared to non-specific threatening stimuli in PTSD patients (Foa et al., 1991; Bar-Haim et al., 2007).

2. Methods

2.1. Participants

In this study, 30 healthy participants (male = 15, mean age = 22.5 years, SD = 3) and 30 PTSD patients who were matched for age and level of education (see Table 1; male = 18, mean age = 23 years, SD = 4) and with normal or corrected-to normal vision participated. All participants were right handed, had normal or corrected-to-normal vision and were naïve with respect to the purpose of the study. Participants were recruited at the Gonoshasthaya Kendra (Peoples Health Center), Dhaka, Bangladesh. PTSD was diagnosed by registered clinical psychologists with the Structured Clinical Interview for DSM-IV (American Psychiatric Association, 2000) and met DSM-IV diagnostic criteria for post-traumatic stress disorder. In addition to the clinical interview, we have also asked participants to fill out a Bangladesh version of the 22-item Impact of Events Scale-Revised (IES-R; Weiss & Marmar, 1997). Furthermore, the exclusion criteria included any neurological or additional psychiatric disorders (i.e., schizophrenia, epilepsy). Additionally, we excluded patients who suffered from alcohol dependence (1 patient) and who were not able to remember the traumatic event, as the nature of this memory loss was not clear (2 patients). The patients were non-medicated. All participants signed a consent form prior to participation. The experiment was conducted in accordance with guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the North South University, Dhaka, Bangladesh (NSU/Pharmacy/2015/001).

2.2. Stimulus material

Stimuli consisted of pictures of human faces (male, female) and buildings. The faces could either be neutral (neutral condition) or emotionally negative (negative condition). The buildings could also be neutral (*normal buildings*) or emotional (pictures of the collapsed Rana Plaza). The pictures of faces and neutral buildings were taken from the Lifespan Database of Adult Facial Stimuli and House stimuli of the University of Dallas (Minear and Park, 2004).

2.3. Design and tasks

Experiment was split into four blocks with 52 pictures/trials each (26 emotional and 26 neutral, half were congruent and the other half incongruent) presented in a pseudo-randomized order. Overall, there were 208 trials and testing took approximately 45 min per participant.

Each trial contained a target arrow that was presented in the center either pointing to the right or to the left. Additionally, two task-irrelevant flanker arrows were presented to the right and to the left side of the central target arrow. These flanker arrows either pointed in the same direction as the central target arrow (congruent trials) or in the opposite direction (incongruent trials). The Flanker stimulus subtended visual angles 6.29° × 2.29° (11 cm × 4 cm). In each trial, there was also a task-irrelevant picture presented in the background of the centrally presented Flanker task. The picture stimulus subtended visual angles 10.85° × 8.01° (19 cm × 14 cm) and remained on the screen as long as the flanker stimuli. Participants were instructed to report whether the central target arrow was pointing to the left (left-hand button) or to the right (right-hand button) and to ignore task-irrelevant

[1] Multistory factory collapse (called Rana Plaza, in 2013) resulted in over 1120 deaths and 2000 causalities. Many victims remain missing.