Psychiatry Research 272 (2019) 304–310

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Zoning out: Automatic and conscious attention biases are differentially related to dissociative and post-traumatic symptoms☆

Sarah Herzog[a,*], Wendy D'Andrea[a], Jonathan DePierro[b]

[a] Department of Psychology, The New School for Social Research, 80 Fifth Avenue, 7th Floor, New York, NY 10011, United States
[b] World Trade Center Health Program, Icahn School of Medicine at Mount Sinai, 1468 Madison Avenue, Annenberg Building, 3rd Floor, New York, NY 10029, United States

ARTICLE INFO

Keywords:
Threat
Dot-probe
PTSD
Derealization
Depersonalization
Avoidance

ABSTRACT

Few studies of attention bias in traumatized samples directly compare automatic and conscious (e.g. supraliminal) attentional strategies. Additionally, research to-date indicates inconsistent evidence for threat-related attention bias in individuals with PTSD symptoms. This may be due to the heterogeneity in PTSD symptoms and concurrent dissociation, particularly derealization and depersonalization, since these may contribute to decreased awareness of, or slower responding to, threatening stimuli. Using an internet-based paradigm, the current study measured attention biases in a visual dot-probe task using rapid (250 ms), brief supraliminal (500 ms), and long-latency supraliminal (2000 ms) exposures. One hundred and forty-seven adult participants completed a range of trauma-related symptom measures. Results indicated a significant association between PTSD symptoms and bias toward threat in the 2000 ms exposure. Both state and trait derealization were significantly related to a bias away from threat at the 250 ms exposure, indicating a reflexive avoidance of rapidly presented threat cues. State measures of dissociation were also related to avoidance of threat in the 500 ms condition. Findings highlight the disparate effects of trauma-related symptoms on attention, and have significant clinical implications for dissociative symptoms as a target of treatment in traumatized samples.

1. Introduction

The study of the cognitive substrates of threat responding emphasizes the automaticity of the brain's reactivity to emotionally salient stimuli (LeDoux, 1998). Trauma-exposed samples have received particular attention in this line of research, since PTSD and acute stress disorders are characterized by altered fear responses to trauma-related cues, including such symptoms as hyperarousal and re-experiencing. However, most studies on threat-related attentional bias in PTSD use stimuli that can be consciously perceived, i.e., supraliminal exposures of 500 ms or longer, (Bar-Haim et al., 2007), which allow for more deliberate responding. This mode reflects a predominantly “top-down” process, whereby processing of relevant sensory input is facilitated by cognitive schemas and expectations (Sarter et al., 2001). For example, when an alarm sounds, individuals may scan the environment with the expectation of detecting danger; this cognitive bias will strongly influence the processing of threatening, or even innocuous stimuli. In contrast, responses to rapidly presented (here referred to as “automatic”) stimuli reflect “bottom up” processes that are largely stimulus-driven and reflexively deployed. In our example, absent the activation of fear-vigilant schemas that may prime individuals to preferentially attend to threatening information, the processing of environmental stimuli will be largely driven by the perceptual qualities of the stimulus. Thus, studies that exclusively use supraliminal exposures obscure the ability to detect whether attention biases in PTSD reflect more automatic versus strategic processes.

Attention biases for threat cues can manifest as either selective attention toward threat, which indicates attentional hypervigilance (MacLeod et al., 1986), or a bias away from threatening material, indicating avoidance (Koster et al., 2004). Studies on attention biases frequently utilize a visual dot-probe paradigm that indexes reaction times to probes that follow presentation of paired neutral and threatening images. The methodological assumption of the task is that participants will respond more quickly to probes in the position of the stimulus with greater emotional salience, which, according to connectionist models of information processing (Frewen et al., 2008), will depend on individual differences in dispositional traits, as well as the evolutionary significance of the stimulus. The attention bias findings

☆ There are no funding sources for this study to be disclosed.
* Corresponding author.
E-mail address: sherzog@newschool.edu (S. Herzog).

https://doi.org/10.1016/j.psychres.2018.12.110
Received 17 December 2017; Received in revised form 20 December 2018; Accepted 20 December 2018
Available online 21 December 2018
0165-1781/

using the dot-probe paradigm in PTSD samples are mixed. Fani et al. (2012), using presentation latencies of 500 ms, found evidence for bias toward threat in participants with PTSD, as did others using similar supraliminal exposure latencies (Bryant and Harvey, 1997; Litz et al., 1996). In a trauma-exposed sample, Thomas et al. (2013) found divergent patterns of attention (vigilance versus avoidance) that shifted as a function of time-course of exposure and severity of PTSD symptoms. In that study, PTSD symptoms at a clinical threshold were related to an initial attentional hypervigilance, followed by later avoidance. Still others find no evidence of threat-related bias in PTSD (Dalgleish et al., 2003; Fani et al., 2011; Reichert et al., 2015). A meta-analytic review revealed a reliable but small effect size favoring bias toward threat in PTSD vs. healthy controls collapsing across tasks, exposure times, and stimuli type (Bar-Haim et al., 2007). A number of studies have also examined attention bias variability by investigating dynamic changes in attention bias scores across the task. A recent review of such studies revealed an association between PTSD symptom severity, and greater attention bias variability for threatening stimuli (Naim et al., 2015).

Divergence in attention bias findings in samples with PTSD (i.e., attentional vigilance, avoidance, or absence of threat-related bias) might be due to differences in stimulus exposure latencies across study designs, but another explanation might be the heterogeneity of PTSD symptoms themselves that may differentially impact attention. Traumatic stress responses can take a variety of forms, for example, Bremner (1999) posits two pathways of psychological stress following trauma exposure, one that is primarily fear-based, and another that is primarily dissociative and "shut down." This is mirrored in more recent neurobiological research that provides evidence for two differentiable patterns of emotion dysregulation in PTSD: a non-dissociative symptom cluster of hyperarousal and re-experiencing that reflects prefrontally mediated *undermodulation* of limbic regions, and a dissociative subtype characterized by an *overmodulation* of affective responses. Prefrontal inhibition of affective reactivity, then, might result in a suppression of the hypervigilant threat response, or perhaps even avoidance. Accordingly, symptoms such as hyperarousal might accompany a hypervigilant attentional bias, while dissociative symptoms, which are implicated in decreased awareness of threat, may create an attentional style that selectively avoids threatening information.

Dissociation is comprised of a number of related processes, some of which might impair coherence or awareness of internal cues, and others that impede processing of external stimuli. In the context of attention, the latter such symptoms are of particular relevance to altered processing of external threat cues. One such facet of dissociation is *derealization*, which is characterized by the experience of one's surroundings as foggy, unreal, detached or distorted (American Psychiatric Association, 2013). Derealization can function to lower awareness of environmental danger, and might therefore be expected to slow processing of threatening stimuli. In contrast to the deliberate avoidance of trauma-related stimuli that might accompany PTSD, attentional avoidance in dissociative derealization can be conceptualized as an involuntary and automatic "bottom up" response. *Depersonalization* is a closely related dissociative experience that consists of alterations in the perception of both internal and external cues. Depersonalization involves distortions in first-person experience, and is usually accompanied by a sense of alienation from one's body, physical sensations, or subjective affective experience of external stimuli. Depersonalization disorder has been associated with both delayed and attenuated autonomic reactivity to threatening stimuli (Sierra et al., 2002), and these inhibited responses are accompanied by reductions in insula activity, an area of the brain implicated in the generation of feeling states (Medford et al., 2016). The effects of depersonalization on latency of responding to threat might similarly manifest in an avoidant attentional bias. However, to the authors' knowledge, there exists very few attention bias studies that account for the presence of dissociation in traumatized samples (DePierro et al., 2013), only one that specifically accounts for derealization symptoms (Herzog et al., 2018b), and none that address depersonalization symptoms. The present study investigated the impact of trauma-related symptoms on attention biases to threat using very rapid exposure (250 ms), short-latency exposure at the lower threshold of conscious responding (500 ms), and long-latency supraliminal exposures (2000 ms). Depressive symptoms were also assessed, to account for their possible influence on reaction time (Bar-Haim et al., 2007). Lifetime trauma exposure was likewise measured.[1] We hypothesized that "classic" PTSD symptoms would be related to a conscious bias toward threat (attentional hypervigilance), while dissociative derealization and depersonalization- both trait and state- would be related to a reflexive avoidance of threat on rapidly presented trials (250 ms and 500 ms).

Table 1
D P*-value is less than or equal to 0.05 (2-tailed)*es.*

Exposure	Variables	Mean	SD	α*
250 ms	Threat Incongruent RT	515.98	105.35	
	Threat Congruent RT	493.67	93.79	
	Neutral RT	471.80	77.64	
	Threat Bias	22.32	62.32	0.333
500 ms	Threat Incongruent RT	494.08	84.46	
	Threat Congruent RT	473.48	81.07	
	Neutral RT	462.62	79.75	
	Threat Bias	20.61	65.45	0.207
2000 ms	Threat Incongruent RT	475.74	87.74	
	Threat Congruent RT	463.91	82.37	
	Neutral RT	451.93	77.46	
	Threat Bias	11.84	56.10	0.217

Note. RT = reaction time. Scores are based on filtered sample (n = 147). All reaction times are reported in milliseconds.

* See Supplement for description of reliability analyses.

2. Method

2.1. Recruitment

Participants were recruited online using Amazon MTurk. A minimum age of 18 and residence in the United States were required for inclusion. See *Participant Characteristics* and Table 1S in *Supplement* for a full description of sample characteristics.

2.2. Measures

2.2.1. Post-traumatic stress disorder checklist for DSM-5 (PCL-5)

The PTSD Checklist for DSM-5 (PCL-5) is a 20-item self-report inventory measuring symptoms of PTSD listed in the DSM-5, with four subscales: intrusive symptoms, avoidance symptoms, negative cognition and mood, and hyperarousal (Weathers et al., 2013). Participants rate each item they have experienced in the past month on a scale of intensity from 0 (not at all intense) to 4 (extremely intense). Recommended clinical cut-offs for the PCL-5 are based on the combined presence of at least 1 intrusion symptom, 1 avoidance symptom, 2 hyperarousal symptoms, and 2 negative cognition/mood symptoms (Weathers et al., 2013). Internal consistency for the present study was high (α = 0.96).

2.2.2. Multiscale Dissociation Inventory (MDI)

The MDI is a 30-item measure of trait dissociation (Briere, 2002) that assesses six domains: depersonalization, derealization, disengagement, emotional constriction, memory disturbance, and identity dissociation. Each item is measured on a frequency scale of 1 (never) to 5

[1] Description of trauma self-report measures, descriptive data, and correlational analyses can be found in Supplement.

(very often). Only the derealization and depersonalization subscales were included in the current analyses. Recommended clinical cut-offs for the MDI are derealization/depersonalization *t* scores greater or equal to 80 (Briere, 2002). Internal consistency for this subscale was satisfactory (α = 0.89).

2.2.3. State Dissociation Scale (SDS)

The State Dissociation Scale (SDS; D'Andrea, et al., 2013) was used to assess dissociative responses (e.g., spacing out, feeling disoriented, numbing) during the study, in response to task stimuli. This 8-item measure was adapted from the Peritraumatic Dissociative Experiences Questionnaire (PDEQ; Marmar, Weiss, & Metzler, 1998), with the prompt inquiring into current experiences, for example, "How numb do you feel?". Four of the eight items indexed state derealization and depersonalization, each ranked on a 0–4 point scale. Present-study reliability for these combined two items was high (α = 0.95).

2.2.4. Brief Symptom Inventory - Short Form (BSI-18)

The BSI-18 (Derogatis and Spencer, 1993) is a self-report index of psychiatric distress, comprised of three 6-item subscales for measurement of anxiety, depression, and somatization. For purposes of the current study, only the 6-item depression symptom subscale, which has demonstrated good convergent validity with the Beck Depression Inventory (Andreu et al., 2008), was used for analyses. Recommended clinical cut-offs for the depression subscale of the BSI are based on *t* scores greater or equal to 63 (Derogatis and Spencer, 1993). Internal consistency for the depression subscale in the current sample was high (α = 0.94).

2.2.5. Visual dot-probe

The visual dot-probe task assesses attentional biases, i.e., hypervigilance or avoidance of threatening stimuli, by presenting paired threatening – neutral images, and comparing reaction times to probes presented in the position of a threatening image with those presented in the neutral position. Shorter reaction times to the former compared to the latter indicate hypervigilance, while longer reaction times might indicate avoidance. Stimuli used were forty pictures selected from the International Affective Picture System (Lang et al., 1999) according to normative ratings for valence and arousal, including ten threatening images (e.g. "mutilated face") and thirty neutral pictures (e.g. "hair dryer"). Normed mean ratings on valence for threat and neutral images were, respectively, 2.02 (*SD* = 0.63) and 5.01 (*SD* = 0.19). Mean arousal ratings were, respectively, 6.37 (*SD* = 0.74) and 2.99 (*SD* = 0.63).

2.3. Procedure

The New School Institutional Review Board approved the present study. Adult participants were recruited via Amazon MTurk (Buhrmester et al., 2011), a web-based crowdsourcing platform that yields high-quality data (Buhrmester et al., 2011; Casler et al., 2013). Prior online MTurk studies have demonstrated equivalent or superior attentiveness to task demands as compared to face-to-face testing (Hauser and Schwarz, 2016). Recruitment was limited to U.S. residents using internal controls. A brief ad described the study as relating to "emotional experiences." After providing informed consent, participants completed demographic and self-report measures using a survey hosted on the Qualtrics website. Following completion of the measures, participants were directed to complete the dot probe task, hosted on Inquisit 4 Web Version (Millisecond Software, LLC; Seattle, WA). Immediately following the dot-probe task, participants complete the state dissociation items, and then compensated $15.00.

The dot-probe task includes 10 practice trials and 80 experimental trials consisting of 40 threat trials and 40 neutral trials. Trials began with the presentation of a fixation cross for 500 ms, followed by a pair of images presented side by side for either 250 ms, 500 ms, or 2000 ms, in random order. Presentation of the paired images was immediately replaced by a probe either on the left or right side of the screen, for 1000 ms. Task directions (presented prior to beginning the practice trials) instructed participants to rapidly respond to the position of the probe on the screen by using the right or left keyboard arrows of the keyboard.

Bias toward threat is indicated when participants' reaction times are shorter for congruent trials (i.e., probe in the position of the threatening image) than incongruent trials (probe in the position of the neutral image, opposite the threatening image), while avoidance is indicated when reaction times to congruent trials are longer than incongruent trials. The resulting formula was as follows: Threat Bias = Mean Incongruent Trial RT - Mean Congruent Trial RT (Koster et al., 2004), with higher (positive) values indicating greater attentional bias toward threat.

2.4. Data preparation and analysis

2.4.1. Sample and data reduction

One-hundered and eighty participants provided consent and completed the study (82 male, 97 female, 1 gender queer). Eight participants with duplicate dot-probe data were removed, yielding a sample of $N = 172$. In accordance with standard practice to ensure data integrity, invalid trials, i.e., trials with reaction times less than 100 ms, were excluded (Mogg et al., 1992). Incorrect responses were likewise eliminated; these include "lapses," i.e., trials with reaction times exceeding presentation of the probe, and "errors," i.e., incorrect responses to probe position. Participants whose excluded trials exceeded 10% of total trials were also removed. In the current sample, 25 particpants of 172 were thus excluded, leaving a total of 147 participants in the final analysis. Participants excluded from analyses ($n = 33$) had marginally higher state dissociation scores once corrected for unequal variances ($t(36.74) = 1.952$, $p = 0.059$), and significantly greater trait dissociation ($t(35.93) = 2.069$, $p = 0.046$), overall childhood trauma exposure ($t(31.85) = 2.265$, $p = 0.030$), and PTSD symptoms ($t(40.25) = 2.457$, $p = 0.018$). Excluded participants did not differ in age, gender, or lifetime trauma exposure. All statistical analyses were performed using IBM SPSS Statistics software (SPSS, 2012).

2.4.2. Plan of analyses

Repeated measures ANOVA were used to examine differences in reaction time on the dot-probe by latency of exposure. Zero-order bivariate correlations were used to examine associations between variables of interest. Linear regression was used to determine which psychiatric symptoms best predict threat-related bias in each exposure condition. Scores for state and trait dissociation were entered as predictor variables into a linear regression, along with PTSD symptoms, depression symptoms, and lifetime trauma. Bias scores constituted the dependant variable. Missing data in the regression was eliminated listwise.

3. Results

3.1. Participant characteristics

The final sample ($N = 147$) included 66 males, 80 females, and one gender-queer participant, between the ages of 20 to 58 ($M = 35.55$, $SD = 9.78$). In terms of ethinic or racial identity, 73.5% of participants identified as White/Caucasian, 10.2% as African-American/Black, 7.5% as Asian, 2.7% Hispanic/Latino, 5.2% mixed-race or "other." With regard to trauma exposure, only 4% of the sample denied exposure to any category of trauma across the lifetime. There were no differences by gender in age, self-reported symptom measures, childhood trauma exposure, or bias scores; however, there were differences in lifetime trauma exposure ($t(126) = -2.329$, $p = 0.021$), with females demonstrating greater trauma exposure ($_{m}diff = 0.91$). There were also no

differences by gender in rate of PTSD or dissociation "caseness" (i.e., likelihood of meeting diagnostic threshold according to clinical cut-off scores). See Table 1S in *Supplement* for a full description of sample rates of trauma exposure, symptoms, and other demographic characteristics.

3.2. Descriptive data on RT and attention bias

One way repeated-measured ANOVA demonstrated no significant within-subjects differences in bias scores as a function of latency of exposure. For threat trials, reaction time (RT) significantly differ by exposure latency and congruency (3 × 2); RTs were longer for incongruent trials, and decreased linearly as latency of exposure increased. There was no significant interaction between RT and congruency. Neutral trials demonstrated a similar pattern, decreasing significantly with each increase in exposure time. See Table 1 for descriptive data and reliablity estimates of bias scores and RT data.

3.3. Associations between trauma symptoms and attention bias scores

3.3.1. Correlational analyses

PTSD symptoms significantly correlated with bias toward threat in the 2000 ms exposure ($r = 0.17$, $p = 0.048$), indicating an association with hypervigilance to threat stimuli presented for a relatively prolonged period. MDI trait derealization correlated negatively with bias toward threat in the 250 ms condition ($r = -0.18$, $p = 0.040$), and state derealization negatively correlated with threat bias in both the 250 ($r = -0.18$, $p = 0.023$) and 500 ms conditions ($r = -0.21$, $p = 0.012$). MDI trait depersonalization was not significantly correlated with threat-related bias in any of the three exposure conditions, but state depersonalization was negatively correlated with bias in the 500 ms condition ($r = -0.171$, $p = 0.041$). Depression scores, while not significantly related to bias, correlated strongly with measures of PTSD and dissociation. See Table 2 for a full reporting of correlations.

3.3.2. Regression analyses

Linear regression was used to determine which cluster or combination of psychiatric symptoms best predicted threat-related bias in each exposure condition. Since lifetime trauma (measured by the TESI) was significantly associated with bias in the 250 ms condition, it was likewise included in the regression. Self-report measures of state and trait dissociation, PTSD, depression, and lifetime trauma exposure were entered as predictors, and bias scores constituted the dependent variable. In the 250 ms condition, the overall model predicted 19% of the variance in bias scores. Both state derealization and state depersonalization significantly predicted an bias scores, respectively, $b = -13.810$, $t = -3.124$, $p = 0.002$ and $b = 10.673$, $t = 2.286$, $p = 0.025$. Here, a unit increase in state derealization reduced bias scores by approximately 14 ms, while a unit increase in state depersonalization increased bias by approximately 11 ms. Lifetime trauma (TESI) was also significant in the model, $b = 7.528$, $t = 2.452$, $p = 0.016$, predicting an increased bias by 7.5 ms for each unit increase in lifetime trauma. In the 500 ms condition, the overall model was not significant ($R^2 = 0.021$, $F = 0.244$, $p = 0.973$), and none of the predictors significantly ($p \leq 0.05$) contributed to variance in bias scores (see Table 3). In the 2000 ms condition, the overall model predicted 25% of the variance in bias scores; mean PTSD symptom scores were the greatest predictors of bias ($b = 48.573$, $t = 4.384$, $p < 0.000$), and depression symptoms were also significantly associated with bias ($b = -5.522$, $t = -3.108$, $p = 0.003$). PTSD symptoms predicted an increased bias toward threat (48.5 ms per symptom scale unit), while depression predicted an attenuated vigilance, or bias away from threat, by 5.5 ms per unit (see Table 3).

Table 3
Linear regression of symptoms and trauma history on bias scores.

Models	B (SE)	t	p	R^2	F
Model 1: 250 ms	_	_	0.016	0.191	2.670
Constant	32.430 (17.90)	1.811	0.074	_	_
State Derealization	−13.810 (4.42)	−3.124	0.002	_	_
State Depersonalization	10.673 (4.67)	2.286	0.025	_	_
Trait Derealization	−1.238 (4.15)	−0.298	0.766	_	_
Trait Depersonalization	−1.080 (4.23)	−0.255	0.799	_	_
PTSD Symptoms	4.703 (10.92)	0.431	0.668	_	_
Depression Symptoms	−1.641 (1.75)	−0.938	0.351	_	_
Lifetime Trauma	7.528 (3.07)	2.452	0.016	_	_
Model 2: 500 ms	_	_	0.973	0.021	0.244
Constant	41.289 (21.65)	1.907	0.060	_	_
State Derealization	−5.157 (5.34)	−0.968	0.336	_	_
State Depersonalization	5.012 (5.64)	0.888	0.377	_	_
Trait Derealization	−0.268 (5.02)	−0.053	0.958	_	_
Trait Depersonalization	−1.710 (5.12)	−0.334	0.739		
PTSD Symptoms	−6.598 (13.198)	−0.500	0.619	_	_
Depression Symptoms	1.303 (2.12)	0.616	0.540	_	_
Lifetime Trauma	1.669 (3.71)	0.450	0.654	_	_
Model 3: 2000 ms	_	_	0.002	0.247	3.698
Constant	−2.449 (18.17)	−0.135	0.893	_	_
State Derealization	0.231 (4.49)	0.052	0.959	_	_
State Depersonalization	−2.149 (4.74)	0.454	0.651		
Trait Derealization	2.382 (4.21)	0.564	0.574	_	_
Trait Depersonalization	−0.616 (4.30)	−0.143	0.886		
PTSD Symptoms	48.573 (11.08)	4.384	0.000	_	_
Depression Symptoms	−5.522 (1.78	−3.108	0.003	_	_
Lifetime Trauma	1.024 (3.12)	0.329	0.743	_	_

4. Discussion

The present study investigated the differential impact of PTSD and dissociative derealization/depersonalization on threat-related biases at various latencies of exposure to assess both automatic and conscious attention biases. We hypothesized that post-traumatic and derealization/depersonalization symptoms would be differentially related to

Table 2
Correlations between psychological variables and threat bias.

Variables	1	2	3	4	5	6	7	8	9
1 MDI Trait Derealization	_								
2 MDI Trait Depersonalization	0.85**	_							
3 State Derealization	0.57**	0.52**	_						
4 State Depersonalization	0.60**	0.57*	0.82**	_					
5 PCL PTSD	0.58**	0.56**	0.48**	0.42**	_				
6 BSI Depression	0.64**	0.71**	0.41**	0.42**	0.78**	_			
7 TESI Lifetime Trauma	0.21*	0.14	0.01	−0.07	0.30**	0.21*	_		
8 Threat Bias 250 ms	−0.18*	−0.13	−0.18*	−0.15†	−0.07	−0.11	0.21*	_	
9 Threat Bias 500 ms	−0.05	0.00	−0.21*	−0.17*	−0.11	−0.07	0.07	0.21*	_
10 Threat Bias 2000 ms	0.12	0.06	0.07	0.06	0.17*	−0.06	0.13	0.06	0.03

* *P*-value is less than or equal to 0.05 (2-tailed)
** *P*-value is less than or equal to 0.01 (2-tailed)
† *P*-value is less than 0.10 (2-tailed).

attention biases to threatening stimuli; PTSD symptoms would be related to bias *toward* threat, while derealization/depersonalization symptoms related to bias *away* from threat in 250 ms and 500 ms trials. Results partially supported both hypotheses: state and trait derealization were associated with bias away from threat in trials with brief exposure latencies, while regression analyses demonstrated that PTSD symptoms predict a significant bias toward threat cues in long-latency trials (i.e. 2000 ms). These results held while accounting for the possible contribution of depressive symptoms, which may overlap with PTSD and dissociative symptoms.

Contrary to our hypotheses, regression analyses indicated a significant positive relationship between state depersonalization and threat-related bias in the 250 ms condition, wherein depersonalization appeared to predict a bias *toward* threat. However, because subscale measures of state dissociation (i.e., state derealization and state depersonalization) were highly intercorrelated ($r = 0.82$), as were subscale measures of trait dissociation ($r = 0.85$), these results are more likely attributed to "suppressor effects." A suppressor effect occurs when the suppressor variable (in this case, state depersonalization), while uncorrelated with the outcome variable in bivariate zero-order analyses, increases the predictive value of other predictors (in this case, state derealization) by dint of the suppressor variable's correlation with those predictors (Conger, 1974; Darlington, 1968; Tzelgov and Henik, 1985). The suppressor variable removes irrelevant variance from related predictor variables, yeilding an increase in the beta weight of those predictors and improving the overall predictive power of the model (Pandey and Elliott, 2010). In some instances, the supressor variable acts as a "negative suppressor" (Lubin, 1957) and is assigned the opposite beta weight of the related predictor variable, in this way "subtracting out" error variance (Darlington, 1968) and complicating interpretation of regression data. This would appear to be the case here, where state dissociation subscales both demonstrated an initial negative sign in zero-order early bias correlations (see Table 2), but state depersonalization was assigned a positive beta weight once entered into the regression model. Rather than eliminate the suppressor variable, several writers recommend retaining the suppressor variable if justified for theoretical purposes (Horst et al., 1941; Pandey and Elliott, 2010), as they result in more accurate regression coefficients, and enhance the overall predictive power and theoretical accuracy of the model (Courville and Thompson, 2001). We would therefore advise readers refer to the zero-order correlations as the best indicator of the covarying relationship between state depersonalization and threat bias.

Findings of hypervigilance related to PTSD symptoms are not novel; however, the current data suggest a more nuanced understanding of the impact of trauma-related symptoms on attention biases that better accounts for mixed findings on attention data in traumatized samples. While PTSD has tradtionally been understood as a disorder of exaggerated anxiety and arousal, neurobiological evidence point to a dissociative subtype of PTSD that reflects a protective detachment from overwhelming emotional stimuli (Lanius et al., 2010). This dissociative subtype may create an attentional style that selectively avoids threatening information. In the current study, state derealization predicted an avoidant attentional bias at shorter latencies, lending support to the protective function of dissociation in rapidly subverting attention to threat. These findings are also consistent with those of Herzog et al. (2018b), who likewise found dissociative derealization to be related to an avoidant attentional bias on a visual dot-probe task. There is, however, a dearth of research on the unique effects of depersonalization on attention to threatening stimuli. In the current study, zero-order correlations suggest that depersonalization is associated with bias away from threat on 500 ms trials (i.e., conscious processing). However, when combined with other measures of state and trait trauma-related symptoms and trauma history, depersonalization does not appear to contribute unique variance to threat-related bias. Previous neurobiological research has shown that individuals with depersonalization disorder demonstrate an autonomic response to aversive stimuli (but not pleasant, neutral, or physical stimuli) that are both delayed in latency and suppressed in magnitude, compared to controls and anxious patients (Sierra et al., 2002). In the same study, the depersonalization and anxiety groups also demonstrated significantly shorter latencies in their autonomic responses to nonspecific "startle" stimuli (i.e., claps and sighs) compared to controls, prompting the authors to suggest that depersonalization might be paradoxically characterized by a tonic heightened state of arousal in combination with an inhibitory response to threat. Further research combining cognitive and physiological measures may be necessary to clarify the impact of depersonalization on attention to threatening stimuli at varying levels in processing.

Attention bias research that accounts of the role of dissociative symptoms are few, and findings are equivocal; using a word-based dot-probe paradigm, DePierro et al. (2013) did not find any significant relationship between an overall composite score of dissociation and attention biases. Other studies on dissociation and attentional alterations are similarly mixed. DePrince and Freyd (1999) found that found that college students with high (versus low) trait compared to those with low levels of dissociation, had enhanced interference on a selective-attention Stroop task, but lower interference on a divided-attention Stroop task. The authors interpret these findings to indicate that dissociation may result in lack of executive attentional control, and a tendency toward compartmentalization of attention. In contrast, Guralnik et al. (2000) did not find any attentional difference on a standard Stroop task between participants with depersonalization disorders and healthy controls. Mixed findings may be attributable to the fact that dissociation reflects a rather broad range of alterations in memory, perception, and consciousness; thus the use of composite measures of dissociation may obscure attentional effects driven primarily by those symptoms that impact processing of external stimuli, such as dissociative derealization and depersonalization.

Dissociation is found in high levels in populations with chronic exposure to interpersonal traumas (Van der Hart et al., 2005), particularly those occurring in early life (van der Kolk et al., 2005). Children are especially likely to dissociate as a means of coping with abuse and maltreatment (Cloitre et al., 2009; Hulette et al., 2011; Spiegel, 1998), since dissociative processes function to limit awareness of threatening stimuli or subjective distress in situations of protracted exposure to trauma, or when escape is not possible. It should be noted that lifetime trauma in the present study was associated with a hypervigilant bias, which might be attributable to the fact that this measure does not parse the effects of traumatic experiences in childhood from events that occur later in life. Consistent with this, Herzog et al. (2018a) found that adults with histories of exposure to multiple forms of trauma in childhood (i.e., poly-victimization) demonstrated an avoidant attentional bias, while those with single-indexed trauma types demonstrated a hypervigilant attention bias. In the current study, the unique association between derealization and avoidant biases to threat cues presented at 250 and 500 ms suggests that derealization might operate as an automatic, "bottom up" response to threat, rather than as a more strategic process. The implications of these results are noteworthy, since a reflexive tendency to avoid attending to threat cues might result in increased risk of repeated traumatization. In the context of interpersonal traumas, for instance, dissociative derealization symptoms might inhibit engagement with early signs of developing threat, leaving individuals locked into dangerous situations past the point of feasible escape. In this vein, attentional avoidance of threat might be related to the study of risk-detection, the ability to take cues from the environment in order to identify potential threat and danger, in retraumatized individuals (Chu et al., 2014). Studies on revictimization have found that revictimized women show delayed responding to danger and are more vulnerable to later victimization (Arata, 2002; Messman-Moore and Brown, 2006).

Dissociative derealization might then be a crucial point of intervention for traumatized samples, by promoting awareness of and a

greater ability to tolerate, internal and external threat cues, which in turn might facilitate faster and more adaptive responding. The treatment of attentional biases and avoidance of threat through attentional retraining, cognitive therapy, or psychodynamic techniques that bring awareness to attentional processes might also have a positive impact on survivors of childhood trauma (D'Andrea and Pole, 2012). Attention bias modification has been demonstrated to reduce PTSD symptoms (Kuckertz et al., 2014), and may similarly impact attendant dissociative, depressive, and anxiety symptoms.

Effect sizes for trauma-related symptoms/bias relations in the current sample were within the small-to-moderate range, similar to prior work; for example, Bar-Haim et al. (2010) found that distress symptoms in participants exposed to rocket shelling were related to attentional avoidance of threat with an effect size of $r = -0.22$. Other studies reporting greater effect sizes used clinical or recently trauma-exposed samples. Dalgleish et al. (2003) found that intrusions symptoms were related to attentional hypervigilance ($r = 0.37$) in participants exposed to a traumatic incident within the last 6 weeks. Considering that the current sample was not limited to those meeting full PTSD or dissociative criteria, or those only recently trauma-exposed, but rather consisted of a non-acutely symptomatic, broad nation-wide community sample, the results of the present study are quite striking. Noteably, participants who were eliminated from analyses, primarily due to high error rates on the dot-probe, had greater PTSD and dissociative symptoms than the final sample. This presents an inherent limitation in the assessment of disruptions in attention in samples with dissociation, as these symptoms might increase the likelihood of lapses of attention, inaccurate responding and longer response latencies (Amrhein et al., 2008; Freyd et al., 1998). Methodologically speaking, these findings highlight the need to address systematic factors accounting for outlying performance on cognitive tasks in clinical samples and might also explain the small effects sizes yielded for dissociative derealization in relation to attention.

In addition to our wide sampling, other methodological factors, such as choice of threat stimuli, may have contributed to lower effect sizes. We opted to utilize general threat cues (e.g., burn victim, armed assault, etc.), which may have introduced signficant response variability. Meta-analytic work examining trauma-specific cues (e.g. sexual victimization; Latack et al. (2017) has indicated reliable bias toward trauma-specific cues in affected individuals. However, the majority of included studies employed a Stroop paradigm, which measures attention bias by way of interference, rather than attentional vigilance or avoidance. To clarify conflicting literatures, updated meta-analytic work should examine effects of presentation time and idiographic cues among individuals with PTSD.

4.1. Limitations

The version of the dot-probe utilized in this study included only neutral and aversive images, and lacked a positive condition; therefore, biased responding might be due to a heightened level of arousal in general, and not specifically due to threat. Moreover, eye-tracking data would be needed to make more detailed conclusions regarding the time course of threat engagement. Additionally, the use of self-report instruments, as well as online administration of the dot probe, both introduce the possibility of increased risk for errors or inaccuracies in responding across measures. However, previous research using MTurk samples has found them to be as or more attentive to instructions and task demands compared to off-line subjects (Hauser and Schwarz, 2016; Paolacci et al., 2010).

4.2. Summary

The current study examined automatic and conscious attentional biases in relation to PTSD and dissociative derealization/depersonalization symptoms. Results provide preliminary evidence for the differential impact of PTSD and dissociative derealization and depersonalization on the direction of attention allocation, at varying levels of processing. The current data provide a framework with which to understand mixed findings in attention bias research, and have significant clinical implications for dissociative symptoms as a target of treatment in traumatized samples.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2018.12.110.

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