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The role of attentional biases in PTSD: Is it interference or facilitation?

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Abstract

Although attentional biases have been demonstrated in individuals with posttraumatic stress disorder (PTSD), the cognitive methodologies used have not allowed for disambiguation of two types of attentional biases. It remains unclear if PTSD involves difficulty disengaging attention from threatening stimuli (interference) or facilitated detection. To differentiate between attentional interference and facilitation, 57 male Vietnam-era veterans (30 High PTSD and 27 Low PTSD) completed a visual search task with a lexical decision component. High PTSD veterans who engaged in the interference task first showed increased interference to threat-relevant words relative to Low PTSD veterans. However, no evidence was found for facilitated detection of threatening stimuli in PTSD.
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Keywords: Posttraumatic stress disorder; Attentional bias; Attentional interference; Attentional facilitation

Introduction

Using the emotional Stroop task (Gotlib & McCann, 1984), several studies have shown that individuals with PTSD exhibit attentional biases to threat-relevant stimuli (e.g., Beck, Freeman, Shipherd, Hamblen, & Lackner, 2001; Buckley, Blanchard, & Neill, 2000). Nonetheless, Stroop interference is not a pure measure of *attentional* bias, because interference may be the result of response selection processes (i.e., reporting the color name) rather than the input stage of information processing (Mogg & Bradley, 1998). In addition, both the emotional Stroop and another well-studied paradigm, the visual dot-probe (MacLeod, Mathews, & Tata, 1986), are ambiguous regarding the exact nature of threat-related bias. Specifically, both tasks fail to differentiate between enhanced detection of threatening stimuli (*attentional facilitation*) and difficulties in disengagement from such stimuli that results in interference to another primary task (*attentional interference*) (Derryberry & Reed, 1994; Fox, Russo, Bowles, & Dutton, 2001; Fox, Russo, & Dutton, 2002; Pollack &

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Tolley-Schell, 2003). A task that allows for disambiguation of mood-congruent facilitated and slowed cognitive functioning is necessary.

Different types of attentional biases have been examined with variations of the visual search task (VST; e.g., Byrne & Eysenck, 1995; Öhman, Flykt, & Esteves, 2001; Öhman, Lundqvist, & Esteves, 2001). In the VST (Neisser, 1963), the goal is to identify a discrepant target in an array of identical stimuli (for review see Treisman & Gormican, 1988). This widely used cognitive methodology has been adapted to assess attentional biases to potentially threatening stimuli. For example, using the VST with schematic faces, it was shown that individuals consistently detect discrepant threatening faces more rapidly and accurately than friendly or sad faces in arrays of neutral distractors, indicating a general bias for facilitated attention to threat faces. A general bias for attentional interference to threat faces was also found where participants were slower to detect neutral targets in arrays of threatening distractors as compared to friendly distractors (Öhman, Lundqvist et al., 2001).

In addition to the tendency for people to exhibit general attentional interference and facilitation for threat stimuli, emotion-congruent attentional biases have been found. Results for emotion-congruent attentional interference have been fairly consistent. In comparison to those with low anxiety, individuals with high anxiety respond slower to neutral targets embedded in arrays of threat stimuli relative to neutral targets in arrays of neutral stimuli. Results supporting attentional interference have been found using different types of stimuli (e.g., faces, pictures, and disorder-relevant words), populations (e.g., high trait anxiety, GAD, social phobia), methods, as well as paradigms other than VST in which attentional interference and facilitation can be measured separately (Byrne & Eysenck, 1995; Fox et al., 2001, 2002; Gilboa-Schechtman, Foa, & Amir, 1999; Rinck, Becker, Kellermann, & Roth, 2003, Experiment 2).

In contrast, the findings for emotion-congruent attentional facilitation to threat stimuli have been less consistent. While some studies found facilitation for threat in anxious individuals (e.g., Byrne & Eysenck, 1995; Gilboa-Schechtman et al., 1999; Öhman, Flykt et al., 2001, Experiment 3), others have not (Fox et al., 2000; Rinck & Becker, 2005; Rinck et al., 2003). Methodological differences may account for this, with facilitation often found in studies using an "odd-one-out" procedure, where subjects are asked to look for the stimulus that differs from the otherwise identical array (Rinck, Reinecke, Ellwart, Heuer, & Becker, 2005; however, see Fox et al., 2000 for an exception). Studies using a "target search" procedure (i.e., search for an explicit target) have shown mixed results. In a study comparing the "odd-one-out" and "target search" methods, facilitated attention was detected with an "odd-one-out" procedure, but not with a "target search" procedure (Rinck et al., 2005).

To our knowledge, the VST as described above has not been used in studies of PTSD. However, of potential relevance, Pollack and Tolley-Schell (2003) used a different task that allowed for the separate assessment of attentional biases in children with and without abuse histories. Unfortunately, PTSD symptoms were not assessed. Abused children showed attentional facilitation to angry faces. Attentional interference results were mixed, with physiological evidence for interference to angry faces in abused children, but this was not reflected by the behavioral data. Thus, there is preliminary evidence that trauma survivors may show both attentional interference and facilitation to threat stimuli.

In summary, there is consistent evidence that individuals with heightened anxiety have relatively more difficulty disengaging from threatening stimuli than individuals with lower levels of anxiety. However, the evidence for anxious individuals exhibiting greater attentional facilitation towards such stimuli is less reliable. It is possible that the mixed findings for emotion-congruent attentional facilitation in anxious populations are due to methodological differences. Alternatively, it could be that all anxiety disorders are marked by interference caused by threatening stimuli, whereas only certain disorders (e.g., phobias) also show facilitated attention towards such stimuli. It appears that children with abuse histories show attentional facilitation and possibly interference to threat stimuli (Pollack & Tolley-Schell, 2003). However, no studies have looked at attentional facilitation and interference in individuals with PTSD.

Differentiating the role of attentional biases in PTSD would deepen our understanding of the psychopathology this disorder. For example, facilitated attention toward threat in patients with PTSD may enhance our understanding of the mechanism of hypervigilance in which individuals scan the environment for potential threat. Likewise, attentional interference may be informative about patients with PTSD having difficulty disengaging from reminders of traumatic events. Moreover, this research has direct relevance for

treatment. For example, interference effects might inform a mechanism of exposure treatment. Habituation to the intense fear associated with trauma-relevant stimuli may allow for more effective processing of the environment, thus allowing flexibility in cognitive interpretations of the situation rather than a focus on the feared stimuli.

Based on the literature and the potential role of both attentional interference and facilitation in maintaining PTSD, the primary aim of this study was to assess these two types of attentional biases in individuals with high and low levels of PTSD symptoms. To accomplish this aim, the VST procedures used by Yovel (2003) were modified to study PTSD. An "odd-one-out" modified VST procedure, in which words were used as stimuli, was employed to differentiate between interference and facilitation effects (cf. Rinck et al., 2005). Words were used as stimuli to assure relevance to the participants, as verbal stimuli can capture a wider range of Vietnam experiences than pictorial stimuli. Since the stimuli consisted of words, a lexical decision component was added to the VST to ensure participant engagement and semantic processing (Yovel, 2003). In this task, an array of letter strings was presented in which all but one were identical. Participants identified if the differing string was a word or nonword.

It was hypothesized that Vietnam-era veterans with High PTSD symptoms would show both greater attentional interference and facilitation to threat-relevant words relative to neutral words as compared to veterans with Low PTSD symptoms. Attentional interference was operationalized as relatively *slower* responses on trials with a neutral target word embedded in arrays of threat words as compared to trials with a neutral target word in neutral arrays (Fig. 1). Attentional facilitation was operationalized as relatively *faster* responses on trials with a threat target word embedded in arrays of neutral words as compared to trials with a neutral target word in neutral arrays (Fig. 2).

Methods

Participants

Fifty-seven male Vietnam-era veterans were recruited from a VA hospital and divided into two groups: High PTSD and Low PTSD, based on scores from the PTSD Checklist (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993). Reflecting the DSM-IV criteria, inclusion criteria for the High PTSD group were a score of "3" (moderately) or above on at least one intrusion symptom, three avoidance symptoms, and two arousal symptoms and a total score of 50 or above on the PCL ($n = 30$). For inclusion in the Low PTSD group, participants needed to score under 50 on the PCL and to *not* score "3" or above on the requisite

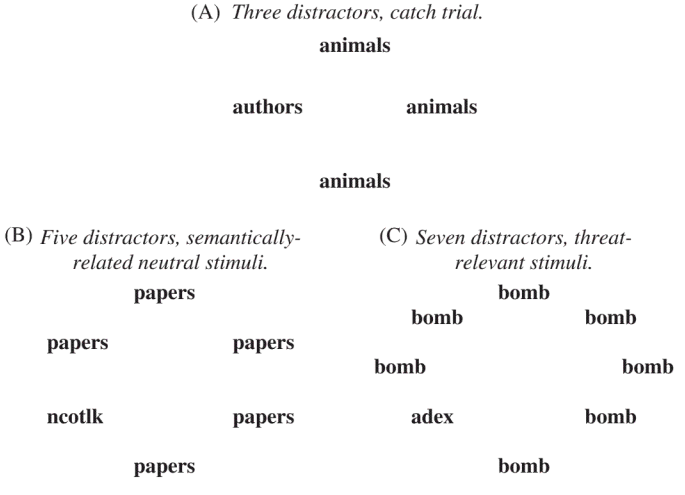

Fig. 1. Examples of all three trial types in the Interference Condition, including an example with each distractor size. *Note*: stimuli are not drawn to scale.

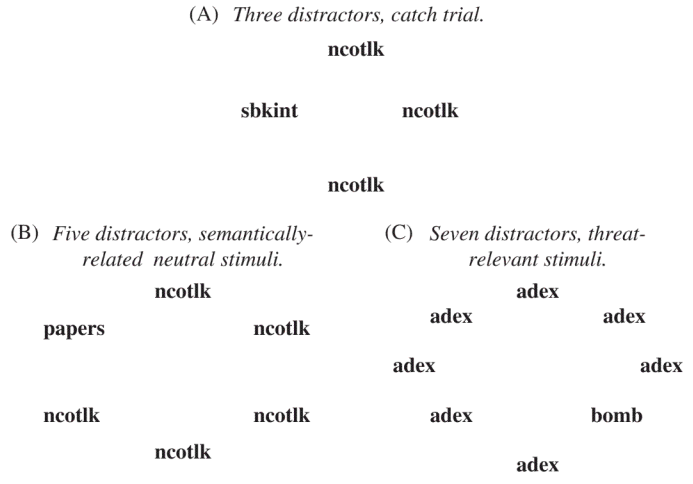

Fig. 2. Examples of all three trial types in the Facilitation Condition, including an example with each distractor size. *Note*: stimuli are not drawn to scale.

number of symptoms to meet criteria for a PTSD diagnosis ($n = 27$). The High PTSD group ($M = 64.2$, $SD = 9.89$) reported more PTSD symptoms than the Low PTSD group ($M = 32.5$, $SD = 8.06$, $t(55) = 13.32$, $p < .001$). Four additional participants were excluded from analyses because they did not meet criteria for either group. The High and Low PTSD groups did not differ in terms of age, ethnicity, marital status, number of children or religion (all p's $> .05$; see Table 1).

Measure

The PCL is a 17-item self-report scale that includes one item for each DSM-IV-TR symptom of PTSD (American Psychiatric Association, 2000). Participants rated the degree to which they were bothered by each symptom over the past month on a 5-point scale ranging from 1: "Not at all" to 5: "Extremely" (range 17–85). The PCL is both internally consistent ($\alpha = .97$) and has high test–retest reliability over a 2–3 day span ($r_t = .96$; Weathers et al., 1993). In the present study, similar internal consistency was found ($\alpha = .96$).

Stimuli

Four types of stimuli were used: threat-relevant words, semantically-related neutral words (school themed), uncategorized neutral words and unpronounceable letter strings ("nonwords"). Words included in the threat-relevant and semantically-related neutral word lists were previously used in an emotional Stroop study in Vietnam veterans (Litz et al., 1996), where veterans validated words in terms of relevance to Vietnam (e.g., *helicopter*, *ambush*) and education (e.g., *pencil*, *eraser*), and rated the level of threat associated with each word. For this study, we selected threat-relevant words from the earlier study that were rated as most relevant to Vietnam, least relevant to education, and high on threat. Semantically-related neutral words were least relevant to Vietnam, most relevant to education, and low on threat. Threat-relevant and semantically-related neutral words were matched for length and frequency of usage (Litz et al., 1996). Uncategorized neutral words (e.g., *cotton*) and nonwords (e.g., *ncotlk*) were previously used in another study of attentional biases (Yovel, 2003).

Apparatus

The VST stimuli were generated and presented on a 21" monitor (800×600, 60 Hz) by Superlab software using a Dell Dimension XPS T500 computer. Response latencies and accuracy rates were recorded by the computer.

Table 1
Demographic characteristics of the participants in the High and Low PTSD groups

	High PTSD ($n = 30$)	Low PTSD ($n = 27$)	
Age, mean (SD)	54.69 (3.29)	54.30 (5.49)	$t(54) = -.33$, n.s.
Children, mean (SD)	1.97 (1.25)	1.27 (1.59)	$t(47) = -1.81$, $p = .08$
Ethnicity			$\chi^2 = 3.30$, n.s.
Caucasian	70.0%	77.8%	
African-American	16.7%	14.8%	
Hispanic/Latino	6.7%	3.7%	
Other	6.6%	3.7%	
Education			$\chi^2 = 14.09$, n.s.
HS Diploma/GED	26.7%	18.5%	
Some college	51.7%	44.4%	
Associates degree	3.3%	7.4%	
BA/BS or higher	13.3%	29.6%	
Employment status			$\chi^2 = 12.99$, n.s.
Full-time	6.7%	30.0%	
Part-time	10.0%	7.4%	
Unemployed/disabled	56.7%	55.6%	
Retired	13.3%	11.1%	
Marital status			$\chi^2 = 3.88$, n.s.
Single/widowed	26.6%	44.4%	
Married/partnered	26.7%	25.9%	
Separated/divorced	46.7%	30.0%	
Religion			$\chi^2 = 5.9$, n.s.
Catholic	46.7%	59.3%	
Protestant	16.7%	25.9%	
Other	36.6%	14.7%	

Procedure

Participants were tested in individual sessions, during which they completed the VST and a questionnaire packet. The VST included two sequentially completed parts (interference, facilitation), presented in a randomized counterbalanced fashion.

In each condition, participants read instructions and performed 20 practice trials with auditory feedback for incorrect responses. The letter strings were equally spaced around a 175 mm × 80 mm (distance 90 cm, visual angles of roughly 11.2° × 5.0°) ellipsoid shape (Figs. 1 and 2). Stimuli were displayed on a white background in black Times New Roman, size-24 font (approximately 0.33° high, length 2.24° for a 7-letter word). Each trial began with a fixation cross appearing center screen for 700 ms. The fixation cross was immediately followed by the stimulus that remained on the screen until a response was made. The computer screen remained blank for 1000 ms between trials.

Instructions for the interference and facilitation conditions were identical. Participants were to quickly report if the 'oddball' letter string was a word by pressing one of the two designated keyboard keys. In both conditions, the 'oddball' was embedded in an array of otherwise identical letter strings that matched the 'oddball' in length. In the interference condition, experimental trials included one nonword (the target) and 3, 5 or 7 identical experimental words (i.e., threat-relevant or semantically-related words; Fig. 1). Catch trials (included for participant engagement) consisted of 3, 5, or 7 identical uncategorized neutral words and one different uncategorized neutral word that served as the target. In the facilitation condition, experimental trial displays consisted of one target experimental word (threat-relevant or semantically-related words) and 3, 5 or

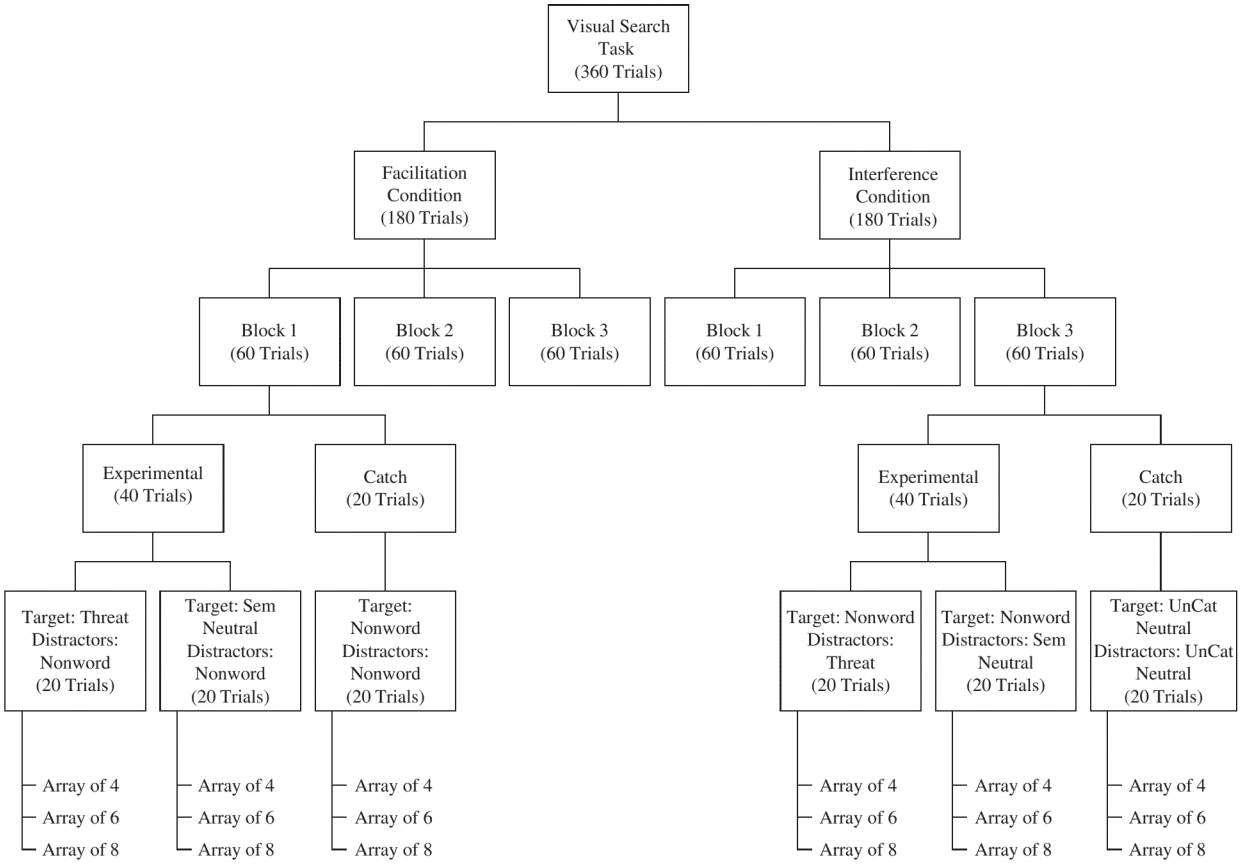

Fig. 3. Visual depiction of the different conditions in the Visual Search Task. For each block, the conditions are identical to those depicted in Block 1 for the Facilitation Condition and Block 3 for the Interference Condition. The number of trials in each condition is noted in parentheses. Sem Neutral = Semantically-related neutral words; Threat = Threat-relevant words; UnCat Neutral = Uncategorized-neutral words.

7 identical nonword distractors (Fig. 2). Catch trials included a target nonword and 3, 5 or 7 identical nonwords (different than the target).

Participants completed 360 trials in six blocks of 60 trials, separated by 30 s breaks. Fig. 3 summarizes the types of the trials. There were three blocks of interference trials and three of facilitation trials (180 trials per condition). Within each condition, 120 trials were experimental trials and 60 were catch trials. Across all three blocks of each condition, the 120 experimental trials were equally divided between arrays of 4, 6 and 8 words (3, 5 or 7 distractors, respectively). For experimental trials, the valence of the stimuli was threat in 60 trials and semantically related neutral words in the remaining 60 trials. Each experimental word was presented once per block, each time in a different array size. The order of trials within the interference and facilitation conditions was randomly generated. The order of administration of the two conditions (interference and facilitation) was counterbalanced over participants. After the VST, self-report measures were administered, and participants were thanked and compensated.

Results

To reduce the effect of outliers, RTs of trials with within-participant z scores greater than 3 or less than −3 were replaced with the person's mean plus or minus three standard deviations (Öhman, Lundqvist et al., 2001). Few outliers were found (.04% of correct answers). Error trials were discarded (average error rate was 3.49%). A 2 Group (High PTSD, Low PTSD) × 2 Condition (Interference, Facilitation) mixed-design ANOVA

Table 2
Mean response latencies in ms (standard deviations in parentheses)

	Task order	Threat-relevant words			Semantically-related neutral words		
		Array of 4	Array of 6	Array of 8	Array of 4	Array of 6	Array of 8
High PTSD group							
Facilitation condition	Fac 1st	1435	1817	1952	1577	1839	1995
		(294)	(438)	(437)	(437)	(363)	(470)
	Int1st	1651	1932	2030	1595	1774	2054
		(453)	(686)	(557)	(425)	(447)	(573)
	Total	1550	1878	1993	1587	1805	2026
		(396)	(577)	(498)	(390)	(404)	(519)
Interference condition	Fac 1st	1439	1593	1758	1537	1686	1714
		(273)	(355)	(379)	(363)	(340)	(341)
	Int 1st	1732	1967	2072	1692	1805	1917
		(625)	(715)	(789)	(589)	(630)	(583)
	Total	1595	1792	1925	1620	1749	1822
		(508)	(598)	(642)	(495)	(510)	(488)
Low PTSD group							
Facilitation condition	Fac 1st	1475	1784	1890	1540	1791	1890
		(259)	(312)	(425)	(302)	(380)	(393)
	Int 1st	1659	1752	1970	1622	1886	2016
		(673)	(771)	(716)	(603)	(868)	(823)
	Total	1570	1767	1932	1582	1840	1955
		(516)	(585)	(585)	(475)	(668)	(643)
Interference condition	Fac 1st	1443	1633	1715	1526	1670	1774
		(296)	(362)	(347)	(334)	(378)	(426)
	Int 1st	1499	1713	1718	1644	1753	1817
		(644)	(681)	(539)	(680)	(837)	(687)
	Total	1472	1674	1717	1587	1713	1796
		(499)	(542)	(448)	(535)	(646)	(566)

$n = 57$.

conducted on the error rates yielded no significant main effects or interactions. Average RTs were computed for each cell of the experimental design (Table 2). p-values are reported with Geisser–Greenhouse adjustment for sphericity.

Interference condition

A $2 \times 2 \times 2 \times 3$ mixed-design ANOVA was conducted on the latency data with two between-subject variables, Group (High PTSD, Low PTSD) and Order (interference first, facilitation first) and two within-subject variables, Word Type (threat-relevant, semantically-related neutral) and Array Size (4,6,8). As expected, the main effect of Array Size was significant ($F(2, 52) = 78.20$, $p < .001$). RTs to trials with arrays of eight ($M = 1810.51$) were longer than RTs to trials of six ($M = 1727.37$), which were longer than RTs to trials of four ($M = 1563.92$). The linear contrast of this main effect was significant ($F(1, 53) = 150.2$, $p < .001$), reflecting the well-documented effect in VST studies of longer RTs with larger arrays (Wolfe, 1998). Additionally, the three-way interaction of Group × Order × Word Type ($F(1, 53) = 9.05$, $p < .01$) and the two-way interaction of Group × Word Type were significant ($F(1, 53) = 11.06$, $p < .01$).

To better account for the three-way interaction Group × Order × Word Type, two separate mixed-design ANOVAs were conducted for the individuals who completed the interference first and those who completed the facilitation first. The design of these analyses was 2(Word Type: threat-relevant, semantically-related neutral) × 2(Group: High PTSD, Low PTSD). For interference first, the Group X Word Type interaction was

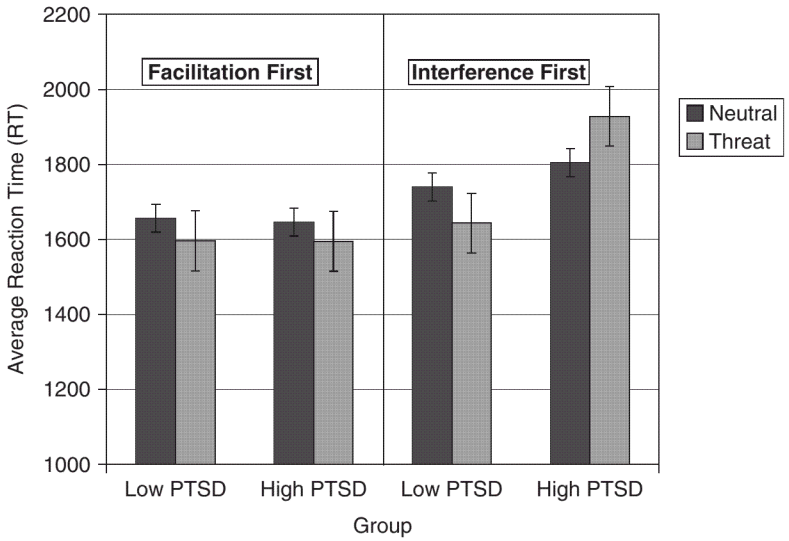

Fig. 4. Differences in reaction times to interference trials in individuals who completed interference versus facilitation condition first.

significant ($F(1,28) = 12.67$, $p < .001$). The High PTSD group showed a *slower* average response to threat trials than to neutral trials ($M_{diff} = 123.28$, $SD = 196.65$; $t(15) = 2.51$, $p < .05$), whereas the Low PTSD group showed *faster* responses to threat trials than neutral trials ($M_{diff} = -96.21$, $SD = 128.54$, $t(13) = -2.80$, $p < .05$; Fig. 4). In contrast, for facilitation task first, there was a main effect of Word Type. Participants were faster on the threat trials ($M = 1595.70$, $SD = 316.86$) than on the neutral trials ($M = 1651.28$, $SD = 346.44$; $F(1,25) = 22.72$, $p < .001$). However, the Group × Word Type interaction was not significant ($F < 1$). Thus, the High PTSD group exhibited greater attentional interference for threat-relevant words relative to individuals with Low PTSD. However, this effect was only apparent for those who completed the interference condition first.

Facilitation condition

A $2 \times 2 \times 2 \times 3$ mixed-design ANOVA was conducted on the latency data with two between-subject variables, Group (High PTSD, Low PTSD) and Order (interference first, facilitation first) and two within-subject variables, Word Type (threat-relevant, semantically related neutral) and array size (4,6,8). As expected, the main effect of Array Size was significant ($F(2,52) = 126.63$, $p < .001$). RTs to arrays of eight ($M = 1974.56$) were longer than RTs to six ($M = 1821.81$), which were longer than RTs to arrays of four ($M = 1569.13$). The linear contrast of the array-size variable was significant ($F(1,53) = 263.4$, $p < .001$). No other main effects or interactions were significant. Thus, we did not find evidence for attentional facilitation to threat-relevant words in individuals with High PTSD.

Discussion

This was the first study utilizing a VST in a study of PTSD and, as such, was the first to examine if PTSD-related attention biases were due to attentional interference (difficulty disengaging from threat) or facilitation (being drawn to threat-related stimuli). The results of this study support the role of attentional interference to threat-relevant verbal stimuli in PTSD. However, no support was found for facilitated attention to threat stimuli in PTSD.

For veterans who completed the interference task first, High PTSD veterans showed difficulty disengaging from threat-relevant words relative to semantically related neutral words, whereas Low PTSD veterans did not. This finding is consistent with the emotional Stroop literature where attentional biases for threat-relevant

words are found in PTSD participants (see Buckley et al., 2000, for a review). In both the VST and the emotional Stroop task, biased attention is operationalized as *slower* RTs in the presence of threat versus neutral distractors.

Difficulty disengaging from threat-relevant stimuli (interference) appears to characterize individuals with high trait anxiety and a wide range of anxiety disorders (e.g., Byrne & Eysenck, 1995; Rinck et al., 2003; Williams, Mathews, & MacLeod, 1996). Although there is an adaptive advantage to the rapid detection (facilitation) of potential threat (e.g., Le Doux, 1996), it is difficult to identify the advantages of slower disengagement from cues determined to be of no imminent danger (e.g., words on a screen). Instead, interference may be related to excessive or pathological levels of anxiety. In contrast, the ability to rapidly disengage from fear-invoking, but nonthreatening, cues may be a protective factor against the development of anxiety disorders (Fox et al., 2001; Georgiou et al., 2005). Specifically for PTSD, the ability of some trauma survivors to disengage from reminders of past traumatic events may be a protective factor against the development of the disorder. In addition, acquiring this ability may lead to symptom improvement as this is the primary objective of exposure therapy for PTSD (e.g., Foa, Rothbaum, Riggs, & Murdock, 1991). The intense distress associated with reminders of traumatic events may be related to difficulty disengaging from these reminders, which in turn may prolong and intensify intrusions (Foa & Kozak, 1986). Further, the combination of distress associated with reminders and difficulty disengaging from threat may lead to a wide array of avoidance behaviors (e.g., behavioral avoidance, thought suppression, substance abuse) in an effort to minimize or avoid this distress (Shipherd & Beck, 2005; Shipherd, Stafford, & Tanner, 2005; Stewart, 1996). Avoidance behaviors are theorized to be important in the maintenance of the disorder, as they prevent individuals from gaining the benefit of habituation from natural exposures to memories or reminders (Keane, Fairbank, Caddell, Zimering, & Bender, 1985).

In exposure therapy for PTSD, change is hypothesized to be related to habituation of fear to trauma-related memories. Habituation may partly explain the finding that delayed disengagement from threat-relevant words only occurred in High PTSD participants if they completed the interference task first. In exposure therapy, individuals typically habituate to memories of trauma over several sessions (Foa et al., 1991). Because brief presentations of words are minor threats, habituation to these stimuli may occur relatively quickly. Perhaps because participants who completed the facilitation task first were exposed to threat-relevant words 60 times prior to the interference task, habituation to the stimuli occurred and lessened the attentional interference effect. Similar habituation over time has been demonstrated with the emotional Stroop (McKenna & Sharma, 1995).

In contrast to the interference results, we failed to find any evidence for attentional facilitation to threat-relevant words in High PTSD veterans. These null results are consistent with several other studies assessing facilitation to threat-relevant words in anxious populations (e.g., Rinck & Becker, 2005; Rinck et al., 2003). It is possible that the facilitation effect is present only in certain types of psychopathology such as phobias (e.g., Öhman, Flykt et al., 2001, Experiment 3) but not in others such as PTSD. Alternatively, attentional facilitation may be a relatively weak effect. It is also possible that the methods used in this study may have contributed to the null results. However, Rinck et al. (2005) suggested that attentional facilitation was more likely to be detected using the "odd-one-out" procedure. Although this procedure was used in the current study, we failed to find support for PTSD group differences in attentional facilitation. Fox et al. (2000) also failed to find evidence for enhanced attentional facilitation in anxious participants using such procedure.

Rinck et al. (2005) also suggested the use of superficial searches in detecting attentional facilitation effects. The current study's methods had two features (lexical decision, verbal stimuli) that required participants to engage in a deeper level of semantic processing, possibly increasing error variance by adding additional steps of processing to the task. In studies of phobias, pictorial stimuli of feared objects are typically straightforward. Unfortunately, in PTSD generating pictorial stimuli that are not too detailed for an attentional task and are relevant across participants is more complex. Although all our participants were Vietnam-era veterans, their experiences and traumatic triggers vary tremendously. By using words as stimuli, we were able to capture a wider range of experiences than would have been possible with pictorial stimuli.

Finally, finding support for attentional interference but not for facilitation may be due to the nature of PTSD. Anxiety disorders such as specific phobias and social phobia may be particularly characterized by the quick detection of threat, whereas disorders such as PTSD and GAD (where rumination and intrusions are

paramount), may be related to difficulty disengaging from threat. Additionally, attentional facilitation may be more robust for stimuli for which fear is more innate. That is, manmade or modern objects (e.g., helicopters and guns), triggering for veterans with PTSD, are not evolutionarily based or natural threats. Thus, individuals may be evolutionarily ''prepared'' to fear the targets presented in studies of attentional facilitation in phobias (e.g., threatening faces, snakes, spiders) (Öhman & Mineka, 2001), but not in GAD and PTSD.

There are several limitations related to the sample studied. Because the study was conducted with a population of veterans who were classified using self-report assessment, these results await replication with a clinically diagnosed sample. Still, the average levels of posttraumatic symptoms in the PTSD group were similar to those reported by Weathers et al. (1993) for clinically diagnosed Vietnam-era veterans with PTSD. In the Low PTSD group, some degree of PTSD symptoms were evident, and although we made an attempt to exclude individuals with partial PTSD, we were conservative in our definition of this rather ambiguous construct. Further, this study was conducted using a sample with chronic and long-lasting PTSD symptoms, and therefore further study of the specific nature of attentional biases in PTSD is warranted with individuals who have experienced more recent and/or different types of trauma.

To summarize, the current study provided evidence for enhanced attentional interference of threat-relevant words in High PTSD individuals. High PTSD participants had more difficulty disengaging from threat-relevant words than did Low PTSD participants. These findings are consistent with the emotional Stroop literature. Attentional interference to threat-relevant words may be related to difficulties experienced by individuals with PTSD, such as intrusions and avoidance symptoms. No support was found for attentional facilitation to threat-relevant words in High PTSD participants. Altogether, the current findings suggest that attentional facilitation and interference are not interchangeable processes and thus should be continued to be assessed separately.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th, text revision ed). Washington, DC: American Psychiatric Association.

Beck, J. G., Freeman, J. B., Shipherd, J. C., Hamblen, J. L., & Lackner, J. M. (2001). Specificity of Stroop interference in patients with pain and PTSD. *Journal of Abnormal Psychology*, *110*, 536–543.

Buckley, T. C., Blanchard, E. B., & Neill, W. T. (2000). Information processing and PTSD: A review of the empirical literature. *Clinical Psychology Review*, *28*, 1041–1065.

Byrne, A., & Eysenck, M. W. (1995). Trait anxiety, anxious mood and threat detection. *Cognition and Emotion*, *9*, 549–562.

Derryberry, D., & Reed, M. A. (1994). Temperament and attention: Orienting toward and away from positive and negative signals. *Journal of Personality and Social Psychology*, *66*, 1128–1139.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin*, *99*, 20–35.

Foa, E. B., Rothbaum, B., Riggs, D., & Murdock, T. (1991). Treatment of posttraumatic stress disorder in rape victims: A comparison between cognitive-behavioral procedures and counseling. *Journal of Consulting and Clinical Psychology*, *59*, 715–723.

Fox, E., Lester, V., Russo, R., Bowles, R. J., Pichler, A., & Dutton, K. (2000). Facial expressions of emotion: Are angry faces detected more efficiently? *Cognition and Emotion*, *14*, 61–92.

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw of hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General*, *130*, 681–700.

Fox, E., Russo, R., & Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition and Emotion*, *16*, 355–379.

Georgiou, G. A., Bleakley, C., Hayward, J., Russo, R., Dutton, K., Eltiti, S., et al. (2005). Focusing on fear: Attentional disengagement from emotional faces. *Visual Cognition*, *12*, 145–158.

Gilboa-Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional biases for facial expressions in social phobia: The face-in-the-crowd paradigm. *Cognition and Emotion*, *13*, 305–318.

Gotlib, I. H., & McCann, C. D. (1984). Construct accessibility and depression: An examination of cognitive and affective factors. *Journal of Personality and Social Psychology*, *47*, 427–439.

Keane, T. M., Fairbank, J. A., Caddell, J. M., Zimering, R. T., & Bender, M. E. (1985). A behavioral approach to assessing and treating post-traumatic stress disorders in Vietnam veterans. In C. H. Figley (Ed.), *Trauma and its wake, the study and treatment of post-traumatic stress disorder* (pp. 257–294). Bristol, PA: Brunner Mazel.

Le Doux, J. E. (1996). *The emotional brain*. New York: Simon and Schuster.

Litz, B. T., Weathers, F. W., Monaco, V., Herman, D. S., Wulfsohn, M., Marx, B., et al. (1996). Attention, arousal, and memory in posttraumatic stress disorder. *Journal of Traumatic Stress*, *9*, 497–518.

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*, 15–20.

McKenna, F. P., & Sharma, D. (1995). Intrusive cognitions: An investigation of the emotional Stroop task. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 1595–1607.

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy, 36*, 809–848.

Neisser, U. (1963). Decision-time without reaction-time: Experiments in visual scanning. *American Journal of Psychology, 76*, 376–385.

Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: Detecting the snake in the grass. *Journal of Experimental Psychology: General, 130*, 466–478.

Öhman, A., Lundqvist, D., & Esteves, F. (2001). The face in the crowd revisited: A threat advantage with schematic stimuli. *Journal of Personality and Social Psychology, 80*, 381–396.

Öhman, A., & Mineka, S. (2001). Fears, phobias and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review, 108*, 483–522.

Pollack, S. D., & Tolley-Schell, S. A. (2003). Selective attention to facial emotion in physically abused children. *Journal of Abnormal Psychology, 112*, 323–338.

Rinck, M., & Becker, E. S. (2005). A comparison of attentional biases and memory biases in women with social phobia and major depression. *Journal of Abnormal Psychology, 114*, 62–74.

Rinck, M., Becker, E. S., Kellermann, J., & Roth, W. T. (2003). Selective attention in anxiety: Distraction and enhancement in visual search. *Depression and Anxiety, 18*, 18–28.

Rinck, M., Reinecke, A., Ellwart, T., Heuer, K., & Becker, E. S. (2005). Speeded detection and increased distraction in fear of spiders: Evidence from eye movements. *Journal of Abnormal Psychology, 114*, 235–248.

Shipherd, J. C., & Beck, J. G. (2005). The role of thought suppression in posttraumatic stress disorder. *Behavior Therapy, 36*, 277–287.

Shipherd, J. C., Stafford, J., & Tanner, L. R. (2005). Predicting alcohol and drug abuse in Persian Gulf War veterans: What role do PTSD symptoms play? *Addictive Behaviors, 30*, 595–599.

Stewart, S. H. (1996). Alcohol abuse in individuals expose to trauma: A critical review. *Psychological Bulletin, 120*, 83–112.

Treisman, A., & Gormican, S. (1988). Feature analysis in early vision: Evidence from search asymmetries. *Psychological Review, 95*, 15–48.

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. M. (1993). *The PTSD Checklist (PCL): Reliability, validity, and diagnostic validity.* Paper presented at the annual meeting of the International Society for Traumatic Stress Studies, San Antonio, TX.

Williams, J. M., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin, 120*, 3–24.

Wolfe, J. M. (1998). Visual search. In H. Pashler (Ed.), *Attention* (pp. 13–73). Hove, UK: Psychology Press.

Yovel, I. (2003). Anxiety-related attentional biases in the spatial and temporal dimensions. *Dissertation Abstracts International: Section B-The Sciences and Engineering, 64*(4-B), 1920.